Chapter III

Methodology

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3.1 Introduction

This chapter is a brief description about the methodology adopted for the study is given. Sample selection has been given in detail for each stage. Tools used have been briefly described. Data collection and data analysis are also given in brief since each would be described in the following chapters.

3.2 Sampling

The sampling was done using cluster sampling technique. A sample is generally selected in units of one. This need not be so. In education it is as easy to contact a whole class as it is to contact an individual. Cluster sampling is the design in which the unit of sampling consists of multiple cases. Rather than listing all secondary school students and randomly selecting these students for the sample, the investigator listed all of the secondary schools and selected at random clusters of units, and used all of the children in the selected schools as the sample. It is a variation of the simple random sample particularly appropriate when the geographic distribution of the individuals is widely scattered, as in the present study. It is synonymous with multistage sampling in which cases to be studied are picked up at random at diferent stages of the study.

The sample was selected from a population of forty one schools of Ponda taluka (refer Appendix-K). Of these schools, ten were government schools, one Mission school and remaining were all privately run management schools. The study involved samples for various purposes at various stages, mainly for (a) standardisation, (b) diagnosis and (c) case study.

a) For Standardisation

There were two stages in standardisation. The pilot study and final administration. The standardised test was again administered on a different sample.

i. Sample for pilot study consisted of three hundred fifty students from six schools. Cluster sampling technique was used.

ii. Sample for final administration consisted of three hundred and seventy seven students from ten schools. Cluster sampling technique was used. These schools were different from the ones chosen for pilot study.

iii. Sample for administering the standardised test for norms consisted of five hundred and eighty six students from fourteen schools.

iv. Sample for administering the standardized test consisted of three hundred and fifty eight students from ten schools. Cluster sampling technique was used.

b) For Diagnosis

From among the ten schools chosen for administering the standardised test, four schools were randomly chosen for the diagnosis. Sample for diagnosis consisted of one hundred and sixty students. Only those students were included in the sample who were found to be below thirty percentile on the standardized mathematics achievement test.

c) For Case Study

The case study approach generally calls for the researcher to make choices from among a number of possible events, people organizations, etc. According to Denscombe (1999) whatever the subject matter, the case study normally depends on a conscious and explicit choice about which case to select from among a large number of possibilities. This selection needs to be justified. A good case study requires the researcher to defend the decision by assigning that the particular case selected is suitable for the purpose of the research. The selection may be on the basis of suitability, convenience. The most common justification to be offered for

the selection of a particular case is that it is typical. The logic being invoked here is that the particular case is similar in crucial respects with the others that might have been chosen and that the findings from the case study are therefore likely to apply elsewhere. Faced with alternatives which are equally suitable, it is reasonable for the researcher to select the one(s) which involves the least travel, the least expense, the least difficulty when it comes to gaining access. The value of a case study approach is that it has the potential to deal with the subtleties and intricacies of complex social situation. There would arise doubts about how far it is reasonable to generalize from the findings of one case. Although each case is in some respects unique, it is also a single example of a broader class of things.

The sample for case study was selected from the sample for diagnostic test. Fifteen students were chosen from two schools. They were chosen on the basis of their score on diagnostic test, their willingness, teachers' opinion. Feasibility with respect to the place of stay of the students was also considered while selecting the sample. Some of the students could not continue due to tuitions, some did not show much willingness. Finally, there were nine cases for the case study.

3.3 Tools

The tools used in the study were, standardised Mathematics Achievement Test, Diagnostic Test, Cattell's Culture Fair Intelligence Tests Scale three Form A, Raven's Standard Progressive Matrices, Interview Schedules, Home Background and other details questionnaire. All tools, except for the Intelligence Tests, were prepared by the investigator.

a) Standardised Mathematics Achievement Test

The tool was constructed and standardised, using standardisation procedures. The data was collected over a period of one year. The construction and administration of the test was done by the investigator. The data for standardisation was collected in two stages – pilot study and final administration. The standardised test was again administered to establish norms. The test consisted of forty eight

items, from algebra and commercial arithmetic based on standard seven mathematics. The data was collected schoolwise. The detailed procedure of test construction is given in Chapter Four. The test is given in Appendix-C.

b) Diagnostic Test

The diagnostic test was constructed, on the basis of the error areas in the standardised test, other diagnostic tests, research evidences, opinion of teachers. The test was constructed and administered by the investigator. The diagnostic test consisted of one hundred and three items. The items were from a wide range of topics like basic skills in arithmetic, basics in algebra, fraction linear equations, rational numbers, bracket expansion. For each topic there were at least three items. The first draft was administered on a small sample. Modifications were done based on opinion of mathematics teachers, researchers, guide, mathematics teacher educators. The detailed construction of the diagnostic test is given in Chapter Five. The test is given in Appendix-E.

c) Intelligence Test

The intelligence of the case study subjects was measured using Raven's SPM, Cattell's Culture Fair Scale 3 Form A. The tests were administered after the Remedial programme. The tests were administered with a gap of one weeak. First Cattell's and than Raven's SPM.

The test items of SPM and Cattell's were non-verbal. The items were all pictorial, with alternatives to choose the response. There were sixty items in SPM and forty eight items in Cattell's. Scoring was done according to the scoring key provided. The raw scores were converted according to the norms provided.

d) Interview Schedules

Interviews were taken of the cases, a parent of each of the case, a randomly selected sample of twenty mathematics teachers of secondary schools in Ponda. The cases were asked queries regarding their school experiences, preferred

qualities in a mathematics teachers, remedial programme, investigator, experience with mathematics and from similar such areas. The parents were interviewed about their ward academic progress, home behaviour, any particular event in childhood or after. The interview for the teachers was about their experiences of teaching mathematics, handling students backward in mathematics. The interview schedules are given in the Appendix-I.

The interviews were taken after the remedial programme got over. All the interviews were semi-structured. Interviews of the teachers were taken either in their respective schools or at their residence. The case study interviews were taken at the respective residence. Interviews of the parents were also taken at their residence. The remedial programme groups were also interviewed, as separate groups.

e) Questionnaire

The questionnaire of fifty two items was made by taking into consideration all procedures according to Mouly (1970), Best (1995). The test items were revised three times. The entire questionnaire construction is given in Chapter Five. The test items consisted of items related to home background, difficulties faced by students in mathematics, suggestions given by students for teaching, examination. The questionnaires were given to be filled at home and later collected back at school. The questionnaires were given to the same sample taken for diagnostic test administration. The questionnaire is given in Appendix-H.

f) Student Records

The answer scripts, notebooks, remedial programme files of all cases were referred, to gather information regarding the errors committed. Academic records fo each individual from standard five to standard eight was collected from the schools.

g) Case Study Protocol

A case study protocol according to Yin (1994) is more than an instrument. It contains the procedures and general rules that should be followed in using the instrument. The protocol is a major tactic in increasing the reliability of case study research and is intended to guide the investigator in carrying out the case study.

The protocol should have the following sections:

i. An overview of the case study project
ii. Field procedures
iii. Case study questions
iv. A guide for the case study report.

The case study protocol for the present study was as follows:

i. An overview of the case study project.

By doing the case study, the investigator hopes to identify and document answers to such questions as: What factors lead the cases to a condition of backwardness in mathematics ? What prerequisites are essential to revitalise their mathematical achievement ? What environmental factors would promote positive attitude towards mathematics in the cases ?

ii. Field Procedures

The investigator intends to collect data from various sources.

Sources of data:

- Individual cases (interviews)
- Academic records
- Parents (interviews)
- Intelligence tests
- Diagnostic test (Pre-test, post-test)
- Questionnaire responses

Tasks in data collection

- Take prior appointment for interview with parents and individual cases
- Carry sufficient writing materials to record interview responses.
- Review the interview questions to ensure sequence and fluency
- Give approximate time required for the interview to the interviews, and also the nature of questions.
- Make the intervievee relaxed by asking questions related to one's well-being.
- Meet the headmistress/ headmaster to take permission for the academic records of the cases
- Take appointment for browsing the academic records
- Take a previously made format to enter the academic records of each individual cases. In case of missing records ask for possibility of procuring if from some other school.
- Maintain separate files for each individual case.
- Enter each data of the individual case immediately in respective files.
- Preserve the answer scripts of intelligence tests, diagnostic test and questionnaire of each individual
- Preserve the interview notes taken at the time of interview of each individual
- Preserve the interview notes of the interview with the parents in the respective files.
- Administer intelligence tests after the remedial programme to avoid law effect on the cases
- Conduct the interviews with the cases and their parents after the remedial programme
- Administer the post-test of the diagnostic test immediately after the completion of the remedial programme

- Conduct the interviews of the individual case and the respective parents either on same day or on consecutive days.
- Provide one day gap between interviews of different cases, to avoid fatigue.

iii. *Case study questions*

a. To the cases:

- What do they like about their school ?
- Who are their favourite mathematics teachers ?
- What qualities of the teacher do they like ?
- Which subjects they like ?
- What they liked about the remedial programme ?
- How mathematics was taught in their school ?

b. To the Parents:

- How was the childhood of their ward ?
- How was his/her academic performance
- What difference did they find in him/her ?
- What was their opinion about the school ?
- What was the study habit of their ward ?

c. Regarding other data

- What was the conclusion from the academic performance of the cases.
- How did the cases differ in terms of intelligence.

iv. ***A guide for the case study report***

The guide for the case study report is the case study protocol itself.

3.4 Design of the Study

The study consisted of construction and standardization of mathematics achievement test, construction of diagnostic test, conducting interviews, conducting remedial programme. The detailed description of standardization, diagnosis, case study and remediation is given in chapter four, five and six respectively. The construction and standardization of the mathematics achievement was carried out in the following manner:

i. Item writing and item selection
ii. Pilot study
iii. Item analysis
iv. Final administration
v. Establishing reliability and validity
vi. Administration of the standardized test.

The test for the pilot study consisted of ninety three test items from Seventh standard Mathematics was reduced to forty eight test items for the final administration. The test items were those related to basic knowledge of the concerned content. The pilot study test consisted of items from algebra and commercial arithmetic. (refer Appendix-A).

The validity was established by content validity. Reliability was established by KR- 21 and Spearman-Brown's split half methods.

The diagnosis was carried out in the following manner:

i. Construction and administration of the diagnostic test.
ii. Analysis of the diagnostic test responses.
iii. Construction and administration of the homebackground and other details questionnaire.
iv. Analysis of the questionnaire responses.
v. Selecting case study subjects

The analysis of the diagnostic test responses brought forth the various errors, and types of errors. The analysis of the questionnaire responses gave the background of the

mathematically backward students, their difficulties and perceptions. The remedial programme was spread out over fifteen days. Three sessions per week for one group. Similarly three sessions per week for the other group. The remedial programme sessions were not rigid and formal. According to Patton (1990) some of the themes of qualitative research are context sensitivity, design flexibility, personal contact and insight. These themes have been incorporated in the present study. These themes, found to be the most relevant of the ten themes of Patton, according to Best & Kahn (1995), make qualitative data powerful due to sensitivity to social, temporal context. The daily sessions were planned taking into consideration the felt need of the group and the pre-planned schedule. No special strategy or programme was adopted but care was taken, not to introduce any of the school based practices. Interviews, of the case study subjects, randomly selected mathematics teachers and parents of case study subjects, were taken. All the interviews were semi-structured. The investigator conducted the interviews after having taken prior appointment. The responses were simultaneously written down.

3.4.1 Case Study Design

According to Yin (1994) every type of empirical research has an implicit, if not explicit research design. The main purpose of the design is to help to avoid the situation in which the evidence does not address the vital research. For case studies, five components of a research design are specially important:

i. A study's questions
ii. Its proportions, if any
iii. Its unit(s) of analysis
iv. The logical linking of the data to the proposition and
v. The criteria for interpreting the findings.

In order to establish the quality of any empirical social research, four tests have been commonly used. In the present study, use of multiple sources of evidences, use of replication logic in multiple-case studies, use of case study protocol, ensured the construct validity internal, external validity, and reliability. The five components of the research design were addressed as follows:

i. The study's questions.

Why were students backward in mathematics, particularly in eighth standard ? How the backwardness in mathematics could be remedied ?

ii. The study being of an exploratory kind it stated the purpose of the study. To find out whether the attitude of the teachers towards students and mathematics, attitude of students towards mathematics, intelligence, socio-economic conditions, lack of knowledge of basic concepts, had significant effect of students' mathematics achievement.

iii. The units of analysis were defined on the basis of their score on diagnostic test, place of stay, opinion of teachers, their own willingness. The feasibility of the cases to attend the remedial programme was the reason for considering the place of stay. Willingness of the cases was an essential criteria to ensure punctuality and regularity in the remedial programme.

iv & v. Pattern-matching, whereby several pieces of information from the same case was related to the theoretical proposition. Currently there is no precise way of setting the criteria for interpreting these types of findings. However, any contrast, contradictions, frequent occurrences, helped in interpreting the findings.

3.5 Data Collection

The data collection was done over a period of one and a half years. For the standardisation of mathematics achievement test, the chosen schools were intimated and tests were administered in the class itself. On an average one school was taken up for administration, one day. Wherever there was an extra classroom in the school, students were arranged one on a bench, otherwise tests were administered in the existing classroom settings.

For the diagnostic test, similar to standardized test, tests were administered in the classroom settings after taking prior permission. It took four days to collect the data. Each administration took one hour thirty minutes. The tests were conducted during sports or library or scouts and guides period.

For the interviews, the interviewees were intimated in advance. Interviews were held at the residence in case of parents and case study cases subjects, at school or residence in case of teachers. Interviews were held in a very relaxed informal manner. Investigator noted the responses immediately.

For the intelligence tests they were administered at the end of the remedial programme in the house of one of the cases.

Cattell's test was administered first. After a week's time Raven's SPM was administered.

3.6 Data Analysis

The study included both qualitative and quantitative data. Scores of students on standardised test, diagnostic test, responses of students on the questionnaire, analysis of errors on diagnostic test, norms based on scores. Norms like mean, SD, percentile, kurtosis, skewness were computed, based on scores of students on final administration test and standardized test. Analysis of errors on diagnostic test was done. The test items with least correct responses, the common errors, were tabulated. The interviews excerpts of the teachers were done questionwise. For each of the prominent questions, from the interview schedule, the verbatim responses of the teachers were recorded. The interview excerpts of the students were presented in a descriptive manner, interspersed with their verbatim response. The home background and other details questionnaire responses were tabulated category wise and analysed schoolwise. The percentages of the responses to the questions were also computed. The interviews of parents were presented in a descriptive manner.