CHAPTER THREE
Design of the study

3.1 Introduction

This chapter deals with the design which includes methodology, collection and analysis of data of the study. The quality of any study is dependent on design and methodology. The design and methodology includes operational definitions of the important variables along with the terms used in this study, objectives, hypotheses, sampling and delimitation of the study. This chapter also describes the research tools and its validity and reliability, collection of data and statistical techniques used in analysis and interpretation of data.

3.2 Operational Definition of the Variables / Terms

3.2.1 Rural Area

Urban Agglomeration (UA): It is a continuous unclean spread constituting a town and its adjoining urban outgrowths or two or more physically contiguous towns together and any adjoining urban outgrowths of such towns.

Rural Area: All area other than urban, are rural. The basic unit for rural areas is the revenue village (source: census 2011, terminology).

3.2.2 Active Delta Area

The area in which formation of delta is still an ongoing process is called the active delta. Here the Sunderban Delta area has been treated as active delta area of South 24 Parganas.

3.2.3 Matured Delta Area

The area in which formation of delta is complete but the rivers are slow and meandering and frequently shift their courses is called the matured delta. Here rest of the active rural South 24 Parganas has been treated as matured delta area.

3.2.4 Achievement in Mathematics

Achievement refers to accomplishments and carries the connotation that the accomplishments follow a period of study, training or practice. The primary usages and interpretation of achievement test have to do with accomplishment and learning (Encyclopedia on Educational
Research, Editor in chief: Marvin C.Alkin, Vol-I). In the present study, the researcher has defined achievement test in mathematics as an instrument designed to measure the accomplishment of the students in the specified content of mathematics upto class VIII under WBBSE, CBSE and ICSE after completing their study at class VIII.

3.2.5 Elementary Education

As mentioned in RTE, 2009 “elementary education” means the education from first class to eighth class. As elementary education is the base of the educational pyramid, it is here that the country must ensure access to good quality education for all the sections of the population with special attention to the needs of the SC, ST, OBC and minority communities and girls. The 86th Constitutional Amendment Act, 2002 led to a new Article 21-A in Part III of the Constitution that made Free and Compulsory Education to all children of 6 to 14 years of age, a Fundamental Right. It is imperative to give good quality elementary education to all children in the age group of 6 to 14 years.

3.3 Significance of the study

In each society academic achievement is considered as key criterion to judge one’s total potentialities and capacities. Hence academic achievement occupies a very important place in education as well as in the learning process.

The National Curriculum Framework -2005 has clearly pointed out ‘a majority of children have a sense of fear and failure regarding Mathematics. Hence they give up early on and drop out of serious mathematical learning. Many a time the tendency embedded in teaching is to accelerate children mathematical skills by teaching them mechanical rules at the expense of understanding and intelligence applications. Therefore there is a need to help the children learn mathematics in a way that develops liking and understanding of mathematics during the early years of schooling particularly in classes I-VIII.

A nationwide sub program to Sarva Siksha Abhijan (SSA) ‘ Padhe Bharat, Badhe Bharat’ is planned in a twin track approach (i) to improve language development by creating an enduring interest in reading and writing with compression and (ii) to create a natural and positive interest in mathematics related to the physical and social world.
Several initiatives have been undertaken in Sarva Shiksha Abhiyan for improvement of quality in mathematics learning in the schools. Universalization of schooling has important implications for mathematics curriculum. Mathematics being a compulsory subject of study, access to quality mathematics education is every child’s right. With many children exiting the system after Class VIII, mathematics education at the elementary stage should help children prepare for the challenges they face further in life. In this context, the present study will try to find the level of achievement of mathematics at the end of elementary education.

In India, RTE, 2009 became effective from 1st April. 2010 in which free and compulsory elementary education is every child’s right. Mathematics is an important subject in school curriculum. It is more closely related to one’s daily life as compared to other subjects. Except one’s mother tongue there is no other subject which is more closely related to one’s daily life as mathematics. Mathematics is considered to be the father of all sciences. Napoleon remarked that—“The progress and improvement of mathematics is linked to the prosperity of the state”. Mathematics now dominates almost every field of one’s activities. In this age of science and technology, it has permeated through the human life in such a way that, it has now become every man’s everyday concern. Mathematics disciplines the mind, systematizes one’s thought and reasoning. The subject has also rich potentialities of affording true enjoyment to its students. Consequently quality mathematics education for elementary education has become an emergence to the policy makers, educators, and teachers in India.

The variation among students’ achievements in different component of mathematics maybe due to the lack of interest or much more interest or due to the lack of concept or enriched concept whether it maybe. So, the students may not interrelate among different component of mathematics. But the perception of interrelationship among different component of mathematics among students is very important. So, in this study the level of achievement in different component of mathematics will be observed.

In modern world, mathematics is being increasingly used in sciences, technologies, social science, education etc. With the use of computer and other devices there is a more emphasis in the mathematics. Though the world is more mathematically inclined, the majority of students in school feel it as more abstract. Though the teacher can teach it with the help of modern educational technological devices and more advanced effective methods of teaching, there is a
The poor performance of the students in mathematics. Hence, there must be some factors like psychological, social and biographical affecting the learner in learning of mathematics at large.

As is the case in the past, most people today still believe that mathematics is all about computation. However, computation, for mathematicians, is merely a tool for comprehending structures, relationships and patterns of mathematical concepts, and therefore producing solutions for complex real life problems. This perspective of mathematicians has gained more attention and importance with rapid advancements in information and communication technologies. It has become necessity for people of all ages to reach, analyze, and apply the mathematical knowledge effectively and efficiently to be successful citizens in our information age. In particular, students need to be well-equipped with higher-order mathematical knowledge. Mathematics is one of the formal disciplines that help man lay a solid foundation for future survival. Scientific and technological developments are dependent on Mathematics. The Nigerian government has made mathematics compulsory both at the primary and secondary school levels (Federal Republic of Nigeria 2004). Also mathematics is a basic requirement for admission into some degree courses in most tertiary institutions in Nigeria. Okeke (2006) noted that there was a general fear and hatred for mathematics; a situation which results in decline performance in the subject. Esu (2006), attributed the pupil’s poor performance in Mathematics to factors such as: the notion among pupils that mathematics is an abstract and difficult subject, inadequate qualified teachers to teach the subject as specialist, improper method of teaching mathematics, lack of mathematics laboratory, insufficient instructional aids and poor use of instructional materials. Basically the goal of teaching mathematics, especially at the primary level is to prepare pupils to develop critical and creative outlook as they confront the challenges of daily life (Meremikwu 2008). Thus, for the teaching of mathematics to be meaningful teaching must exist at the concrete operational level. By the nature of children, they need a large number of and variety of educational or instructional resources to interact with. Children at the primary level like to explore, experiment, create and interact intensively with the environment. The use of copious types of instructional resources, therefore, helps create an enabling environment for effective learning of the subject. Mathematics is an important subject in secondary school because it is associated with more academic and career opportunities (Akinsola and Tella, 2003). Ironically, this subject is the basis for scientific, industrial and technological advancement of any country. But it is very sad to note that the performance by the secondary school students are not
up to the mark and student’s general impression is that it is a dreadful subject. Thus, mathematics learning and student’s performance in mathematics receive considerable attention from educators, teachers and parents. It is therefore important to identify which particular school and student’s factors influence student mathematics achievement most significantly, in order to help them improve and make substantial academic progress.

Gender, touted to be a significant contributor for mathematics achievement has not been consistent and continue to be a much debated topic (Leder, 1992). Friedman (1989) noted that until age 10 either no differences between genders or differences favouring girls are observed. For the middle school years, some researchers favoured girls (Tsai and Walberg, 1983) and some favoured boys (Hilton and Berglund, 1974); other researches showed no difference (Fennema and Sherman, 1978; Abiam and Odok, 2006). Friedman (1989) observed that in five of seven studies 12th grade boys outperformed 12th grade girls, with the remaining two studies showing no differences between them. Further, general consensus seems to indicate that females tend to perform better than males in computation and males tend to perform better than females in problem solving (Hyde et. al., 1990). Gender issue has become the talk of today’s forum. Although the literacy rate is more among boys than girls, it is quite interesting to observe that girls are securing better ranks than boys in almost all competitive examination. From the last ten years, it is very fascinating to find note the girls figure to be more often in top ten ranks in tenth class annual examination. Thus the present study is an attempt to find out the gender difference, if any, in the achievement level of mathematics at the end of elementary education.

As revealed by National Achievement Survey in mathematics for class III, V and VIII by NCERT, level of achievement in mathematics is very low compared to achievement in social studies and language groups. So, it becomes urgent to measure the level of achievement in mathematics at elementary evaluation. But, how to measure? Is there any standardized test in mathematics for those students who had completed their elementary education? Is there sufficient standardized tool to compare students’ achievement in mathematics at national level? To what extent the difference are visible in students (girls and boys) mathematics achievements in school at elementary level? Is there any specific area of weaknesses in mathematics for students learning at elementary level? Is there any geographical or biographical effect on achievement in mathematics? Also there is no research work for achievement in mathematics
after implementation of RTE in West Bengal. West Bengal being a densely populated state, its importance in mathematics education at elementary level may lead thrusts in overall achievement. Because, mathematics education is to a nation what protein is to a young human organism as a vital tool for the understanding and application of science and technology. Also the second chapter viz. Review of Related Literature had opened a gap in the research work on achievement in mathematics after implementation of RTE. 2009 especially in West Bengal. Therefore to find students achievement in mathematics at elementary level of education is quite relevant and will certainly be effective to frame policy, plan and program for mathematics education. The choice of this study is predicated on the current world trends and research emphasis on gender differences, area of weaknesses, whether any effect of biographical domain in learning and achievement of mathematics.

3.4 Objectives of the study

1. To construct a standardized achievement test in mathematics of class VIII.
2. To find out the level of students’ achievement in mathematics.
3. To compare the students’ achievement in mathematics gender wise.
4. To identify the areas of under achievement of the students in different components of mathematics.
5. To find out the probable causes of under achievement in mathematics.
6. To suggest remedial measures for the under achievers in mathematics.

3.5 Hypotheses

H₀₁. There is no significant difference between the achievement in mathematics of boys and girls students of schools in rural areas of south 24 Parganas.

H₀₂. There is no significant difference between the achievement in mathematics of students of active delta area and matured delta area.

H₀₃. There is no significant difference between the achievements in mathematics of the boys students of active delta area and matured delta area.

H₀₄. There is no significant difference between the achievements in mathematics of the girls students of active delta area and matured delta area.
There is no significant difference between the achievement in mathematics of boys and girls students of active delta area.

There is no significant difference between the achievement in mathematics of boys and girls students of matured delta area.

There is no significant difference between the achievement in mathematics of girls of active delta area and boys of matured delta area.

### 3.6 Methodology

#### 3.6.1 Population

Students of different government aided/sponsored schools of rural area of South 24 Parganas are considered as population for the study.

#### 3.6.2 Sample and Sampling Technique

Stratified random techniques were adopted for the study. 400 students were taken from nineteen schools. Out of these 160 students were taken from schools in active delta area and 240 students from 12 schools were taken in mature delta area randomly. Details of sample size are given in Table 3.1.

Table 3.1: Details of sample size

<table>
<thead>
<tr>
<th>Area</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature Delta area</td>
<td>130</td>
<td>110</td>
<td>240</td>
</tr>
<tr>
<td>Active Delta area</td>
<td>80</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>Total</td>
<td>210</td>
<td>190</td>
<td>400</td>
</tr>
</tbody>
</table>

#### 3.6.3 Pilot Study

Pilot study was conducted to check whether the tools were working or not. The researcher had applied the preliminary draft of the constructed tool on 77 students of a government-aided school. After analyzing the findings of the pilot study the test was slightly modified to suit the need of giving a final shape to the preliminary draft. This study helped the researcher to get an idea about the probable findings.
Figure 3.1: Research area under study in West Bengal
Figure 3.2: Research area\(^1\) under study

\(^1\) Note: The areas visited for the research have been marked in red.
Fig. 3.3: Distribution of schools under areas of study
3.7 Delimitation

The study was delimited to the Government Aided / Sponsored Bengali medium schools under West Bengal Board of Secondary Education situated in the rural areas of South 24 Parganas.

3.8 Tools

An Achievement test in mathematics for class VIII was made and standardized. The test was comprised of 40 items and the researcher found the reliability by KR-20 method. Values of reliability were found 0.87.

3.9 Collection of data

The researcher has visited 19 schools shown in the fig.3.3 and administered the achievement test in mathematics on 400 students of these schools and collected data from the students with the help of the teachers of the respective schools.

3.10 Statistical Treatment

Both qualitative and quantitative analyses have been done. For variables yielding quantitative results, percentage, mean, standard deviation, t-value, co-relation, were calculated and graphically presented. Qualitative analysis was made on the basis of visit to nineteen schools and discussion with the students and teachers of the concerned schools. In West Bengal, West Bengal Board of Secondary Education introduced seven grades in the evaluation at secondary level. These are AA Grade – Outstanding (90-100% marks), A+ Grade – Excellent (80-89% marks), A Grade – Very good (60-79% marks), B+ Grade – Good (45-59% marks), B Grade – Satisfactory (35-44% marks), C Grade – Marginal (25-34% marks), D Grade – Disqualified (below 25% marks). In the present study this grade norm was taken for consideration.

For quantitative analysis of data, ratio, percentage, mean, standard deviation, t-test were applied as recommended by standard books of statistics e.g., the book of M. K. Gupta and N. G. Das.

\[ \text{Mean} = \bar{x} = \sum_{i}^{n} f_{i} x_{i} \]
S.D. = \sqrt{\frac{1}{N} \sum_{i}^{k} f_i \left( x_i^2 - \overline{x}^2 \right)}

Where \( x \) is the variable, \( k \) is the number of classes or groups in which the variable is classified, \( x_i \) is the midpoint of the \( i^{th} \) group

\( f_i \) is the frequency of the \( i^{th} \) group, and

\[ N = \sum_{i}^{k} f_i = \text{total number of observations.} \]

2. To compare the means of two populations or groups (say \( \mu_1 \) and \( \mu_2 \)) the t-static was used. Let \( N_1 \) and \( N_2 \) be the sample sizes drawn from the two groups and \( \overline{x}_1 \) and \( \overline{x}_2 \) the sample means. The sample variances are defined as

\[ S_1^2 = \frac{\sum_{i}^{n_1} f_i \left( x_{1i}^2 - N_1 \overline{x}_1^2 \right)}{N_1 - 1} \]

\[ S_2^2 = \frac{\sum_{i}^{n_2} f_i \left( x_{2i}^2 - N_2 \overline{x}_2^2 \right)}{N_2 - 1} \]

Then the t-statistic is defined as

\[ t = \frac{\overline{x}_1 - \overline{x}_2}{S \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}} \]

Where \( S^2 = \frac{(N_1 - 1) s_1^2 + (N_2 - 1) s_2^2}{N_1 + N_2 - 2} \)

To test \( H_0: \mu_1 = \mu_2 \) against \( H_1: \mu_1 > \mu_2 \)

We reject \( H_0 \) at the 0.05 level of significance if

\[ t > t_{n-1, 0.05} \]

\[ \text{or} \quad t > t_{n-1, 0.025} \]
**Item Difficulty**

Item difficulty was calculated as the proportion of the examinees that marked the item correctly. Item difficulty is the percentage of students that correctly answered the item, also referred to as the p-value. The range is from 0% to 100%, the higher the value, the easier the item. P values above 0.90 are very easy items and might be a concept not worth testing. P-values below 0.20 indicate difficult items and should be reviewed for possible confusing language or the contents needs re-instruction. Optimum difficulty level is 0.50 for maximum discrimination between high and low achievers. For example an item answered correctly by 70% examinees has a difficulty index of 0.70. If 90% of a standard group pass an item, it is easy; if only 10% pass, the item is hard or too difficult. Generally, items of moderate difficulty are to be preferred to those which are much easier or much harder.

The following formula is used to find difficulty level.

\[
DL = \frac{Ru + Rl}{Nu + Nl}
\]

Where,

- \(Ru\) = the number students in the upper group who responded correctly
- \(Rl\) = the number students in the lower group who responded correctly
- \(Nu\) = Number of students in the upper group
- \(Nl\) = Number of students in the lower group

[Ref. Boopathiraj. C; Chellamani, 2013]

**Item Discrimination:**

Item discrimination or the discriminating power of a test item refers to the degree to which success or failure on an item indicates possession of the ability being measured. It determines the extent to which the given item discriminates among examinees in the function or ability measured by the item. This value ranges between 0.0 and 1.00. Higher the value, more discrimination of the item is. A highly discriminating item indicates that the students who had high tests scores got the item correct whereas students who had low test scores got the item incorrect.

Discrimination power is estimated using the following formula:

\[
\text{Discrimination power} = \frac{RU - RL}{NU(\text{or})NL}
\]

The procedure involves the following steps:

1. Administration of the draft test on a sample of about 200
2. Identification of upper 27% and lower 27% examinees having highest and lowest scores in rank order respectively on the total test.

3. Calculation of each item, of the proportion of the examinees attempting it correctly.

4. The discrimination index, DI will be given by using above mentioned formula.

5. The DI can be tested for significance by using a critical ration test and items with positive and significant differences retained.

6. The value of the discrimination index can range from -1.00 to +1.00.

7. Items having negative discrimination are rejected. Items having discrimination index above 20 are ordinarily regarded satisfactory for use in most tests of academic achievement (Aggarwal, 1986).

[Ref. Boopathiraj. C; Chellamani,2013].

**Split-half method**

In this method, the test was divided into two equal halves. One half consisted of items with odd serial numbers (T_o) and the other half consisted of items with even serial numbers (T_e). (Appendix 1)

The correlation between (T_o) and (T_e) was found by the following formula

\[ r = \frac{N\Sigma xy - \Sigma xy}{\sqrt{(N\Sigma x^2 - (\Sigma x)^2)(N\Sigma y^2 - (\Sigma y)^2)}} \]

Where \( x \) represents T_o scores
\( y \) represents T_e scores

and \( N \) represents the number of responses i.e., the number in the sample.

The reliability of the test was calculated by the Spearman Brown Prophesy formula given below

\[ Reliability \ of \ the \ test = \frac{2r}{1 + r} \]

Where \( r \) is the correlation between T_o and T_e scores

(Ref. M. K. Gupta and N. G. Das)

### 3.11 Conclusion
This chapter is designed to satisfy the objectives of the study e.g., to find out and to compare the achievements of students in mathematics and their weakness area in that subject at the end of elementary level education.