# CHAPTER III

# RESEARCH METHODOLOGY

## 3.0 Introduction

The chapter of research methodology provides in-depth knowledge about what type of methodology was followed by the researcher in that particular study. It also gives direction and suggestion for other researchers to adopt the appropriate methodology as per their study. This chapter includes research design, sample and sampling technique, tool and techniques adopted for data collection, tool construction, piloting of tool, establishing validity and reliability of the tool, design of the study, as well as analysis of the collected data. Thus, this chapter presents a comprehensive idea about the research methodology adopted for the study.

## 3.1 Design of the Study

Research design is a blueprint of a research study, and it provides the structure and framework of the research process. A descriptive survey method was used for the present study. According to Creswell (1994), the descriptive research method gathers information about the present condition. The focus of this research was to study status of misconceptions in science and therefore the descriptive survey method was the most appropriate method.

## 3.2 Population

The population for the present study consists of all the schools affiliated to Jharkhand Board of Secondary Education of Ranchi district of Jharkhand state. There were a total of 866 schools under Ranchi district. All standard VIII students and science teachers of the academic year 2019-2020, of those schools formed the population for the present study. *(Source: District Superintendent of Education, Ranchi)*

Jharkhand is a state in eastern India. The state shares its border with the states of Bihar to the north, Uttar Pradesh to the north-west, Chattisgarh to the west, Odisha to the south and West Bengal to the east. It is known for its waterfalls, the elegant Jain temples of Parasnath Hill and the elephants and tigers of Belta National park. Ranchi, the capital of Jharkhand state has an overall literacy rate is 77.13 % as per 2011 census.

Ranchi district has good educational facilities at school, college and university level. Most of the schools in Ranchi district are affiliated to Jharkhand Board of Secondary Education (JBSE), and a few have affiliation but some schools are also affiliated to CBSE and ICSE. The district has good facilities for higher education in the field of agriculture, management, medicine, psychiatry, engineering, rural development, science and technology etc. The district is the home to some of the prestigious institutions like Birsa Agriculture University, Birsa Institute of technology, Central Institute of Psychiatry, Central University of Jharkhand, Indian Institute of Management, Ranchi University, Shri Krishna Institute of Public Administration, State Institute of Rural Development, Xavier Institute of Social Service, etc. *(Source: Ranchi District Collectorate)*

## 3.3 Sample and Sampling Technique

For the present study the sample was selected from Ranchi District of Jharkhand State. The literacy rate of Ranchi district is 77.13% (Male- 85.63% and Female- 68.20%) which is comparatively higher than Jharkhand state literacy rate 67.63% (Male-76.84% and Female-55.42%), (Census, 2011). Total number of blocks in Ranchi district is depicted in the table 3.1.

**Table_3.1 Blocks of Ranchi District**

| Sr. No. | Name of District | Total Number of Schools | Number of Selected school |
|---|---|---|---|
| **1** | Angara | 70 | 1 |
| **2** | Bero | 43 | 1 |
| **3** | Bundu | 48 | 1 |
| **4** | Burmu | 68 | 1 |
| **5** | Chanho | 43 | 1 |
| **6** | Itki | 19 | 1 |
| **7** | Kanke | 121 | 1 |
| **8** | Khelari | 25 | 1 |
| **9** | Lapung | 50 | 1 |
| **10** | Mandar | 35 | 1 |
| **11** | Nagri | 21 | 1 |
| **12** | Namkum | 48 | 1 |
| **13** | Ormanjhi | 42 | 1 |
| **14** | Rahe | 35 | 1 |
| **15** | Ratu | 22 | 1 |
| **16** | Silli | 45 | 1 |
| **17** | Sonahatu | 45 | 1 |
| **18** | Tamar | 86 | 1 |
| **TOTAL** | | 866 | 18 |

There were a total of 18 blocks in Ranchi district. One school from each block was selected using lottery method. All the students of standard VIII and teachers teaching subject of science to the students of the selected schools constituted the sample for the study. Thus, the sample constituted a total of 926 students and 18 teachers.

**Picture: 3.1 Map of Ranchi District**


*(Source: Ranchi District Collectorate)*

The map of Ranchi district of Jharkhand State depicting the 18 blocks from where sample was drawn for the present study.

## 3.4 Sources of Data

The sources of data in the present study were students studying in standard VIII of the selected schools of Ranchi district of Jharkhand state and the teachers teaching the subject of science to these students. Data pertaining to identification, reasons and sources of misconceptions in science was to be obtained from students. Data with regard to the educational and professional qualification of teachers, their teaching experiences etc. was to be obtained from teachers. Data pertaining to availability of teaching learning materials as well as availability and use of science laboratory were to be obtained through observations.

## 3.5 Tools used for Data Collection

In order to collect the requisite data for any theme of research, one has to devise an appropriate tool. To collect the data on Misconceptions in Science following tools were used.

1. Content analysis of Science & technology textbook of standard VIII of Jharkhand State Board.
2. Semi-Structured Interview for school teachers.
3. Three-tiered Multiple Choices Science Misconception Test
4. Information Schedule for school teachers.
5. Observation Schedule for availability of teaching learning material.
6. Observation Schedule for availability of science laboratory.

## 3.6 Construction of Three-tiered Multiple Choice Science Misconception Test (TTMCSMT)

To achieve objectives of the present study, Three-Tiered Multiple Choice Science Misconception Test was constructed by researcher. The detailed description of the tool construction is presented below.

### 3.6.1 Content Analysis of Science and Technology Textbook

The researcher has done the content analysis of science and technology textbook of standard VIII of Jharkhand State Board. The objective of the text book analysis was to know the content, topics and concepts covered in each chapter. There were a total of 16 chapters in the book. Text book analysis also helped the researcher to identify the proper representation of chapters of physical and biological sciences. It also helped the researcher to figure out the inter-linkages between the chapters and its gradual progression from easy to difficult concepts. The content analysis of the textbook was also done to find out the adequate representation of concepts, diagrams/pictures, language and terminology used in the textbook (Appendix: A). The scientific concepts or topics covered in each chapter would become the base for the construction of three-tiered multiple choice science misconception test. A detailed analysis of the content of science and technology text book is shown in the table 3.2.

**Table_3.2 Text Book Analysis of Standard VIII**

| Standard VIII Science and Technology Text Book | | | |
|---|---|---|---|
| Total Chapters | | | **18** |
| S. N. | **Chapter Name** | **Stream of Science** | **Content/Topics/Concepts** |
| **1.** | Cell | Biology | Discovery of cell, Introduction of cell (shape, size and number), prokaryotic and eukaryotic cell, structure and function of cell, parts of the cell, plant cell and animal cell and their components. |
| **2.** | Metals and Non Metals | Chemistry | Physical & chemical properties of metal & non metal. |
| **3.** | Micro Organisms | Biology | Introduction of micro organisms, different types of micro-organisms, useful & harmful Micro organisms, disease caused by micro-organisms in both plants & animals, pasteurisation, nitrogen fixation, nitrogen cycle. |
| **4.** | Chemical Effect of Electric Current | Physics | Introduction of electric current, chemical effect of electric current, conductor & non conductor of electricity, electrolysis, electroplating. |
| **5.** | Towards Adolescence | Biology | Introduction to adolescence, changes during adolescence, nutritional needs during adolescence, hormones, metamorphosis, AIDS. |
| **6.** | Force and Pressure | Physics | Push & pull, Pressure, muscular, frictional, magnetic, electrostatic & gravitational force. Pressure exerted by liquids and gases, atmospheric pressure. |
| **7.** | Combustion and Flame | Chemistry | What is combustion? Conditions necessary for combustion, methods to control fire. |
| **8.** | Reproduction in Animals | Biology | Viviparous & oviparous, asexual & sexual, external & internal fertilization, male & female reproductive organ, IVF, clone, life cycle of frog. |
| **9.** | Light | Physics | Luminous & non-luminous objects, reflection, Kaleidoscope, periscope, sunlight, human eyes & its components, protection and care of eyes, Braille script. |
| **10.** | Crop | Biology/ EVS | Introduction to crop production Kharif, |

| | | | |
|---|---|---|---|
| | Production & Management | | Rabi & Jayad, preparation of soil, equipments used for agricultural activities, crop rotation, protection from weeds, manures and fertilizers. |
| **11.** | Know the Universe | Physics | Introduction to universe, Solar system, constellation, planets, satellite, comets, meteors & meteorites. |
| **12.** | Friction an Essential Force | Physics | Introduction to friction, factors affecting friction, examples of friction, merits & demerits of frictional force. |
| **13.** | Synthetic Fibres and Plastic | EVS/Chemistry | Introduction to fabric, natural & synthetic fibres, Rayon, Nylon, Polyester, acrylic, thermoplastic, thermosetting plastic, usage & harm of plastic. |
| **14.** | Sound | Physics | Properties of sound, sound produced by human, amplitude, time-period, frequency of vibration, audible & inaudible sounds, noise & music, noise pollution & its effect. |
| **15.** | Natural Phenomena | Physics | Lightning, types of charges & their interaction, transfer of charges, lightning safety & lightning conductor, earthquake- causes & protection. |
| **16.** | Air and Water Pollution | Chemistry/EVS | Introduction to air and water pollution, causes of air & water pollution & its remedy. |
| **17.** | Conservation of Plants & Animals | Biology/EVS | Deforestation and its harmful effects, conservation of wild life & plants, biodiversity parks, recycle of paper. |
| **18.** | Underground Fuel | EVS/Chemistry | Inexhaustible & exhaustible fuel, coal, carbonification, coal tar, coal gas, petroleum, natural gas. |
| **Total Chapters related to Biology** | | 6 | |
| **Total Chapters related to Chemistry** | | 5 | |
| **Total Chapters related to Physics** | | 7 | |
| **Total Chapters related to EVS** | | 5 (The chapters of EVS are also related to Biology and Chemistry) | |

### 3.6.1.1 Findings of the Textbook Analysis

- Chapter 1 & 3 are interrelated chapters of biology.
- Five chapters of EVS are either related to chemistry or biology
- Some of the concepts of chapter 6 & 12 are inter-related. For example frictional force.
- The detailed analysis of science and technology text books of standard VIII helped the researcher to establish vertical and horizontal relationship among chapters.
- It also helped the researcher to identify whether, the contents were adequately represented. For example: The diagrams depicting the difference between plant cell and an animal cell is not clear (pg-10). The concept of plant cell and an animal cell was briefly explained (pg-10). Only one example of unicellular organism is included (pg-4). Metals are generally brown in colour. But metals like silver, aluminium and mercury are white in colour, is not mentioned in the textbook (pg-14).
- Some concepts could have been better explained through diagrams/pictures. For example: Presence of more than one nucleus in a cell can be better illustrated through pictures along with the text (pg-7).
- Language and terminology used was not simple and appropriate. For Example the definition of unicellular organism was not explained properly (pg-4).
- Diagrams/pictures were not clear. For example: the diagrams of a cork cell (pic-1.3) an onion cell (pic-1.4 & 1.5), nucleus (pic- 1.9), E. Coli (pic-1.10), human cheek cell (pic-1.11). Picture of coal and graphite is (pic-2.9 & 2.11) Picture of burning of magnesium ribbon is not clear (pic-2.13) Picture of reaction of lead with acid is not clear (pic-2.14). Picture of burning of sulphur is not clear (pic-2.16).
- The labelling of the diagram depicting pressure exerted by liquid is not done (pic-6.3). In the text it is written that the water at level A exerts maximum pressure whereas at level C minimum pressure is exerted, but in picture there is no labelling. It may create confusion among students. Some student may consider level A at top and C at bottom and vice-versa.

- ❖ The font size of labelling of the picture of male reproductive system (8.3), life cycle of frog (pic-8.11) and nitrogen cycle (pic-3.9) is too small for students to read.
- ❖ Certain pictures related to different concepts of (Food Production and Management, chapter-10) could have been taken from the local culture of Jharkhand State to make the book more comfortable and interesting for the students.
- ❖ Most of the pictures and diagrams in the book are not clear.
- ❖ The cover page, the pictures and diagrams, paper quality could have been better. The book could have been made more attractive and lucrative so that the students feel motivated to read it.

On the basis of textbook analysis the researcher has identified chapters where students may lack proper understanding.

### 3.6.1.2 Physics

**(1) Force and Pressure:** Push & pull, Pressure, muscular, frictional, magnetic, electrostatic & gravitational force. Pressure exerted by liquids and gases, atmospheric pressure**.**

**(2) Friction an essential force:** Introduction to friction, factors affecting friction, merits and demerits of frictional force.

**(3) Light:** Luminous & non-luminous objects, reflection, Kaleidoscope, periscope, sunlight, human eyes & its components, protection and care of eyes, Braille script.

**(4) Sound:** Properties of sound, sound produced by human, amplitude, time-period, frequency of vibration, audible & inaudible sounds, noise & music, noise pollution & its effect.

### 3.6.1.3 Chemistry

**(1) Metals and non-metals:** Physical and chemical properties of metals and non-metals.

#### 3.6.1.4 Biology:

**(1) Cell:** Discovery of cell, Introduction of cell (shape, size and number), prokaryotic and eukaryotic cell, structure and function of cell, parts of the cell, plant cell and animal cell and their components.

### 3.6.2 Semi Structured Interview of School Teachers

The researcher has conducted semi structured interview (Appendix: B) of school teachers who taught science to the students of standard VIII in Jharkhand State Board Schools. The researcher has conducted the interview of 25 teachers teaching science in different schools. Most of the teachers had a minimum of 10-15 years of teaching experience. The objective of this interview was to identify those concepts where students face difficulty in comprehension. Discussion was also done related to concepts where teachers face difficulty in making students comprehend in spite of all their efforts. Following concepts were identified through interview:

#### 3.6.2.1 Physics

**(1) Force and Pressure:** Introduction to force, interaction between different types of force, pressure exerted by liquid and gases and atmospheric pressure.

**(2) Light:** Luminous and non-luminous objects, reflection, human eye.

**(3) Sound:** Properties of sound, Amplitude, time-period, frequency.

**(4) Chemical effect of electric current:** Electrolysis, electroplating.

#### 3.6.2.2 Chemistry:

**(1) Metals & Non-metals:** Physical and chemical properties of metals and non-metals.

**(2) Combustion and Flame:** Ignition temperature and calorific value, acid rain.

**(3) Synthetic fibres and plastics:** Polymers, thermosetting plastics and thermoplastics.

#### 3.6.2.3 Biology

**(1) Cell:** Plant and animal cell and its components.

**(2) Towards Adolescence:** Menstruation, Sex-determination.

**(2) Reproduction in animals:** Test-tube babies, metamorphosis.

**(3) Conservation of plants and animals:** Endemic species, ecosystem.

## 3.6.3. Final Selection of Chapters

On basis of text book analysis and semi structured interview of school teachers the researcher has identified one chapter each from physics, chemistry and biology for the construction of three-tiered multiple choice science misconception test. The researcher has covered all the concepts included in each chapter. Thus, the first draft of the test contains items from the following chapters.

### 3.6.3.1 Physics

**Force and Pressure:** Push & pull, Pressure, muscular, frictional, magnetic, electrostatic & gravitational force. Pressure exerted by liquids and gases, atmospheric pressure.

### 3.6.3.2 Chemistry

**Metals & Non-metals:** Physical and chemical properties of metals and non-metals.

### 3.6.3.3 Biology

**Cell:** Discovery of cell, Introduction of cell (shape, size and number), structure and function of cell, parts of the cell, plant cell and animal cell and their components.

## 3.6.4 Principles Followed While Constructing Three-tiered Multiple Choice Science Misconception Test

- The researcher had a broad frame of mind while framing the questions and did not miss any concept included in the selected chapters.
- Prior to the construction of the test the researcher had carefully reviewed the existing research literature, as well as all related instruments that have already been used by other researchers on misconceptions in science.
- Language used in the tool should be simple and understandable by the students.
- Double barrelled questions that are questions having two different answers were avoided.

- ❖ Researcher followed ordering of items in the test. Easy items were kept first so that students get motivated to answer.

### 3.6.5 Three-tiered Multiple Choice Science Misconception Test (TTMCSMT)

In order to collect the data on misconceptions in science from the selected sample, researcher constructed the Three-tiered Multiple Choice Science Misconception Test for the students of standard eight. This test contained a set of items, each one composed of three parts. The first part or the first tier of the item is multiple choice content questions with a set of true and false responses. The second part or the second tier consists of a set of justifications for the chosen response to the question in the first part. Space is provided for writing an alternative response. The third part or the third tier consists of set sources of the information. By considering the study objectives, research questions, nature of date required, and student's cognitive level, researcher has constructed the first draft of the three-tiered multiple choice science misconception test. The items included in the first draft are shown in table 3.3 (Appendix C & D).

**Table 3.3 Item Pool for Three-tiered Multiple Choice Science Misconception Test (First Draft)**

| S. N. | Concepts | Total No. of items. | Item No. |
|---|---|---|---|
| **Physics** | | | |
| **1** | Introduction to force | 4 | 1,2,9,22 |
| **2** | Pull | 1 | 26 |
| **3** | Muscular force | 1 | 18, |
| **4** | Frictional force | 3 | 16,17,25 |
| **5** | Magnetic force | 1 | 20 |
| **6** | Gravitational force | 4 | 14,15,23,24 |
| **7** | Electrostatic force | 1 | 21 |
| **8** | Introduction to pressure | 4 | 3,4,5 |
| **9** | Pressure exerted by liquids | 2 | 9,7 |
| **10** | Atmospheric pressure | 7 | 6,8,10,11,12,13,27 |
| | Total | **27** | |
| **Chemistry** | | | |
| **11** | Physical properties of metal | 9 | 28,31,43,45,48,50,51,52,56 |
| **12** | Chemical properties of metal | 11 | 30,32,35,36,40,41,49,53,54,57,38 |

| | | | |
|---|---|---|---|
| **13** | Physical properties of non metal | 5 | 29,33,34,37,46 |
| **14** | Chemical Properties of non-metal | 3 | 39,44,55 |
| **15** | Displacement | 1 | 42 |
| **16** | Common Salt | 1 | 47 |
| | **Total** | **30** | |
| **Biology** | | | |
| **17** | Introduction to cell | 6 | 58,59,61,62,64,73 |
| **18** | Prokaryotic cell | 1 | 80 |
| **19** | Eukaryotic cell | 1 | 68 |
| **20** | Components of cell | 6 | 65,70,71,72,74,84 |
| **21** | Plant cell | 6 | 63,66,67,76,81,82 |
| **22** | Animal cell | 2 | 60,83 |
| **23** | Amoeba | 5 | 69,75,77,78,87 |
| **24** | Nerve cell | 2 | 79,86 |
| **25** | Tissue | 1 | 85 |
| | **Total** | **30** | |
| | **Grand Total of all items** | **87** | |

### 3.6.6 Expert's Validation

The item pool of Three-tiered Multiple Choice Science Misconception Test was send to experts in the field of science and technology to ensure its content validity and appropriateness of items. The experts were either working as a science teacher in elementary/secondary/higher secondary schools or assistant professor of science method in teacher education institutes. The minimum qualification of the experts was M. Sc., B.Ed. However, some experts had the qualification M. Sc., M. Ed. while many of them had earned a Ph. D. in Education too. The minimum teaching experience of the experts was five years; however, some experts had a vast experience of 25 years too. The tool was also sent to English and Hindi language experts to examine its language aspects. (Appendix: E) The comments and suggestions received from the experts were incorporated to formulate the final draft of the test. Some of the comments and suggestions received from the experts are as follows:

- Avoid repeating too many questions on one concept. For examples questions related to pressure should be reduced to avoid repetition. Similarly questions related to chemical properties of metals, introduction to cell and its organelles should also be reduced.
- Add more questions on pressure in liquid.

- ❖ Avoid questions having very lengthy reasons.
- ❖ Avoid putting questions related to one concept together.
- ❖ As the tool is too lengthy, so it is better to divide the questions of Physics, Chemistry and Biology into three different sections. After completion of one section the students will gradually feel motivated to move to the next section.

### 3.6.7 Pilot Testing

Researcher had personally administered the Three-tiered Multiple Choice Science Misconceptions test on a group of 45 students who were not the part of the sample. The main purpose of pilot testing is to examine the tool of its language aspect and ambiguity of the items. According to Johnson and Christensen (2008) a pilot testing of minimum five to ten pupils is enough to establish the reliability of the tool. Subsequent to completion of pilot test researcher has used "Think aloud Technique" to know strength and weakness of the items. In this technique the participants verbalise their suggestions and perceptions about each items. Think aloud technique is for determining whether participants are interpreting the items the way researcher has intended (Johnson and Christensen, 2008). Instead of using the "Think aloud Technique" on all the 45 students, it was rather used on a small group of 15 students so that the researcher can more accurately figure out whether the students are interpreting the items, the way researcher has intended. Some of the suggestions given by students were as follows:

- ❖ The students were of the opinion that the time duration of the test should be increased.
- ❖ The students were of the opinion that after completion of each question, line spacing should be increased.
- ❖ The students were of the opinion that each part of the Three-tiered Multiple Choice Science Misconception Test should have different alpha-numeric symbol to avoid confusion.
- ❖ According to students, the tool contained some thought provoking questions which were not directly answerable from the content of science and technology textbook.

Experts' comments and suggestions during validation of the item pool and the findings of the pilot testing were used to frame the final draft of the test. In the final draft some items were substituted, some were deleted and few were modified. Thus the final draft

consists of 76 three-tiered multiple choice questions. A revised version of the tool with respect to its specification is shown in the table 3.4 (Appendix F & G).

**Table 3.4 Item Pool for Three-Tiered Multiple Choice Science Misconception Test (Final Draft)**

| S. N. | Concepts | Total No. of items. | Item No. |
|---|---|---|---|
| **Physics** | | | |
| **1** | Introduction to force | 2 | 3,7 |
| **2** | Pull | 1 | 23 |
| **3** | Muscular force | 2 | 2,4 |
| **4** | Frictional force | 3 | 13,20,24 |
| **5** | Magnetic force | 1 | 10 |
| **6** | Gravitational force | 3 | 16,19,22 |
| **7** | Electrostatic force | 1 | 11 |
| **8** | Introduction to pressure | 4 | 1, 6,12,15 |
| **9** | Pressure exerted by liquids | 3 | 9,17,14 |
| **10** | Atmospheric pressure | 5 | 5,8,18,21,25 |
| | Total | **25** | -- |
| **Chemistry** | | | |
| **11** | Physical properties of metal | 9 | 26,29,35,40,41,44,47,48,49 |
| **12** | Chemical properties of metal | 7 | 28,30,32,34,37,42,45 |
| **13** | Physical properties of non metal | 5 | 27,31,33,39,46 |
| **14** | Chemical Properties of non-metal | 3 | 36,38,43 |
| | Total | **24** | --- |
| **Biology** | | | |
| **15** | Introduction to cell | 6 | 50,55,59,63,74,76 |
| **16** | Prokaryotic cell | 1 | 70 |
| **17** | Eukaryotic cell | 1 | 58 |
| **18** | Components of cell | 5 | 52,54,56,57,68, |
| **19** | Plant cell | 5 | 51,60,65,71,75 |
| **20** | Animal cell | 2 | 53,69 |
| **21** | Amoeba | 3 | 61,64,66 |
| **22** | Nerve cell | 3 | 62,67,73 |
| **23** | Tissue | 1 | 72 |
| | **Total** | **27** | |
| | **Grand Total of all items** | **76** | |

Thus, the final draft of the test contains 76 multiple choice items. Each item of the test contains three- tier. Each tier has got multiple choice responses. The first part or the first

tier of the item is multiple choice content questions with a set of true and false responses. For every given question in the first tier the students have to choose whether it is true or false. In the second part or the second tier the multiple choice responses are in the form of probable reasons for the responses chosen in the first tier. Four probable reasons were kept in the second tier. A blank space is also provided for writing an alternative reason/response. In other words, the second part or the second tier consists of a set of justifications for the chosen response to the question in the first part. The third part or third-tier consists of set sources of the information. Six probable sources of information were kept in the third-tier. Among all the seventy six items, thirty eight items are true and thirty eight items are false. A detail of the true and false items are depicted through table 3.5.

**Table_3.5 True & False Items of Three-Tiered Multiple Choice Science Misconception Test (Final Draft)**

| Item No. | Physics | | Correct Reason No. |
|---|---|---|---|
| | True | False | |
| **1** | T | -- | I |
| **2** | -- | F | III |
| **3** | T | -- | IV |
| **4** | -- | F | II |
| **5** | T | -- | III |
| **6** | -- | F | I |
| **7** | F | -- | IV |
| **8** | T | -- | II |
| **9** | -- | F | I |
| **10** | -- | F | II |
| **11** | -- | F | IV |
| **12** | T | -- | III |
| **13** | -- | F | IV |
| **14** | T | -- | I |
| **15** | -- | F | III |
| **16** | -- | F | II |
| **17** | T | -- | III |
| **18** | -- | F | I |
| **19** | T | -- | IV |
| **20** | T | -- | II |
| **21** | T | -- | I |
| **22** | T | -- | III |
| **23** | -- | F | II |

| | | | |
|---|---|---|---|
| **24** | -- | F | IV |
| **25** | T | -- | II |
| **Total** | **12** | **13** | -- |
| | **Chemistry** | | |
| **26** | -- | F | I |
| **27** | T | -- | II |
| **28** | -- | F | IV |
| **29** | T | -- | III |
| **30** | -- | F | I |
| **31** | -- | F | III |
| **32** | | F | II |
| **33** | T | -- | II |
| **34** | -- | F | III |
| **35** | T | -- | II |
| **36** | -- | F | I |
| **37** | -- | F | IV |
| **38** | T | -- | I |
| **39** | -- | F | II |
| **40** | -- | F | IV |
| **41** | T | -- | III |
| **42** | T | -- | I |
| **43** | -- | F | II |
| **44** | T | -- | III |
| **45** | T | -- | IV |
| **46** | -- | F | I |
| **47** | T | -- | II |
| **48** | T | -- | III |
| **49** | -- | F | II |
| **Total** | **11** | **13** | |
| | **Biology** | | |
| **50** | T | -- | I |
| **51** | -- | F | II |
| **52** | T | -- | IV |
| **53** | -- | F | III |
| **54** | T | -- | III |
| **55** | -- | F | I |
| **56** | -- | F | II |
| **57** | T | -- | IV |
| **58** | -- | F | II |
| **59** | T | -- | I |
| **60** | -- | F | IV |
| **61** | -- | F | III |

| | | | |
|---|---|---|---|
| **62** | T | -- | II |
| **63** | F | -- | III |
| **64** | -- | F | I |
| **65** | T | -- | IV |
| **66** | T | -- | IV |
| **67** | -- | F | I |
| **68** | T | -- | II |
| **69** | -- | F | III |
| **70** | T | -- | III |
| **71** | T | -- | IV |
| **72** | T | -- | II |
| **73** | T | -- | I |
| **74** | -- | F | I |
| **75** | T | -- | III |
| **76** | T | -- | II |
| **Total** | **15** | **12** | -- |
| **Grand total of all items** | **38** | **38** | -- |

## 3.7 Information Schedule for School Teachers

The researcher has made an information schedule for the teachers to know about their gender, teaching experiences, educational qualification, professional qualifications, and mode of teaching, use of teaching learning materials in the classroom, availability and use of science laboratory in the school. This tool was administered on 18 science teachers teaching students of standard VIII in schools of Ranchi district (Appendix: H).

## 3.8 Observation Schedule for Availability of Teaching Learning Material

The researcher has made an observation schedule to check the availability of teaching learning materials in the selected schools. This observation schedule has six items. These items were kept in the tool to assess the availability of books, blackboard along with the presence and use of charts/models/diagrams/posters etc. in the classroom. The researcher has also observed the availability of electricity so that the use of information and communication technology can be assessed. The observation regarding availability and use of teaching learning material in the classroom was noted in the field diary (Appendix: I).

## 3.9 Observation Schedule for Availability of Science Laboratory

The researcher has made an observation schedule to check the availability of science laboratory for teaching-learning process. This observation schedule has ten items. These items were kept in the tool to assess the presence of science laboratory in the school. The researcher was also keen to observe that whether science laboratory was well illuminated and ventilated so that the students feel comfortable and there is no difficulty in performing any experiments. The tool also contained items related to the availability and working condition of the scientific equipments. The equipments were in accordance to the needs of the student and whether it was used by teachers only or students were also allowed to manipulate with the equipments. Items related to the proper allocation of equipments to the students as well as the presence of sufficient number of equipments were also added in the tool (Appendix J).

## 3.10 Design of the Study

As per the objective of the study, the investigator has adopted survey method for the study. The type of information the survey method procures is in wide demand and is capable of rendering important services because it helps to identify the present trends and solves current practical problems. It guided the researcher towards the eventual derivation of a valid generalization.

## 3.11 Procedure for Data Collection

First the researcher has taken a permission letter from her guide for data collection. Then a forwarding letter was taken from the Dean and Head of The Faculty of Education and Psychology, Department of Education (CASE) The Maharaja Sayajirao University of Baroda (Appendix: K). This forwarding letter was presented to the District Superintendent of Education (DSE) of the Ranchi District. There after permission letter was sought from the DSE of Ranchi district which allowed the researcher to collect her data in the selected schools (Appendix: L). The tools used for data collection was also submitted to the office of the District Superintendant of Education and an assurance was given that the data collected would be used for research purpose only and would be kept strictly confidential. The data was collected during the period of February 2020 to March 2020.

Time duration of 150 minutes was given to the students for attempting the test. Students were instructed to fill primary details such as their names, school names, gender and educational qualification of parents before they started attempting the questions. Following instructions were given to the students before starting of the test.

- ❖ It is compulsory to attempt all the questions.
- ❖ Each question has three parts.
- ❖ Put a tick mark to the most appropriate response from each part.
- ❖ Each question has only one correct answer.
- ❖ There is no negative marking for incorrect answer.
- ❖ Each correct answer carries one mark.
- ❖ Do not make any marks in the question paper.
- ❖ Return the question paper to the invigilators after completion of the test.

## 3.12 Data Analysis Techniques

The tools used to gather data for each objective along with the appropriate data analysis techniques employed for each tool is depicted in the table 3.6

**Table_3.6 Tools and Data Analysis Technique**

| S.N. | Objectives | Tools used for data collection | Data Analysis Technique employed |
|---|---|---|---|
| **1.** | To identify misconceptions in science among students of standard VIII. | Three-tiered multiple choices science misconceptions test | Frequency and Percentage |
| **2.** | To study the reasons and sources of misconceptions in science among students of standard VIII. | Three-tiered multiple choices science misconceptions test | Frequency and Percentage |
| **3.** | To study misconceptions in science with respect to:<br>a) Gender<br>b)Availability of teaching learning materials<br>c)Availability of science laboratory<br>d)Educational qualifications of teachers<br>e) Experience of teachers<br>f) Educational qualifications of parents | Misconception Tool for variable **a** & **f**,<br><br>Observation Schedule for variable **b & c**<br><br>Information Schedule for teachers for variable **d & e.** | t-test, ANOVA |

In this chapter a detailed description about the methodology adopted for the present study is discussed. This chapter also deals with the population of the study, the sample and sampling techniques employed along with the sources of data collection. An elaborate detail about different tools used for data collection, along with its construction, validity and reliability is also discussed. The researcher has also elaborated the techniques that had been employed for the analysis of the collected data. A brief demography of the Ranchi district along with its map has also been added for clear understanding of the educational blocks of the district. The subsequent chapters would describe about the analysis and interpretation of data in detail.