CHAPTER III

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RESEARCH DESIGN

A research design has a great bearing on the efficiency and the effectiveness of the research work. The smoothness of the research work and the accuracy of the results depend upon the well thought out, comprehensive and workable research design.

'Research design is a conceptual structure within which research is conducted. It specifies clearly the blue print for the collection, measurement and analysis of data. It includes a detailed description of the manner in which decisions have been made about the type of data needed for the study, the tools and devices used for their collection and the method by which they have been collected. (1)

In the forthcoming paragraphs, various aspects of the design of the present research work have been discussed.

3.1) Meaning of research design:

"A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure". (2)

Infact, in the design, a researcher may present definition of the population, the size of the sample, and the rationale for the size of the sample, the method of sampling, why, where and when and what types of data collected, the tools and devices used for collecting data along with their reliability and validity, the types of data analysis made, the statistical methods employed and reasons for selecting such methods and
how the data will be organized and presented for analysis and interpretation

The research design can be split into the following points:

A-The sampling design: which deals with the methods of selecting items to be observed for the given study.

B-The observational design: which relates to the conditions under which the observations are to be made.

C-The statistical design: which concerns with the question of how many items are to be observed and how the information and data gathered are to be analyzed.

D-The operational design: which deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

3.2) Need for Methodological Research Design:

Research design is needed to carry out the research operations with ease, economy and efficiency. Research design gives the researcher deep insight into the sampling, research methodology, and analysis and interpretation of the data collected. It is similar to the blueprint that an architect uses before setting up a project.

Research design stands for advance planning of the methods to be adopted for collecting the data and the techniques to be used in their analysis, keeping in view the objectives of the research and the availability of the staff, time and money.

In a nutshell, it can be stated that, research design has great bearing on the efficiency and the effectiveness of the research work. The
smoothness of the research work and the accuracy of the results depend upon the well thought out, comprehensive and workable research design.

3.3) Need and Significance of the problem:

In Maharashtra, the Maharashtra state board of secondary and higher secondary education Pune is a body responsible for framing the curriculum of secondary and higher secondary education, deciding the way of transaction of the curriculum and the evaluation procedures to be employed to determine the attainment of educational goals.

In order to evaluate attainment of educational goals of secondary and higher secondary education, Maharashtra state board of secondary and higher secondary education Pune, conducts two public examinations viz. S.S.C. examination and H.S.C. examination.

S.S.C. examination is a turning point in the life of every student. A student who gets better success at the S.S.C. examination, experiences much better educational prospects and gets a chance to move ahead on the track of education as per his choice. Passing at S.S.C. examination is essential for a student to continue his journey of education. Failure of students at S.S.C. examination is generally due to few difficult subjects like English and Mathematics.

So far as mathematics subject is concerned, it is taught compulsorily worldwide simply because it is extremely useful not only for a common man but also for the scholars of almost every field of knowledge. The progress and prosperity of any nation or country depends upon mathematics. There is no doubt about the importance and utility of mathematics. This subject has taken cardinal position in the field of higher education as well as in the day today life of human being. From
ancient period up to the date, man has not been able to live without mathematics. It is mostly related with 3 R i.e. reading, writing and arithmetic. We cannot imagine of life without the knowledge of mathematics. That is why mathematics is a compulsory subject up to secondary school levels.

In Maharashtra state, mathematics is taught compulsorily up to standard X. Unfortunately, mathematics is considered as the most difficult subject not only by the students but also by the teachers, parents, society and the government. Because of mathematics, majority of the students fail at S.S.C. examination resulting in high dropout at secondary school stage.

In order to avoid high drop out at secondary school stage, government of Maharashtra made passing of mathematics subject very easy at S.S.C. examination by introducing a special grace marks scheme, apart from regular grace marks, namely combined passing provision (cpp). According to cpp, a student who scores 38 marks out of 150 (i.e. 25% marks) in either mathematics or science and scores 105 marks (i.e. 35% marks) out of 300 in aggregate, at S.S.C. examination conducted by the board of secondary and higher secondary education, Pune, is to be declared passed in both the subjects.

Cpp is an encouraging scheme of grace marks for those students who are afraid of mathematics and are likely to discontinue education because of failure in mathematics. The major purpose of introducing cpp is to enhance percentage of the pass students at S.S.C. examination and help maximum students to continue the journey of education in future.
The adverse effects of combined passing provision cannot be denied. Combined passing provision gives undue relaxation to both students and teachers of mathematics. Teachers do not justify the teaching of mathematics. They try to cover easy portion of the syllabus only. In the classroom they pay attention on the drilling of simple examples only. Special methods of teaching mathematics, which are meant for developing intellectual powers and intellectual skills of the students, are not followed. The teachers encourage Cramming. For home assignment also they target easy and simple problems. The students adopt rote-learning method for the study of mathematics. The students study limited portion of the syllabus. Majority of the students study mathematics just to get minimum marks required for passing the examination.

This kind of teaching-learning practices makes the teaching aimless and tasteless, dry and ineffective. This kind of teaching learning practices do not help to develop intellectual powers and skills which are essential on the part of the students to continue with mathematics at the advance stages of education. Such kind of teaching learning really causes huge drop out at the higher stages of education. The number of students, opting mathematics at the graduation and post graduation stages, is decreasing at an alarming rate. The departments of mathematics and other departments, where mathematics is compulsory, are crying for the unavailability of students. The post graduation departments are being closed due to unavailability of the students. Engineering, technical and other such institutions are unable to produce good products simply because they are not getting students having sound base of mathematics.
The researcher belongs to a big circle of teachers, teaching mathematics in Urdu medium secondary schools of Maharashtra state. His discussion with mathematics teachers and few head masters of Urdu medium high schools let him know that;

- Cpp is not causing significant enhancement in the passing percentage of the students at S.S.C. Examination.
- It is not working as a motivating factor for the students to study mathematics.
- It may make the teaching of mathematics examination oriented, tasteless, dry and fruitless.
- It is not an appealing scheme of grace marks for the students and teachers of mathematics of Urdu medium secondary schools.

Though the information received by the researcher was superficial and subjective, it cannot be ignored as it reveals a serious matter. Interest of the researcher in mathematics education and the information explored by his circle mates about cpp inspired him to undertake the present research work to investigate;

- Whether or not, cpp is causing significant enhancement in the passing percentage of students at S.S.C. examination conducted by Maharashtra state board of secondary and higher secondary education.
- Whether or not, cpp is causing adverse effect on the teaching learning of mathematics.
- To what extent cpp is causing adverse effect, if any, on the teaching learning of mathematics.
3.4) Statement of the Problem:
"Study of the effect of 'combined passing provision', in science and mathematics subjects at S.S.C. examination, on the teaching-learning of mathematics".

3.5) Operational definition of the terms:
1. Combined passing provision (cpp): According to this provision, a student who scores 25% marks i.e. 38 marks out of 150 in either mathematics or science and scores 35% marks i.e.52 marks, in aggregate in both the subjects, is to be declared pass in both the subjects, at S.S.C.examination conducted by Maharashtra state board of secondary and higher secondary education, Pune.

2. S.S.C. Examination: Secondary school certificate examination conducted by Maharashtra state board of secondary and higher secondary education, Pune

3. Mathematics: The subject ‘mathematics’ which is taught in the Class X of Urdu medium secondary schools of Maharashtra state.

3.6) Aims and objectives of the study:
1) Principal aims:
1. To find out the significance of the enhancement of the passing percentage of students, at S.S.C. examination, due to cpp.
2. To find out the adverse effects of cpp, if any, on the teaching learning of mathematics, in Urdu medium secondary schools of Maharashtra state.
2) Minor aims:

1. To study the effect of cpp on the passing percentage of students at S.S.C. examination.
2. To study the effect of cpp on the achievement of the students in mathematics at S.S.C. examination.
3. To study the effect of cpp on the classroom teaching of mathematics.
4. To study the effect of cpp on the home study of the students pertaining to mathematics.

3.7) Hypotheses:

H₁) cpp causes insignificant enhancement in the passing percentage of the students at S.S.C. examination.
H₂) cpp causes low achievement of the students in mathematics at S.S.C. examination.
H₃) Cpp causes teaching of selective portion of the syllabus of mathematics.
H₄) Teachers of mathematics assign inadequate homework to the students due of cpp.
H₅) Due to cpp, students devote inadequate time for the study of mathematics.
H₆) Cpp causes examination-oriented teaching learning of mathematics.

3.8) Population:

Urdu medium high schools of Malegaon, Dhule, Bhiwandi and Mumbai of the Maharashtra state were taken up as the population.
3.9) Sample:

S.S.C. examination results of 7262 students (4172 boys & 3090 girls) from the three year’s S.S.C. examination results of nineteen Urdu medium high schools of the four cities viz. Malegaon, Dhule, Bhiwandi and Mumbai were taken up to constitute the sample for the study. For the administration of the opinionnaire, 100 teachers of Urdu medium high schools of the four cities viz. Malegaon, Dhule, Bhiwandi and Mumbai, teaching mathematics to Class X, were randomly selected.

3.10) Research methodology:

Research methodology involves the systematic procedure by which the researcher starts from the initial identification of the problem to its final conclusion. The methodology consists of procedures and techniques for conducting a study.

Research methodology involves such general activities as identifying problem, review of literature, formulation of hypotheses, and procedures for testing hypotheses, measurement, and data collection. More or less research design and methodology have the same meaning i.e. mapping strategy of research.

Research methodology not only concerns with the research methods but also with the logic behind the methods used in the context of our research study and explains why a particular method or technique is preferred over others.

3.11) Research:

According to advanced learner’s dictionary the term research implies,
“A careful investigation or enquiry specially through search for new facts for any branch of knowledge” (3)

P. M. Cook has given a very comprehensive and functional definition of the term research as;

“Research is an honest, exhaustive, intelligent searching for facts and their meanings or implications with reference to a given problem. The product or findings of research should be an authentic, verifiable and contribution to knowledge in the filed studied” (4)

3.12) Educational research:

According to the Monroe and M. D. Engel hart, educational research is

the name for a type of procedure employed in answering thought questions about education; that is, questions for which answers must be manufactured by reflective thinking. This procedure is one in which the best data obtainable are used and the thinking is critical. At times, a research worker may be concerned with fact questions answerable by routine clerical activities. If the answers to such questions are needed as a means of dealing with thought questions, such activities are a phase of ‘educational research’.

F. L. Whitney has defined educational research comprehensively as;

“Educational research aims to make contribution towards the solutions of problems in the field of education by the use of scientific and philosophical methods, the method of critical reflective thinking. On the level of science, this operates in terms of specifics of experiences which are organized and evaluated and which result in the hypotheses and theories each successfully subjected to deductive thinking. The
philosophical method is used to arrive at larger and longer generalization, constantly approaching truth in the field studied” (5)

Thus educational research refers to a systematic attempt to gain a better understanding of the educational process, generally with a view to improving its efficiency. It is an application of scientific method to the study of educational problems.

3.13) Classification of educational research:

Generally, research is classified as i) basic research ii) applied research. According to Travers, basic research is designed to add to an organized body of scientific knowledge and does necessarily produce results of immediate practical value.

Applied research is undertaken to solve an immediate practical problem and the goal of adding to scientific knowledge is secondary.

3.14) Types of educational research:

It is not just desirable to classify educational research into watertight compartments. All research involves the element of observation, description and analysis of what happens under certain circumstances. A rather four point analysis is used to classify educational research. Particularly all studies fall under one or combination of these types.

1-Historical research: It describes what was. This method helps to understand past and the present, and, to a limited extent, in anticipating the future.

2-Quantitative descriptive research: It uses quantitative methods to describe ‘what is’. It attempts to discover relationship between existing non-manipulating variables. Some form of statistical analysis is used to describe the results of the study.
3-Qualitative descriptive research: It uses non-quantitative methods to describe ‘what is’. It uses systematic procedure to discover relationship between existing variables.

4-Experimental research: It describes ‘what will be’, when certain variables are carefully controlled or manipulated.

Keeping in view the objectives of the present research work, hypotheses to be tested and the nature of data required, the researcher adopted survey method as the most suitable method of research.

3.15) Normative survey method:

Normative survey deals with “what is?” It describes and interprets what exist at present. It concerns with conditions or relationships that exist, practices that prevail, beliefs, point of views or attitudes that are held, processes that are going on, influences that are being felt and trends that are developing. (6)


3.16) Types of descriptive research:

For the sake of convenience, descriptive studies may be classified in the following three categories; (7)

1. Survey studies
2. Inter-relationship studies
3. Developmental studies
3.17) Survey studies:

Survey studies are conducted to collect detailed description of the existing phenomena with the intent of employing data to justify current conditions and practices or to make more intelligent plan for improving them. Survey studies describe and specify the properties of educational phenomena. They include (1) school surveys (2) job analysis (3) public opinions and (4) social surveys.

**School surveys:**

The school surveys, generally, is a comprehensive study of existing conditions. Its main function is to determine the overall effectiveness of the school programme and suggest improvement where necessary.

Cooper (1946) and Keller (1942) have categorized school survey as: (8)

a) The investigative, evaluative or status survey which serves primarily to evaluate existing conditions.

b) The descriptive, planning or developmental survey, which is intended primarily to make proposals for development and improvement.

c) The plmplementive survey, which not only makes suggestions for development but also attempts to create conditions in the conduct of the survey.

According to Good (1966, page 207), the comprehensive school survey usually covers the following aspects of school system: (9)

1. Aims, outcomes, pupil achievements, curriculum, method, and instructional aids.

2. Administrative problems and procedures of the school.
3. Financial policies and procedures.
4. Operation and maintenance of the physical plant.
5. Pupil transportation
6. Staff and personnel.
7. School plant and related factors.

Some of the surveys are confined to gather all three types of information;
1. Data concerning existing status
2. Comparison of existing status with the established status and standard and
3. Means of improving the existing status, while other are limited to one or two of these types.

"The survey is an important type of study. It must not be confused with the mere clerical routine of gathering and tabulating figures. It involves a clearly defined problem and defines objectives. It requires expert and imaginative planning, careful analysis and logical and skillful reporting of the findings"

3.18) Kinds of Normative Survey Method:

Normative survey investigations may be classified on the basis of the field they study, the purposes they achieve, the geographical areas they cover or the techniques they employ.

The educational survey in educational field may be classified further according to; (10)

a) The major aspects of the school system they study, school plant, educational programme, educational outcomes, behavior and attitude etc.
b) The geographical areas they cover: local, state, regional, national or international.

c) The type of preparation they aim at: general, teacher-training, engineering, medicine, law or social work.

d) The level of investigation they investigate into: nursery, elementary, secondary and higher.

e) The data gathering techniques or procedures employed; questionnaire, interview, observation, testing, sociometric, rating and ranking.

3.19) Characteristics of Normative Survey Method:

Some characteristics of normative survey research are given below;

1. It gathers data from relatively large number of cases.

2. It is essentially cross-sectional, most of ‘what exists’ type.

3. It is not concerned with the characteristic of individuals but with generalized statistics of the whole population or a sample thereof.

4. It is an important type of research involving clearly defined problems and definite objectives.

5. Survey vary greatly in complexity, some concerning themselves only with the frequency count of events, while other seek to establish relationship among events.

6. Description may be verbal or expressed in mathematical symbols.

For the present research study normative survey method was selected and a cross-sectional study of the large sample was done keeping in view the objectives and hypotheses of the study.
3.20) Sampling:

A research work cannot be undertaken without the use of sampling. The total population is not possible and it is also not practicable in most of the cases.

A sample is a small portion of a population selected for observation and analysis. By observing the characteristics of sample, one can make certain inferences about the characteristics of the population from which it was drawn.

A population is any group of individuals that have one or more characteristics in common that are of interest to the researcher.

Population or universe means entire mass of observations, which is the parent group from which a sample is to be framed. In research methodology, population means the characteristics of a specific group.

3.21) Definitions of sampling:

1. W. G. Cochran. “In every branch of science we lack of the resources, to study more than a fragment that might advance our knowledge”. Here fragment is sample and phenomenon is population. The sample observations are applied to the phenomenon i.e. generalizations.\(^{(11)}\)

2. David S.Fox. “In social sciences, it is not possible to collect data from every respondent to our study but only from some fractional part of the respondents. The process of selecting the fractional part is called sampling”. \(^{(12)}\)
3.22) **Sampling design:**

Sampling design means the joint procedure of the selection and the estimation of the sample. Sampling should be such that error of estimation is minimum.

3.23) **Randomization:**

Randomization is a method of sampling in which each individual of the population has equal chance or probability of selection for constituting a sample.

This is an objective method of sampling and economical as well. It permits statistical treatment. However a random sample may or may not be good representative. There is no guarantee for representativeness by this method.

3.24) **Types of sampling designs:**

1) **Probability sampling:**

According to G. C. Halmstadter, “a probability sample is one that has been selected in such a way that every element chosen has a known probability of being included”.

Probability sampling is generally used in fundamental research in which the purpose is to generalize the results.

2) **Non-probability sampling:**

In the absence of any idea of probability, the method of sampling is known as non-probability sampling.

It is generally used in action research in which one studies a class without any generalization purpose.

**Types of non-probability sampling:**

1. Incidental or accidental sampling
2. Purposive sampling
3. Quota sampling

3.25) Types of probability sampling:
Simple random sampling: A sample selected by randomization method is known as simple random sample. Randomization is done by using the following techniques as:
1) Tossing a coin (2) Throwing a dice (3) Lottery method (4) Blind folded method (5) By using random table or Tippett’s table.

Systematic sampling: It is more advantageous than simple random sampling. In it, knowledge about all the individuals of the population is necessary. The size of the simple is decided as follows,

If sample size is n and population size is N then each N/nth individual is selected. The sample obtained in such a manner is called as systematic sample.

Stratified sampling: The population is divided in strata on the basis of some characteristics. From each of these smaller homogeneous groups (strata), at random a predetermined number of units are drawn.

3.26) Types of stratified sampling:

- **Disproportionate sampling:** It means that the size of the sample in each unit is not proportionate to the size of the unit but depends upon the personal judgment and convenience.

- **Proportionate sampling:** It refers to the selection of a sample from each sampling unit that is proportionate to the size of the unit.
- **Optimum allocation stratified sampling:** It is representative as well as comprehensive. It refers to selecting unit from each stratum in proportion to the corresponding stratum of the population.

- **Multiple or double sampling:** This is generally used whenever questionnaire is administered to collect information. A sample from non-respondents is selected randomly and the questionnaire is re-administered. This is done to check the reliability of the first sample.

- **Multi-stage sampling:** In it, the primary sample units are inclusive groups and secondary units are subgroups within these ultimate units to be selected, which belong to one and only one group. Whenever two or more stratifications are done before selecting the sample, the sampling is called multistage sampling.

- **Cluster sampling:** In this, the intact group as a whole is selected at once. The sample units contain groups of elements (clusters) instead of individual members or items in the population.

3.27) **Need for sampling:**

Most of the educational phenomena consist of a large number of units. It would be impracticable, to study each unit of the population. It would be expensive in terms of time, money, effort and manpower. Sampling is a process by which relatively smaller number of units are selected and analyzed in order to find out facts regarding the population from which it was selected. Sampling procedures provide generalizations on the basis of a relatively small portion of the population.

Sampling process usually involves four steps;

1. Defining the population
2. Listing the population  
3. Selecting a representative sample  
4. Obtaining an adequate sample

3.28) Sampling for the present study:

Population:

Researcher’s mother tongue is Urdu. He received basic education in Urdu medium schools. After becoming lecturer in education, he was engaged in training pupil teachers in mathematics methodology for Urdu medium schools. He belongs to a big circle of mathematics teachers, teaching mathematics in Urdu medium schools.

Malegaon, Mumbai, Dhule and Bhiwandi are the cities having relatively large number of Urdu medium schools. Specially, Malegaon and Mumbai are well known centers of education having a large number of Urdu medium high schools. Malegaon and Bhiwandi are Taluka places, Dhule is a district place whereas Mumbai is a metro city.

The main objectives of the present study were to find out the significance of the enhancement in the passing percentage of students of Urdu medium secondary school at S.S.C examination due to cpp and to study the effect of cpp on the teaching learning of mathematics in Urdu medium secondary schools. Hence the researcher considered it most suitable to take the entire Urdu medium secondary schools of Malegaon, Dhule, Bhiwandi and Mumbai as the population for the present study.

Sample:

Nineteen Urdu medium secondary schools of the four cities viz. Malegaon, Dhule, Bhiwandi and Mumbai constituted the sample for the study.
Three year’s S.S.C. examination results (2002, 2003, 2004) were collected from each school. In all, S.S.C. examination results of 7262 students (4172 boys and 3090 girls) were taken up for the study of the significance of CPP.

100 teachers, teaching mathematics to class X in the Urdu medium secondary schools of Malegaon, Bhiwandi, Dhule and Mumbai were taken up for the administration of the opinionnaire.

3.29) Procedure of the research work:

In order to carry out the present research work, a systematic procedure was followed keeping in view the objectives of the research and the hypotheses to be tested.

Urdu medium high schools of four cities viz. Malegaon, Bhiwandi, Dhule and Mumbai were taken up as the population for the research work. Five schools from each city were selected at random by lottery method. Twenty Urdu medium secondary schools constituted the sample for the study. Four schools cooperated each from Bhiwandi and Dhule, from Mumbai five schools cooperated whereas from Malegaon six schools cooperated. Thus in all nineteen schools cooperated in providing the S.S.C. results of the students. From each school three year’s S.S.C. examination results of the students were collected. In all S.S.C. examination results of 7262 students (4172 boys and 3090 girls) were collected from the target schools.

For this, researcher had to go to target schools. Researcher consulted principals of the schools, convinced them so as to seek their co-operation. Few schools considered S.S.C. examination result a very confidential document and hence refused to co-operate. The researcher had to go
number of times in schools for the collection of the S.S.C. results of the students as most of the schools refused to give Xerox copies of the results of the students.

Apart from this, the researcher constructed an opinionnaire, in order to study the adverse effect of the cpp, if any, on the teaching learning of mathematics in Urdu medium secondary schools, with the consultation of his guide. The opinionnaire was given to two recognized research guides of Marathwada college of education Aurangabad (Maharashtra) for the external validity. It was administered to the teachers, teaching mathematics to class X, of Urdu medium high schools of the four cities viz. Malegaon, Dhule, Bhiwandi and Mumbai. The teachers who were given the opinionnaire were selected at random. The teachers were requested to fill up the opinionnaire honestly, free from any bias.

The opinionnaire collected from various teachers of Urdu medium secondary schools of Malegaon, Dhule, Bhiwandi and Mumbai were analyzed to find out the facts regarding the following;

- Are the teachers of mathematics aware of cpp?
- Are the students of mathematics aware of cpp?
- Are the students of mathematics in favour of cpp?
- Are the teachers of mathematics in favour of cpp?
- Do the teachers of mathematics instruct their students to take the advantage of cpp?
- Do the teachers of mathematics guide their students in taking advantage of cpp?
- Do the teachers of mathematics manage classroom teaching keeping in view the cpp?
• Do the teachers of mathematics assign homework keeping in view cpp?
• Do the students study mathematics keeping in view combined passing provision?
• Are the teachers and students of mathematics happy with cpp?

The S.S.C. examination results of the students collected from various schools of Malegaon, Dhule, Bhiwandi and Mumbai were analyzed to:
• find out significance of the ‘combined passing provision’, over all and with regards to sex and location.
• compare the percentages of students passing with grace marks and percentage of the students passing under ‘combined passing provision’, over all and with regards to sex and location.
• compare mean scores of students of Urdu medium secondary schools, in mathematics and science, with regards to sex and location.
• compare the number of students passing under cpp and number of students scoring marks in the range of 38 to 52 (excluding 52) in mathematics at S.S.C. examination.

After analysis, the data was interpreted keeping in view the hypotheses to be tested. After analysis and interpretation of the data, conclusions were drawn.

After careful drawing of conclusions, suggestions were given for further possible research work to be conducted in connection with the present research work. Suggestions were also made for the Maharashtra
state board of secondary and higher secondary education, Pune, for revising the combined passing provision, to make it more useful, worth and less harmful to the teaching learning of mathematics.

3.30) Data analysis and statistical treatments:

In order to facilitate interpretation and draw accurate inferences, the data collected was analyzed and given statistical treatments.

Analysis of the results: Initially, tables showing number of students passing clearly (P1), passing with grace marks (P2), passing due to cpp (P3) and number of failure students (F), sex wise and area wise and overall, were prepared.

Apart from this, frequency distribution tables, showing achievement of the students in science and mathematics, sex wise, area wise and overall, were also prepared.

The initial data was used to compute the following:

1. Percentage of P1, P2, P3 and F, sex wise, area wise and overall.
2. Critical ratio for the significance of difference between percentages of P3 of male and female students, area wise and overall.
3. Mean and standard deviation of the achievement of the students in science and mathematics, sex wise, area wise and overall.
4. Percentage of students, securing marks between 25% and 35%, in mathematics, sex wise, area wise and overall.
5. Critical ratio for the significance of difference between the achievement of the students in science and mathematics, sex wise, area wise and overall.
3.31) Analysis of the opinionnaire:

The opinionnaires collected from various mathematics teachers of Malegaon, Dhule, Bhiwandi and Mumbai were arranged area wise. The analysis of the responses was done hypothesis wise. For each hypothesis the propositions that were put forth to test the hypothesis were grouped together and the responses pertaining to them were analyzed to test the hypothesis. The responses against the group of questions pertaining to each hypothesis were counted and written in a tabular form so as to facilitate interpretations and conclusions.

3.32) Graphical representation:

In order to facilitate visualization of the data, following pie graph and column graphs were plotted;

1. Pie graph showing percentage of P1, P2, P3 and F, sex wise, area wise and overall.
2. Bar graph showing performance of students in science and mathematics at S.S.C. examination, sex wise, area wise and overall.

The data, collected from the S.S.C. results of the students and through the opinionnaire administered to the teachers of mathematics of Urdu medium high schools of the four cities, is presented along with its analysis and interpretation in the next chapter entitled ‘Analysis and Interpretation of Data’.
References

>> Ibid page 6.
>> Sukhia and Mehrotra, Elements of educational research. Allied publication, Delhi. P. 182.
>> Ibid, page 151.