CHAPTER III

PLAN AND PROCEDURE

The methodologies of educational research are based, in most instances, on research methods in the behavioral and social sciences, relying most heavily on psychology, sociology and anthropology. Because research in these fields emphasizes logical positivism, which uses experimental and quantitative research methods, most educational research also utilizes these methodologies. Still some research concerns may be addressed more appropriately with a phenomenological or qualitative research approach derived from the humanities, particularly History and Philosophy, or with qualitative methods from the social sciences.

Research can be divided into two broad categories: quantitative research and qualitative research.

**Meaning of research**

Research = Re + Search

“Systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among natural phenomenon.”

“The manipulation of generalizing, extending, correcting or verifying knowledge. . .”

(Encyclopedia of social sciences)

Research may be defined as the systematic method of discovering new facts or verifying old facts, their sequences, interrelationships, causal explanations and the natural laws which govern them.”

(Young P V)
It is systematic and objective analysis and recording of controlled observation that may lead to the development of generalizations, principles and theories, resulting in prediction and possible control of events.

**Educational research -**

In day to day life much more problems came in picture in the area of science and education.

In order to achieve the target or fulfill the objectives problem should be analyzed and it is necessary to choose a solution. The aim of educational research is related to the laws, methods and principles.

“Educational research aims to made contributions towards the solution of problems in the field of education by the scientific, philosophical method.”

**Research methodology -**

Different research methods are there for educational research. Educational research methods are divided on the basis of research objectives, data collection.

Educational research methods are divided in following three types

1. Historical research
2. Descriptive research
3. Experimental research

The main objective of historical research is to know the solution of present problems or issues with reference to past issues.

The objective of descriptive research is to know the current situation.
**Descriptive research** -

The objective of descriptive research is to know the current situation. Descriptive research deals with the relationships between variables, the testing of hypotheses and the development of generalizations, principles or theories that have universal validity. Descriptive research is sometimes divided into correlational research, causal-comparative research and other descriptive research that is neither correlational nor designed to find causation but describes existing conditions. All of these types of descriptive research have same basic components.

It is a fast finding investigation with adequate interpretation. In this, researcher has to present the things, which are occurring.

In present research, researcher checked the relationship between misconceptions in Physics and Critical thinking skills of IX standard students. Hence researcher used a survey method to check the current relationship or situation.

**Experimental research** -

Experimental research provides a systematic and logical method for answering the question, “If this is done under carefully controlled conditions, what will happen?” Experimenters manipulate certain stimuli, treatments, or environmental conditions and observe how the condition or behavior of the subject is changed. Their manipulation is deliberate and systematic. They must be aware of other factors that could influence the outcome and remove or control them so that they can establish a logical association between manipulated factors and observed effects.

Experimentation provides a method of hypothesis testing. After experimenters define a problem, they propose a tentative answer or
hypothesis. They test the hypothesis and confirm or refute it in the light of the controlled variable relationship that they have observed. It is important to note that the confirmation or rejection of the hypothesis is stated in terms of probability rather than certainty.

Experimentation provides a method of the science laboratory where elements manipulated and effects observed can be controlled. It is most sophisticated, exacting and powerful method for discovering and developing an organized body of knowledge.

Although the experimental method finds its greatest utility in the laboratory, it has been effectively applied in non-laboratory settings such as the classroom, where significant factors or variables can be controlled to some degree. The immediate purpose of experimentation is to predict events in the experimental setting. The ultimate purpose is to generalize the variable relationships so that they may be applied outside the laboratory to a wider population of interest.

In this research, researcher provided a remedial program to students and in order to find out its effectiveness he used a experimental research methodology.

**Variables** -

Variables are the conditions or characteristics that the experimenter manipulates, controls or observes.

**Independent and dependent variables** -

The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. The dependent variables are the conditions or characteristics that appear, disappear, or change as the experimenter introduces, removes, or changes independent variables.
Experimental Design -

Experimental Design is the blueprint of the procedures that enable the researcher to test hypotheses by reaching valid conclusions about relationships between independent and dependent variables. Selection of a particular design is based on the purposes of the experiment, the type of variables to be manipulated, and the conditions or limiting factors under which it is conducted. The aim of the experimental design is to be helping researcher in working with the independent variables freely and to provide maximum check on the irrelevant variables.

Three categories are presented here:

1. Pre experimental design is the least effective, for it provides either no control group or no way of equating the groups that are used.

2. True experimental design employs randomization to provide for control of the equivalence of groups and exposure to treatment.

3. Quasi experimental design provides a less satisfactory degree of control, used only when randomization is not feasible.

1. Pre experimental designs -

   1. The one shot case study
      \[
      \begin{array}{c|c}
      \text{X} & \text{O} \\
      \end{array}
      \]

   2. The one group, pretest-posttest design
      \[
      \begin{array}{c|c|c}
      \text{O}_1 & \text{X} & \text{O}_2 \\
      \text{O}_1 & \text{Pretest} & \text{O}_2 & \text{Posttest} \\
      \end{array}
      \]

   3. The static group comparison design
      \[
      \begin{array}{c|c}
      \text{X} & \text{O} \\
      \text{C} & \text{O} \\
      \end{array}
      \]

2. True experimental designs

   1. The post-test only, equivalent groups design
      \[
      \begin{array}{c|c|c}
      \text{R} & \text{X} & \text{O}_1 \\
      \end{array}
      \]
2. The pretest posttest equivalent groups design

\[ \begin{array}{ccc}
R & C & O_2 \\
\end{array} \]

\[ \begin{array}{ccc}
R & O_1 & X \\
R & O_3 & C \\
\end{array} \]

\[ O_1O_3 = \text{Pretests} \]

\[ O_2O_4 = \text{Posttests} \]

3. The Solomon four-group design

\[ \begin{array}{ccc}
R & O_1 & X \\
R & O_3 & C \\
R & X & O_5 \\
R & C & O_6 \\
\end{array} \]

3. Quasi experimental designs

1. The pretest – posttest Nonequivalent group design

\[ \begin{array}{ccc}
O_1 & X & O_2 \\
O_3 & C & O_4 \\
\end{array} \]

\[ O_1O_3 = \text{Pretests} \]

\[ O_2O_4 = \text{Posttests} \]

2. The time series Design

\[ \begin{array}{cccccccc}
O_1 & O_2 & O_3 & O_4 & X & O_5 & O_6 & O_7 & O_8 \\
\end{array} \]

3. The equivalent time samples design

\[ \begin{array}{ccccccc}
O_1 & X_1 & O_2 & C & O_3 & X_1 & O_4 & C & O_5 \\
\end{array} \]

4. The equivalent Materials, Pretest, Posttest Design

\[ \begin{array}{cccccc}
O_1 & X_{MA} & O_2 & O_3 & X_{MB} & O_4 \\
\end{array} \]

\[ X_{MA} = \text{Teaching method A} \]

\[ X_{MB} = \text{Teaching method B} \]

\[ O_1 \text{ and } O_3 \text{ are pretests} \]

\[ O_2 \text{ and } O_4 \text{ are posttests} \]
Research design for present study -

Research design is needed because it facilitates smooth sailing of the various research operations. It is logical, Scientific and systematic planning of research for fruitful result.

Research design is a set of research methods and associated methodologies with a distinctive purpose. It provides a means to judge actions and activities in terms of values, criteria and standards. At the same time research design is an accepted practice that seeks to enhance effectiveness of research.

Research design for present study is mix group design i.e. descriptive and experimental research design

The pretest post test Non equivalent groups design

\[ O_1 \quad X \quad O_2 \quad O_1O_3 = \text{Pretests} \]
\[ O_3 \quad C \quad O_4 \quad O_2O_4 = \text{Posttests} \]

Pretests are administered before the application of the experimental and control treatments and posttests at the end of the treatment period. Pretests scores can be used in analysis of covariance to statistically control for any differences between the groups at the beginning of the study. There may be a possibility of the influence of the interaction effect of testing with the experimental variable.

Controlling experimental variables -

The students involved in experiment are in same age group and the number of girls and boys in control and experimental group are same hence the sex variable is controlled. The tests to check the misconceptions in physics which is basically a diagnostic test and critical thinking skill test is given to sample in same time span and it is observed by researcher. All students belong to Marathi medium secondary school.
students. By going through their previous results they are divided into Control and Experimental group.

Tools of Research -
To investigate the present problems, the researcher used the following tool to collect data.

1. Diagnostic test
This test is used to diagnose misconceptions in physics of IX standard students.

2. Test to measure critical thinking skill
The critical thinking skills related with science specially with Physics is measured with the help of the test.

Designing a diagnostic test -
A diagnostic test is one of the many ways through which data can be collected. Diagnostic test used by researchers to collect information on related study. Diagnostic test is a method of getting data about respondents by asking them rather than by observing and sampling their behavior. Diagnostic test should be standardized, its anonymity can be assured and diagnostic test should be designed to meet the specific purpose of research.

The diagnostic test must have the following characteristics-
1. Construction of the diagnostic test should be relevant and specific to the problem and reflect quality.
2. It should be as concise as possible and to the point so that respondents should not get bored.
3. Items should be properly phrased in easiest language for easy understanding with no ambiguity.
4. Diagnostic test should have a very positive approach.
5. Diagnostic test must possess exhaustive alternative.
6. Diagnostic test should be in order with logical arrangement.
7. No or minor calculation.
8. Avoid double barreled questions and give footnotes.
9. Avoid personal and embarrassing question.
10. The precision of hypothesis.

As per the subject experts and teachers from different schools in rural area of Karveer tehsil of Kolhapur district and Kolhapur city. The concepts related to Physics in particular from Science and Technology textbook of 9th standard are separated. The separation of these concepts is on criteria that concept should belong to Physics and also useful in 10th standard.

Secondly researcher developed a diagnostic test, a five step test development process can be used to develop new tests or to improve existing teacher developed tests. The process is straightforward and employ procedures that teachers already use in some form or another to plan instruction and create their own instructional materials.

Teachers know that diagnostic tests have an important place in planning instruction and improving student learning. Unlike the more global standardized achievement tests administered yearly in most school districts, diagnostic tests provide profiles of strengths and weaknesses for specific students on a limited number of clearly defined instructional objectives.

The narrow focus and curricular relevance of diagnostic tests make them a useful tool for instructional planning throughout the school year.
In the fall, teachers use diagnostic tests to determine student or class mastery of perquisite skills. Individual and class needs are pinpointed so that the teacher can target instruction at the appropriate level. Sometimes test results indicate that students can be effectively grouped for instruction on particular objectives; other times, diagnostic test reveals that an entire class may need to review certain material or can be skipped ahead of where the teacher traditionally begins instruction.

During the year, diagnostic tests help teachers make regrouping decisions and identify students who may need extra help or more challenging assignments. They keep the teacher informed about class progress toward mastering grade level content and skills.

At the end of particular instructional units, a semester or even a year, teacher may use diagnostic tests to judge the effectiveness of their instructional materials or methods.

Although teachers know that diagnostic tests can enhance instructional planning and evaluation, such tests are difficult to find. Very few commercially published tests are diagnostic. Of course, many teachers have attempted to solve problem in the same manner as teachers have traditionally coped with a lack of materials for their classrooms; they have developed their own tests and methods for obtaining diagnostic information. And they have created these tests with little support or technical guidance from testing experts.

More teachers think of diagnostic tests as tests specifically designed to measure a set of narrowly defined skills in order to a provide profile of strengths and weaknesses for an individual pupil. Diagnostic testing then, includes tests used to make instructional decisions about groups of students as well as about individuals.

The test development strategies described in this manual are appropriate for creating any type of test. However, the manual focuses on
assessment of academic achievement. Although non-cognitive factors such as student attitude, motivation, nutrition and vision must be included in a comprehensive diagnostic system. A thorough understanding of which academic skills students have or have not acquired is at the heart of sound diagnostic approach to instructional planning, the procedures and examples presented relate specifically to the development of achievement tests.

Diagnostic tests attempt to measure what an individual has learned – is correct or not. They are used in diagnosing strengths and weaknesses and as a basis for awarding prizes, scholarships or degrees. Many of the diagnostic tests used in schools are non-standardized, teacher-designed tests.

In research, achievement test scores are used frequently used in evaluating the influences of courses of study, teachers, teaching methods, and other factors considered to be significant in educational practice.

Present research is experimental research and different research methods are there for educational research. Educational research methods are divided on the basis of research objectives, data collection.

It is concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing.

1. Specify skill map

   I. identify important skills for which diagnosis is needed
   II. Do task analysis to identify skills that build toward test
   III. Sequence subskills from simple to complex
2. Create Test description

   I. Identify Skills to Test
   II. Specify content to be covered on Test
   III. Select item format

3. Write test items

   I. Draft items following specifications contained in test description
   II. Attend to item writing convention for item types elected

4. Review test items

   I. Check against test description
   II. Check for technical flaws
   III. Check wording for clarity, unnecessary ambiguity/complexity

5. Try out items and Revise

   I. Identify poor items
   II. Adjust test description
   III. Doublecheck completeness and sequence

Step 1. Specify skill map

This first step in developing a diagnostic test is often the most difficult for a test to be useful in planning instruction for individuals or group of students, it must assess skills related to the mastery of particular instructional objectives.
Along with considering which skills to test, the teacher should think about the range of the difficulty that the diagnostic test will encompass. Three variables affect task, hence test item difficulty; the linguistic complexity of the students are asked to perform on the test; the level of discrimination along concepts and topics required to answer test questions; and the level of prompting offered.

Step 2 Create test description

This step is the most creative and often the most arduous. Developing a test description requires hard thought about the nature of the skills, item content and item formats that will appear on the test.

The test description standardizes the test items and makes the item writing process easier, description provide detailed guidelines for item contents, level of difficulty and answer choices.

General guidelines for Item writing

Typical rules for Multiple Choice Items:

a) The stem of the items should be meaningful by itself and should present a clear problem.
b) The stem should be free from irrelevant material.
c) The stem should include as much of the item as possible except where an inclusion would clue the responses. Repetitive phrases should be included in the stem rather than being restated in each alternative.
d) All alternatives should be grammatically consistent with the item stem and a similar length, so as not to provide clue to the answer.
e) An item should include only one correct or clearly best answer.
f) Items used to measure understanding should contain some novelty and not merely repeat verbatim materials or problems presented in instruction.

g) All distracters should be plausible and related to the body of knowledge and learning experiences measured.

h) Verbal associations between the stem and correct answer or stereotyped phrases should be avoided.

i) The correct answer should appear in each of the alternative positions with approximately equal frequency and in random order.

j) Special alternatives such as “none”, “all of the above”. Should be used sparingly.

k) Avoid items that contain inclusive terms (e.g. “never”, “always”, “all”) in the wrong answer.

l) Negatively stated item stems should be used sparingly.

m) Avoid alternatives that are opposite in meaning or that are paraphrases of each other.

n) Avoid items which ask for opinions.

o) Avoid items that contain irrelevant sources of difficulty, such as vocabulary, sentence structure.

p) Avoid interlocking items, items whose answers clue responses to subsequent items.

q) Don’t use multiple choice items where other item formats are more appropriate.

Typical rules for short answer and completion items:

a) A direct question is generally better than an incomplete statement.

b) Word the item so that the required answer is both brief and unambiguous.
c) Where an answer is to be expressed in numerical units, indicate the type of units wanted.
d) Blanks for answers should be equal in length. Scoring is facilitated if the blanks are provided in a column to the right of the question.
e) No grammatical clues should be give, e.g. a …; an………
f) Where completion items are used, do not leave too many blanks.
g) For completion items, only key words should be left blank. Leave blank only those things that are important to remember.
h) In composing items, don’t take statements verbatim from student’s textbook or instruction.
i) The scoring key should anticipate possible synonyms or acceptable variants at the desired response.

Typical rules for True-False or Alternative Response Items:

a) Avoid broad general statements for true false items.
b) Avoid trivial statements.
c) Avoid negative statements and especially double negatives.
d) Avoid long complex sentences.
e) Avoid including two ideas in a single statement unless cause-effect relationships are being measured.
f) Avoid questions which include indefinite terms, degrees or amounts.
g) Include opinion statements only if they are attributed to particular sources.
h) True statements and false statements should be approximately the same length.
i) The number of true statements and of false statements should be approximately equal.

j) Avoid taking statements verbatim from students' text or instruction.

k) An item’s truth or falsity should not depend on an insignificant word or phrase.

Step 3 Write the test items

An important decision is the number of items that should be written to match any test description, as well as the number of items that should appear on the diagnostic test itself which encompasses several skills. A rule of thumb suggests that anywhere from three to eight good items per skill may be required for diagnostic purposes.

Step 4 Review of test items

The formal test item review should be done by persons other than the item writers. The purpose of the review is to screen out poorly written questions and ones that don’t assess the skill as intended. The review questions suffice to identify these two kinds of poor items.

Step 5 Try out items

The item tryout, sometimes called a pilot or field test depending upon the number of students involved is the final step in the test development process. The tryout sample should be small, from 5 to 20 students and need not be randomly selected. Students will make pilot versions of the diagnostic test so that items can be tried out “in context”.
Remedial Program -

In the end researcher prepared a remedial program for these students. Remedial instruction is appropriately reserved for the relatively few students whose test scores reveal achievement deficits in the basic school subjects that demand intensive, highly individualized attention. Remedial instruction is offered to small groups or individuals outside the regular classroom for remedial program few steps should be followed by instructor

1. Secure the learner’s cooperation

2. focus instruction

3. keep learning task and material meaningful

4. facilitate remembering

5. Encourage pupil discovery of relationships


The specifics of corrective and remedial teaching must always be worked out in view of the information and resources that are available. Nevertheless, the following guidelines, which are based on sound learning principles, can be useful in planning and carrying out instruction.

1. Secure the learner’s cooperation - An active participant learns more efficiently than a passive spectator. Too many underachievers have become passive spectators in the learning situation – they do not learn because they do not expect to learn. The success of corrective and remedial teaching depends heavily on the extent to which the learner gets
involved as an active participant in the learning process. Each of the guidelines that follow will help to secure the learner’s involvement.

2. **Focus instruction** - In order to focus instruction, a teacher must know only what a learner does not know but also what he or she does know. One never starts with a blank state in working with an underachiever. Underachievers usually have a spotty assortment of concepts and skills – some of which they misunderstand, misuse, or over apply. Developmental teaching is like building a good, solid wall brick by brick.

3. **Take small steps** - The teacher will do well to borrow a basic tenet of programmed instruction: make each step so small that a correct response is virtually assured. Teacher should also help pupils set realistic goals for themselves. Unless pupil perceived small step as a significant step, they are not likely to be satisfied with the small step.

4. **Reinforce success** - In many instances a success experience is its own reinforcement. The assumption in most programmed learning is that small steps ensure correct responses are rewarding to the learner. A related assumption is that the learner will have immediate knowledge of results; that is, he or she will know whether the response was correct. Knowledge of results is particularly important if the learning experience is to be reasonably self sustaining. One of the main advantages of one to one remedial teaching is that the teacher is constantly available to provide immediate knowledge of results.

5. **Keep learning tasks and materials meaningful** - The results of countless research studies demonstrate that meaningful tasks and materials are mastered more rapidly than materials that have limited meaning or tasks that are not clearly understood. Although additional research regarding specific applications is needed, certain implications are clear. The problem in remedial teaching is not merely to be sure that
tasks and materials have inherent meaning, for the use of nonsense materials is generally limited to experimental settings. The remedial teacher must be constantly alert to see that materials are meaningful for the particulars pupil being taught and that assigned tasks are understood.

6. Facilitate remembering - Researches usually get at memory by studying forgetting, and most psychologists agree that forgetting is due primarily to interface. That is, old learning’s tend to stand in the way of new learning’s, and new learning’s tend to blur old learning’s because similarities in what is known and what is freshly learned tend to merge, thus interfering with both efficient learning and remembering. The remedial teacher can combat interference by taking care to see that the unique of each new learning are stressed and understood; the more clear the differentiation, the less chance that interference will cause forgetting.

7. Encourage pupil discovery of relationships - when pupils are able to discover important relationships and generalizations for themselves, transfer to new tasks and situations is better.

Of course we are not suggesting that pupils be abandoned to proceed at random as they seek to make their own discoveries. The point is that the learning sequence should be so structured that the pupil is so led to the place where relationships and generalizations are clear and self discovery is a logical next step.

8. Guard against motivation that is too intense - Too much of any good thing can be harmful. Motivation that is too intense is likely to be accompanied by distracting emotions and limited utilizations of cues, both of which interfere with efficient learning. The remedial teacher can, however, be sensitive symptoms of anxiety and fear and adapt motivational techniques as needed.

9. Provide spaced practice - Perhaps little can be done to glamorize the over learning recommended for certain basic tasks.
Nevertheless, there is evidence that where there is high response similarity distributed practice will produce better results than massed practice. In other words, short, intensive work study sessions separated by frequent rest periods are more productive, particularly for certain tasks, than longer sessions.

**10. Build a backlog of success experiences** - Tolerance for failure is based largely on a backlog of success. Our observations support this assertion. The child who has a history of success in learning is sustained by that experience when he or she encounters difficulty. The child with learning problems, on the other hand, expects to fail in academic areas and has little reason to try again when he or she fails at a task. An extremely important function of the remedial teacher, then, is to see that each pupil adds to his or her store of success experiences during each remedial session.

Corrective and remedial teaching must be viewed as important and interacting parts of a school's overall developmental program of instruction.

**Remedial specialist** -
The remedial specialists role is to take two major responsibilities:
1) Assess cognitive functioning with particular emphasis on strengths and weaknesses in skill development.
2) Transform the findings and recommendations of the entire team in to an instructional program that is suitable for the underachiever. The effective specialist provides the all important bridge between the expertise of the team members and application in the classroom. One might think of the effective specialist as a consultant to the team and as a resource to the classroom teacher.
**Sampling -**

The primary purpose of research is to discover principles that have universal application, but to study a whole population to arrive at generalizations would be impracticable, if not impossible. Some populations are so large that their characteristics cannot be measured; before the measurement could be completed, the populations would have changed.

Fortunately, the process of sampling makes it possible to draw valid inferences or generalizations on the basis of careful observation of variables within a relatively small proportion of the population. A measured value based on sample data is a statistic. A population value inferred from a statistic is a parameter.

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

The term ‘sampling’ means the selection of a part of group or an entirely with the sole aim of collecting complete information. This entirely or totality of all members is known as ‘population’.

A sample as the name implies, is smaller representative of a larger whole.

(George & Hatt)

A sample is a small proportion of a population selected for observation and analysis.

The selected or chosen part, which is used to determine the feature of the entire population is known as sample.

A probability sampling can be divided into four categories, namely simple random sampling, systematic sampling, stratified random
sampling and cluster sampling similarly non-probability samples can be divided into three categories, namely quota sampling, convenience sampling and judgment sampling.

1. Simple random sampling -

Simple random sampling is a process, which ensures that each of the samples of the size n has an equal chance of being selected for the purpose, which means that under simple random sampling, each and every element of the population has an equal probability of being included in the sample.

2. Systematic sampling -

Systematic sampling is sampling in which individuals are selected from a list by taking every n\(^{th}\) name.

Systematic sampling is in most methodological way and proceeds by picking up one element after a predetermined time depending on the sampling ratio.

   e.g. If we want to have a sample of size 10 from a population of size 100, our sampling ratio would be

   \[
   \frac{n}{N} = \frac{10}{100} = \frac{1}{10}
   \]

   We would therefore, have to decide where to start from among the first 10 names in our frame. If this number happen to be 8 for example, then the sample would contain member – having numbers 8, 18, 28, --------, 98 in the frame.

3. Stratified sampling -

Stratified sampling may be complex than simple random sampling, but where applied approximately, stratification can considerably improve the statistical efficacy of sampling. The basis for
using stratified sampling is the existence if strata such that each stratum is more homogeneous within and markedly different from another stratum. The higher is the homogeneity within each stratum, the higher the gain in statistical efficiency due to stratification.

The strata are so clear that they represent a partition of the population.

4. Cluster sampling -

Cluster sample is sampling in which groups, not individuals are randomly selected. All the members of the selected group have similar characteristics.

(Gay 1992)

Suppose we are interested in knowing the demand for some consumable items in a residential area. The area is divided in to 13 blocks. We might use cluster sampling in this situation by considering each block as a cluster. We will then select any 3 or 4 blocks out of the 13 blocks at random or systematically as situation deems fit and then collect information from all families residing in those blocks.

5. Convenience sampling-

Under convenience sampling, as the name implies, the samples are selected at the convenience of the investigator. Here, we have no way of determining the representative ness of the sample. This results in to biased estimates. This method may be quite useful in investigate design as a source for formulating hypothesis. This is also useful in testing of questionnaire etc.
6. Judgment sampling -

Judgment sampling is also called purposive sampling. Under this sampling modus operandi, researcher intentionally or deliberately draws a sample from the population, which he thinks is a representative of the population. Needless to mention, all members of the population are not given chance to be selected in the sample. The personal bias of the investigator has a great chance of entering the sample and if the investigator chooses a sample to give results, which favor’s his viewpoint, the entire study may be vitiated.

7. Quota sampling -

This is a very commonly used sampling method especially in social research studies. Here the sample is selected on the basis of certain basic parameters such as age, sex, income and occupation that depict the character of the population so as to make it representative of the population. So as to make it representative of the population. The investigator or field workers are instructed to select a sample that matches to this parameter.

**Sampling Design -**

The term sampling means the selection of a part of Group or an entirety with the sole aim of collecting complete information. This entirety or totality of all members is known as population. The selected or chosen part, which is used to determine the features of the entire population, is known as sample.

In this research work researcher is going to use convenience (Purposive) sampling. It is also called as intentional sampling.
All secondary schools in Kolhapur district form population of the study.

The sample for survey is selected as follows

Schools in Kolhapur District

Karveer tehsil

Urban (Kolhapur city 36) Rural (43)
6 Schools 7 Schools
160 students 200 Students

Fig.1 Sampling design for Survey method

Secondary schools in Karveer tehsil are in 79 number, from these schools 13 schools i.e. 6 schools from Urban area and 7 schools from Rural area are selected by convenience sampling. The Boys and Girls from each school form a sample of 360 students for survey method.
The sample for the experimental study is selected as follows

Secondary schools in Karveer tehsil are 79 in number, from these schools 5 schools i.e 2 in urban and 3 in rural area are selected by Purposive or convenience sampling. The Boys and Girls from each school forms a sample of 400 students for this study.
**Data Collection Procedure -**

Firstly researcher work on pilot study in which he interviewed some teachers about the common concepts in 9th syllabus of Physics introduced by state government of Maharashtra.

Then he also interviewed few students from population to identify the concepts which have misconceptions then he will give a test which is achievement test prepared by him on his own based on diagnosed concepts. From result of this test he will interpret about the relationship between misconceptions and critical thinking skills.

After a discussion with experts (School teachers) he listed a concepts of Physics involved in Science and Technology text book of IX standard, and these concepts are checked by experts; those can teaching Science subject, with their suggestions some concepts are removed and finally Physics concepts in IX standard Science and Technology text book are finalized.

In order to find out misconceptions in Physics; researcher prepared the diagnostic test keeping in mind the suggestions and feedback from school teachers.

While preparing the diagnostic test, test items were written. The prepared diagnostic test was checked by the experts, with all suggestions of experts researcher updates the test. The prepared test was first used for pilot study. the test was administered on 20 students for pilot study.

The questions involved in diagnostic test are updated to diagnose misconceptions. The Science teachers, having Physics as principal subject, and teaching Science at secondary level are experts to check the
test. All questions are multiple choice questions; and specially in diagnostic test all choices are probable. Every correct answer contributes unit score and every wrong answer contributes misconception.

The final diagnostic test was prepared of 53 questions and administered on the IX standard students, chosen as sample for the study. the test was used to diagnose misconceptions of IX standard students in Science subject especially in Physics and the scoring of the diagnostic test was used for equivalence of the groups.

Two groups named as Control and Experimental were formed on the basis of diagnostic test.

Critical thinking skills Test -

Critical thinking has 35 dimensions and as we know every subject can be useful to enhance critical thinking skill; it directly indicates that all dimensions are not related with any single subject. Out of these 35 dimensions researcher selected 17 dimensions from Paul, Binker, Jensen and Kreklaus (1990) list such as thinking independently, developing confidence in reason, clarifying issues, conclusions or beliefs, evaluating the credibility of sources of information, generating or assessing solutions, making interdisciplinary connections, comparing and contrasting ideals with actual practice, examining or evaluating assumptions, such skills can be enhanced through Science teaching hence they are selected to frame a test based on them.

Researcher write the test items and these test items were checked by experts in education and Psychology with measurement and evaluation. Every correct answer contributes a unit score and this test
contains 53 questions. The test was used to measure critical thinking skills of IX standard students.

The score of diagnostic test and Critical thinking skill test are used to calculate correlation coefficient by using statistical measure ‘r’.

To develop remedial program -

In the end he prepared a remedial program for those students, who have more misconceptions. Remedial instruction is approximately reserved for the relatively few students those test scores reveal achievement deficits in the basic school subjects that demand intensive, highly individualized attention.

By use of diagnostic test researcher knows only what a learner does not know but also what he or she know. In many instances a success experience is its own reinforcement. Meaningful tasks and materials are mastered more rapidly than materials that have limited meanings or tasks that are not clearly understood. Old learning’s tend to stand in the way of new learnings.

When pupils are able to discover important relationships and generalizations for themselves, transfer to new tasks and situations is better. Tolerance for failure is based largely on a backlog of success.

The developed remedial program is checked by experts: the language used in study material is good for learning, diagrams used are useful to avoid misconceptions, presentation of study material is good, content of concepts is sufficient to avoid misconceptions and content in the study material is enriched or not. All these issues are checked by experts.
This remedial program is helping for IX standard students. After giving this remedial program to experimental group the posttest which is a diagnostic test is administered on IX standard students and it is seen that the posttest scores of experimental group are more than that of the control group i.e. it shows there is difference in the pretest and posttest scores of experimental group; and it is due to remedial program.

**Statistics used for analysis** -

Researcher analyzed data by statistical methods such as Mean, Correlation and ‘t’ test and test hypothesis and interpret result.

\[ t = \frac{M_1 - M_2}{SED} \]

- \( M_1 \) – is mean of first group
- \( M_2 \) – is mean of second group

\[ SED = \sqrt{\left[ (SEM_1)^2 + (SEM_2)^2 - 2r(SEM_1)(SEM_2) \right]} \]

- \( SEM_1 = \frac{S.D.}{\sqrt{n_1}} \)
- \( SEM_2 = \frac{S.D.}{\sqrt{n_2}} \)

- \( S.D._1 \) – Standard deviation of first group
- \( S.D._2 \) – Standard deviation of second group
- \( r \) – Coefficient of correlation between two groups

\[ r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} \]

and

\[ \chi^2 = \sum \frac{(Observed\ Value - Expected\ Value)^2}{(Expected\ Value)} \]