CHAPTER III

METHODOLOGY OF THE STUDY
CHAPTER 3

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3.0 Introduction:

As pointed out earlier, the present investigation is related to the study of effectiveness of the training programme aiming at the development of problem solving skills in student-teachers. The objectives of the study have been spelt out in Chapter 1. The literature related to this research has already been reviewed in Chapter 2. The present research has been designed taking into consideration the objectives and various implications of the research studies reviewed. This chapter contains the rationale for the selection and detailed description of the design.

It also spells out the procedure of conducting the field trials.

The major points elaborated are as given below;
3.1 Design of the study,

3.1.1 Method of study,
3.1.2 Variables,
3.1.3 Sample,
3.1.4 Hypotheses,
3.1.5 Experimental design,
3.1.6 Ex post facto approach,
3.1.7 Tools used for measurement,
3.1.8 Statistical techniques used for analysis,
3.1.9 Qualitative analysis,

3.2 Pilot study,

3.3 Conduct of the field trials,

3.3.1 Organisation of the time table,
3.3.2 Seating arrangement,
3.3.3 Instructions to the student-teachers,
3.3.4 Collection of data before the training,
3.3.5 Conduct of the training sessions,
3.3.6 Collection of data after the training,
3.3.7 Time schedule of the activities involved in the field trials,

3.4 References.
3.1 Design of the study

3.1.1 Method of the study:

Selection of the method of the study is an important part of the whole research process. The objectives and hypotheses formulated act as a guide to what the researcher is proposing to test. The major intention of the present investigation is to study the effectiveness of the training programme, developed by the researcher, on the development of the problem-solving skills in student-teachers. Besides this, an attempt was made to study the relationship of intelligence and creativity with the development of problem-solving skills. Keeping these points in view, ultimately experimental method of research was selected for the present study.

In experimental research, researcher strives to ascertain how and why a particular condition or event occurs, through manipulating an experimental variable under highly controlled conditions. The main steps of experimental research given by Van Dalen (1966)⁠¹ are shown here in the form of a flow chart.
Fig. 3.1  Flowchart showing steps of experimental research

1. Identify and define problem.

2. Formulate hypotheses and deduce their consequences.

3. Construct an Experimental design.

4. Conduct the experiment.

5. Reduce the raw data to produce the best unbiased appraisal of the effect which is presumed to exist.

6. Apply an appropriate test of significance to determine the credence one can place on the results of the study.
The discussion in this chapter is primarily concerned with the third important step – designing the experiment and establishing the necessary controls.

3.1.2 Variables:

In experimentation, the researcher manipulates the independent variable and controls all other extraneous variables to determine if such manipulation generates change in the dependent variables. The total variance in the dependent variables is caused by various factors as shown in the figure below –

**Fig. 3.2 : Various factors affecting total variance**

![Diagram showing the breakdown of total variance into experimental variance, extraneous variance, and error variance.](image)

Experimental variance is variance due to purposeful manipulation of independent variable. Extraneous variance is contributed by all the variables other than the independent variable, whose effect is being studied in the
experiment. These variables affect independent variable and hence dependent variable indirectly. Error variance results from random fluctuations in the experiment due to known and unknown variables and masks the effect of experimental variable.

Main functions of experimental design are to maximize the effect of experimental variance, control extraneous source of variance, and minimize error variance. This is to ensure the internal validity of the design.

Another criterion to satisfy is external validity. It means representativeness or generalizability of the results. A good design satisfies both these criteria. The various aspects of the experimental design are elaborated here.

3.1.2.1 Selection of independent variable :

The present study intends to investigate the effect of special training programme on the development of problem-solving skills in the student-teachers. The independent variable was the training programme in Marathi prepared by the researcher to develop problem solving skills in the student-teachers. The various training programmes developed by other researchers and educationists are discussed in Chapter 2. Sidney Parnes and Others (1960),
conducted over two hundred researches on the college freshmen, for evaluating the impact of a creative problem solving curriculum based on Osborn's techniques. Covington and Crutchfield (1962) prepared a programme for the development of productive thinking in school children. Various other researchers prepared programmes to develop creativity in the children. The present training programme differs from the previous programmes in the following way —

i) The training programme consists of twenty lessons of sixty minutes, keeping in view all the steps involved in problem solving process.

ii) The programme included the openend problems related to educational situations.

iii) The programme incorporated various techniques suggested by various researchers.

iv) The subjects under consideration were student-teachers from education college.

The training programme consisted of twenty lessons, each having a particular instructional sequence and several activities to be done by the students in the sessions, individually or in group.

( Please refer to Appendix no. A2 for original training programme in Marathi and refer to 4.1.5 for short summary of the training programme in English. )
3.1.2.2 Selection of dependent variable:

The present study intends to measure the effect of special training programme on the development of problem solving skills in the student-teachers. The measurement of problem solving skills in the student-teachers was the dependent variable. It was assumed that the development of problem solving skills on the part of the student-teachers should reflect in their achievements on test of problem solving skills. Therefore, dependent variable in this study was - 'Achievement of the student-teachers in the form of raw scores on the test of problem solving skills prepared by the researcher.'

Standardized test on problem solving skills involving openend problems using Marathi language was not available. Therefore, the researcher constructed a test based on the cognitive skills involved in problem solving process to be tested. (Refer to 4.2 for validity and reliability of the test).

The scores on test items related to fluency, flexibility and originality on divergent type test items and scores on convergent type test items were added to get composite scores. These composite scores were taken as dependent variables for the analysis of the data.
3.1.2.3 **Control of extraneous variables to ensure internal and external validity.**

An experiment has internal validity, if it ensures that the results observed may be attributed within limits of error to the treatment only. If the difference brought about in the dependent variable results from some extraneous variables, they may mask the original effect of the treatment variables.

Campbell and Stanley (1966) have discussed various threats to internal validity such as maturation, history, testing, selection bias etc.

To ensure the maximum internal validity, influence of variables extraneous to the purposes of the study, were minimised, nullified or isolated through various ways, such as -

i) Control of variables during the experiment by eliminating the variably or by incorporating the variables in the experiment.

ii) Randomisation, and

iii) Statistical control of the variables.

External validity is the extent to which the variable relationships can be generalized to other
setting, other treatment variables, other measurement variables, and other populations.

Randomisation used for sampling is one way of increasing generalizability, or external validity of the results.

Control of variables achieved through various above mentioned ways in the present study is discussed below.

3.1.2.3.1 Control of variables during the experiment

i) Age of the subjects - All the student-teachers were adults (above 21 years).

ii) Sex of the student-teachers - It is likely that the training programme may have differential effects on the development of problem solving of male and female student-teachers. It may be an influential variable in this respect. But this question did not arise in the present study, because the research was conducted on female student-teachers only. The researcher was aware of the fact, that by involving only female student-teachers as subjects for the experiment, the generalizability of the research was somewhat reduced.
iii) Tests - The tests administered to the control and experimental groups were the same, i.e. Raven's Standard Progressive Matrices, Marathi adaptation of the Torrance Test of Creative Thinking and Test of Problem Solving skills, prepared by the researcher.

iv) Test administration - Tests were administered using a uniform procedure by the same persons and at the same time, to control and experimental groups. Thus the error variance due to persons, time and procedure was properly taken care of.

v) Evaluation of the answer scripts - A detailed scoring key was prepared by the researcher for uniform assessment of answer scripts of all the student-teachers.

vi) Physical environment - The same classrooms were used for testing both the groups.

vii) Contamination, diffusion of experimental treatment - The possible interaction between the experimental and control groups was minimised through special provision in the time table of the college, which is further discussed in 3.2.1.
viii) Hawthorne effect relates to motivational aspect of the subjects, which is difficult to control. However, arrangements were made to engage both the groups simultaneously, i.e. the experimental group received training in problem solving, while the control group was busy with routine B.Ed. curricular activities during the same period. This might help to reduce the error variance due to Hawthorne effect.

ix) History and maturation - As the experiment involved a short duration training programme, these two variables may not affect considerably.

3.1.2.3.2 Control by randomisation:

Error variance is variability of measures due to random fluctuations of the known and unknown variables. Error variance may be due to unpredictable individual differences in the student-teachers involved in the study and errors of measurement. Though the sample was incidental sample, randomisation was used while selecting the student-teachers to the two groups and while assigning these two groups to the different treatments.

Thus, every possible attempt was made to reduce error variance.
3.1.2.3.3 **Statistical control of variables**

In order to estimate precisely the variance due to the treatment, other concomitant variables must be controlled or minimised.

One method is direct control of experimental error by incorporating the variables in the experiment considering there different levels. When this is difficult, the statistical control by using analysis of covariance can be used as an indirect control (Winer, 1962)².

In the present study, though the student–teachers were randomly assigned to control and experimental groups and to different treatments, the groups may be initially unlike with regard to various abilities. The effects of these initial differences may mask the effect of treatment variables.

As discussed in Chapter 2 (2.3), intelligence has a prominent role in all higher mental processes and so in the development of problem solving skills.

On the basis of discussion in chapter 2(2.4) creativity was also considered an important variable affecting the development of problem solving skills.
It was not feasible to use factorial design, involving a number of different groups and conduct the treatment to the various small groups. Considering the time constraint and other practical difficulties, it was thought desirable to use statistical control of these variables instead of direct control.

Therefore, the special statistical technique- 'Analysis of Covariance' was used for the statistical control of the two crucial cognitive variables, i.e. intelligence and creativity.

Scores on Raven's test and scores on Marathi adaptation of Torrance test of Creative Thinking were considered as covariates and masking influence of these covariates on dependent variable, i.e. scores on problem solving skills, was partialled out. Initial differences of the student-teachers, regarding intelligence and creativity were thus taken care of by statistical control.

3.1.3 Sample :
3.1.3.1 Selection of the Population

As already discussed in Chapter 1 (1.1.4) it is hypothesized that development of problem-solving skills in the student-teachers will facilitate the development of problem solving skills in their students.
It was decided to develop the training programme for the student-teachers in Marathi medium. The population considered for the experiment consisted of Marathi medium student-teachers of secondary school level. But because of constraints such as time at disposal, rigorous and rigid programmes of different colleges of education, it would have been difficult to conduct the field trials on a selected representative sample. So it was decided to select sample from one college of education which was convenient for adopting an uniform procedure all along, to maintain the internal validity of the experiment.

3.1.3.2 **Choice of the college**

The effectiveness of the training programme was to be judged by the use of experimental method of research. The following considerations were made while selecting colleges for experimental trials.

1) The experimental treatment consisted of twenty training sessions of one clock hour to the experimental group and administration of two tests of one hour duration to control and experimental groups before and after the treatment. This entails an additional work to be conducted besides the regular routine work of B.Ed. course.
ii) In order to control error variance arising out of contamination between control group and experimental group, it was planned to have different time schedules for both the groups.

iii) From the point of view of external validity it was thought desirable to involve sufficiently large sample i.e. more than one hundred student-teachers.

These conditions demand full cooperation of the head of the institute, with its staff members as well as all the student-teachers. It is also obligatory to have perfect control over experimental conditions.

In order to get representative sample, it would have been desirable to involve student-teachers from various colleges outside Pune, at least some colleges from Pune. But it would have been difficult to prepare uniform time schedule for the student-teachers coming from various regions of Pune. Also considering practical considerations already discussed ultimately it was decided to select only one college for the final experiment. The college selected was the one, where the researcher has been working as a lecturer - "S.N.D.T. College of Education for Women, Pune". Conducting experiment in one
college also helped to overcome the practical constraint of availability of time to conduct the experiment.

The plan, duration, nature of the research work and its relevance to the teacher training programme as a whole was made familiar to the principal of the college as well as colleagues. In order to secure full cooperation and support from the principal and staff of the college, the days and dates of administration of the various tests and implementation of the training programme were decided through discussions with them.

3.1.3.3 Selection of the sample

There were one hundred and thirty student-teachers enrolled in the college in the beginning of academic year 1990-91. All the student-teachers were treated as sample of the study. As the sample selected was incidental sample, it was a limitation to the external validity of the experiment. In order to get equivalent groups to minimise error variance due to known and unknown factors, the student-teachers were randomly assigned to two groups and these two groups were randomly assigned to control and experimental treatments. Thus randomisation was used at every stage, wherever possible. The procedure
of random assignment is described below.

Names of the student-teachers from the catalogue of the year were written alphabetically and given serial numbers from 1 to 130. The random digit table number 'B-1' (Dayton 1970,) was used to assign the student-teachers in two different groups of sixty five student-teachers named as Group 'A' and 'B'.

These two groups were randomly assigned to two different treatments by choosing a chit by a blindfold small boy. Group 'A' was treated as control group, while group 'B' was treated as an experimental group, both consisting of sixty five student-teachers each.

However, the actual sample used for the statistical analysis was reduced to some extent, i.e. fifty eight student-teachers in control group and fifty two student-teachers in experimental group. Hence, the total sample for the final analysis consisted of one hundred and sixteen student-teachers. The following were the reasons for experimental mortality -

1) Some student-teachers, enrolled in the beginning, did not join the college.
ii) Some student-teachers left the college in between.

iii) Some student-teachers could not appear for all the tests and training sessions, in the experiment, due to inevitable personal difficulties.

These student-teachers were omitted from the sample. Though the groups were formed by random assignment, equivalence of the control and experimental group regarding intelligence and creativity was judged by ANOVA, which will be discussed later in Chapter 5 (5.3)

(Please refer to Appendix no.B2 for the list of student-teachers used as a sample of the study.)

3.1.3.4 Characteristics of the sample

i) The student-teachers were adults (age above 21 years) and hence were cognitively matured enough to participate actively in the field trials.

ii) The sample was a heterogeneous group of student-teachers with respect to socio-economic status, academic background, previous teaching experience and other personal variables.
3.1.4 Hypotheses

The objectives of the study have already been mentioned in the first chapter (1.4), for testing these objectives statistically, it was thought desirable to form statistical hypotheses in null form, in order to maintain impartial attitude while interpreting the results. The null hypotheses are listed below:

Main hypotheses:

1) There will be no significant difference between the meanscores of the student-teachers from control and experimental groups on test of problem solving skills.

2) There will be no significant difference between the gains of the student-teachers from control and experimental groups on the Marathi adaptation of Torrance test of Creative Thinking.

3) There will be no significant difference between the achievements of the groups formed on the basis of teaching experience, on the test of problem solving skills.

4) There will be no significant difference between the achievements of the groups formed on the basis of graduation faculties, on the test of problem solving skills.
Subsidiary:

5) There will be no significant difference between the achievements of experimental group on creativity pretest and post-test, with respect to component abilities, such as fluency, flexibility and originality.

6) There will be no significant difference between the achievements of the control and experimental groups on test of problem solving skills, with respect to component abilities such as fluency, flexibility, originality and convergent thinking.

3.1.5 Experimental design

Selection of experimental design depends upon the information, the investigator wants to explore with respect to a particular problem. In the light of the objectives of the study and the hypotheses to be tested the decisions regarding the experimental designs were taken as discussed below.

3.1.5.1 Experimental design to test the development of problem solving skills

In the present investigation, the researcher wanted to study the effectiveness of the special training programme prepared to develop problem solving skills, in the student-teachers.
As discussed earlier, in the present chapter (3.1.2.3.3), it was also decided to partial out the effect of two crucial cognitive variables, i.e., intelligence and creativity on the development of problem solving skills, with the help of a special statistical technique - Analysis of Covariance.

Considering the nature of the problem of research, the design selected was 'Randomised post test only control group design with two covariates.'

The diagrammatic representation of the design is shown in figure 3.3 below.
Fig. 3.3: Randomised post-test only, control group design, with two covariates

Experimental group
N=58

Measurement of first covariate
i.e. intelligence

Measurement of second covariate
i.e. creativity

Treatment

Measurement of criterion measure i.e. problem solving skills

Control group
N=58

Measurement of first covariate
i.e. intelligence

Measurement of second covariate
i.e. creativity

No Treatment

Measurement of criterion measure i.e. problem solving skills
The 'R' placed before the paradigm indicates that the subjects have been randomly assigned to the experimental and control groups.

The main features of the design were as given below:

i) The subjects were randomly assigned to the two groups and the two groups were randomly assigned to the two treatments.

ii) Out of the two groups, only the experimental group received treatment, while the control group did not receive the training regarding problem solving skills. Inclusion of control group was useful to test that the variance developed was attributed to the treatment only.

iii) Pretest regarding problem solving skills was not given to both the groups. Only the post-test was given for measuring the problem solving skills.

iv) Scores on the test of intelligence as well as on the test of creativity were taken prior to the treatment and were treated as covariates. Scores on the test of problem solving skills were taken after the treatment and were treated as criterion measures.
The pretest was not given for measuring problem solving skills of the student-teachers for the following reasons -

1) Randomization technique permitted researcher to ensure that at the time of assignment both the groups were equivalent.

2) The researcher wanted to avoid the undue influence of pretest sensitization due to the familiarity and practice on the dependent variable. This might be useful to increase internal validity of the experiment.

3.1.5.2 **Experimental design to test the development of creativity**

It was decided to study the effect of the training programme on the development of creativity in general in the student-teachers. For this purpose the same test of creativity i.e. Marathi adaptation of Torrance test of Creative Thinking was administered before and after the treatment to both the groups.

Hence, the design was randomised pretest post test control group design. The diagrammatic representation of the design is given in the figure 3.4 below:
Fig 3.4 - The randomised pretest post-test control group design

The 'R' placed before the paradigm indicates that the subjects have been randomly assigned to the experimental and control group.

The gain of the control group and experimental group over the TTCT was compared and significance of the differences between means of gain was tested with the help of ANOVA.

3.1.6 Ex post facto approach to study the effect of teaching experience and faculty of graduation

As mentioned earlier in the present chapter (3.1.3.4), the sample was heterogeneous with respect to previous teaching experience and academic backgrounds.
It could be presumed, that the previous teaching experience and familiarity with educational situations, may help the experienced student-teachers. This exposure may help them in understanding and analysing the problems involved in the treatment, resulting into better scores on the final test.

Hence, it was decided to study the effect of teaching experience of the student-teachers, on the development of problem solving skills.

Another variable was faculties of graduation of the student-teachers, such as Arts, Commerce and Science faculties. The nature of these disciplines is totally different. Hence the student-teachers may have different academic experiences, affecting differentially their problem solving abilities.

Therefore, faculties of graduation was also thought to be another important variable.

It was not practicable from the point of view of time and resources at disposal, to incorporate these two variables in the experiment itself.

Hence, the effect of these two variables on the development of problem solving skills was
ascertained by doing Ex post facto analysis of the results.

The achievements of the different groups formed on the basis of previous teaching experience and faculties of graduation were compared with the help of Analysis of variance.

3.1.7 **Tools used for measurement**

3.1.7.1 **Raven's Standard Progressive Matrices**

The test of RSPM was used for the measurement of intelligence of the student-teachers. Reasons for selecting the test are as following:

i) It is a well known standardized test used all over the world.

ii) The test is a non-verbal test of intelligence, therefore, the scores on the test are not adversely affected by the differences in linguistic ability of the subjects.
iii) It can be used either as an individual or as a group test.

iv) Being a culture free test, it can be used to measure intelligence of the student-teachers coming from different socio-economic status and coming from different regions of Maharashtra.

According to Raven (1960), "The scale has a retest reliability varying with age from 0.83 to 0.93. It correlates 0.86 with the Terman-Merrill Scale." 4

The raw scores of the student-teachers on RSPM were treated as one covariate.

3.1.7.2 Marathi Adaptation by Dr. Kothurkar of Torrance Test of Creative Thinking

This test was used for the measurement of creative thinking of the student-teachers before the treatment and after the treatment. The test used was Marathi adaptation of Torrance Test of Creative Thinking verbal form A.

Test-retest Reliability: This reliability is important for our purpose. Several studies of individual tasks with the same or alternate forms and with intervals from one week to six months, are quoted in the N-T manual yielding co-efficients ranging from 0.47 to 0.89 mostly around 0.75. Torrance's (1974) assurance that, "The simple practice effects at taking the tests do not seem
to have a great deal of effect on performance", shows that the scores could be relied upon.

Content validity: Rationale of the tasks and the behaviour sampled by them is given in the N.T. Manual (1974). Though the author of the tests admits that, "These test tasks do not sample the entire universe of creative abilities, but a rather wide range of them." 6

A somewhat serious shortcoming of the tasks is that they ignore an important portion of the assumed definition of creativity. Let us state the definition again. Creativity is, "a process of:

i) becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies and so on; identifying the difficulties;

ii) Searching for solutions, making guesses or formulating hypotheses about the deficiencies;

iii) testing and retesting these hypotheses and possibly modifying and retesting them,

iv) and finally communicating the results."

Test tasks assess the first and the second stage but stage three of testing, modifying and retesting hypotheses is not assessed.

With awareness of some of these limitations the researcher selected this particular test for measurement of creative thinking for following reasons:
i) The test is widely used by the researchers working on creative problem solving, such as Osborn-Parnes and others.

ii) Torrance (1980) has assured that there are no racial or socio-economic biases regarding use of the test, because the test tasks are openended and a person may respond to them in terms of his experiences whatever these may have been.

iii) The definition of problem solving process accepted in the present study is similar to the definition accepted by Torrance of creativity, as a rationale for the test.

iv) The test can be administered individually as well as in group.

v) Marathi adaptation done by Dr. Kothurkar facilitates its use for Marathi medium student-teachers, under consideration.

The pretest scores of the student-teachers on this test were used as second covariate. The pretest and post-test scores of the student-teachers also enabled the research worker to study the effect of training programme, on the development of problem solving skills.
3.1.7.3 **Test of problem-solving skills**

As no standardised Marathi test of problem-solving skills involving open-ended problems was available, the test prepared by the researcher was used. The test was based on the objectives of the training programme for the development of problem solving skills. The tasks assessed the various divergent and convergent abilities involved in problem solving process, such as

i) being sensitive to the problems
ii) analysing the problems
iii) redefining the problems
iv) generating probable solutions
v) evaluating ideas
vi) elaborating ideas.

Development and tryout of the test is discussed in detail in chapter no. four (4.2.3).

A detailed scoring key was prepared. The composite scores consisted of fluency, flexibility, originality scores and scores on convergent type items. The scores on the test were treated as a criterion measure to study the effectiveness of the training programme on the development of the problem solving skills in the student-teachers.

(For different items in the test please refer to Appendix no. A 6)
3.1.7.4 Questionnaire for collecting personal data of the student-teachers

This was prepared by the researcher to collect personal information of the student-teachers regarding educational background, teaching experience etc. The information was used to form subgroups of the experimental groups to study the effect of subject specialization, age and teaching experience on the development of problem solving skills in the student-teachers.

(Please refer to Appendix no.A 1 for the questionnaire.)

3.1.7.5 Opinionnaire for collecting reactions of the student-teachers

Reactions of the student-teachers from experimental group were collected with the help of an opinionnaire. These reactions were useful for qualitative evaluation of the treatment and feedback to the researcher.

(Please refer to Appendix no.A 5 for the opinionnaire.)
3.1.8 **Statistical techniques used for the analysis of the data**

i) Analysis of variance was used to analyse and compare the scores of both the groups, on various tests, such as intelligence test, creativity test and test of problem solving skills.

This technique was used for testing all the hypotheses.

ii) Analysis of covariance was used to partial out statistically the effect of intelligence and creativity on the development of problem solving skills and further confirm the results regarding the first hypothesis.

iii) Scheffe's test was used for multiple comparisons of the various group means.

Statistical analysis of the data is discussed further in Chapter V.

3.1.9 **Qualitative analysis**

i) Individual reactions of the student-teachers, from the experimental group with respect to various aspects of the training programme were collected with the help of an opinionnaire. These reactions were analysed, to evaluate the training programme, from the point of view of the participants.
ii) The responses of both the groups on the test of problem solving skills, were analysed qualitatively, with the help of specific criteria developed. An attempt was made to relate these results to those of statistical analysis.

Qualitative analysis of the data is discussed further in Chapter VI.

3.2 Pilot study

Pilot studies were conducted before finalising the training programme and the test of problem solving skills, in the following ways:

i) The training programme developed by the researcher was implemented on a small group and the results were studied to judge the effectiveness and practicability of the training programme. The details are discussed in Chapter IV. (4.1.7)

ii) A pilot study was also conducted on a small sample for judging the validity and reliability of the test of problem solving skills, prepared by the researcher. The details are discussed in Chapter IV. (4.2.3)
3.3 **Conduct of the field trials**

The main considerations at this stage of the study were to realize the internal, as well as external validity of the experiment, as planned in the previous section (3.1). From this point of view, attempts were made to establish a good standardized and uniform working procedure for the administration of the various tests and the training programme. The procedure used is discussed below.

3.3.1 **Organisation of the time table**

The training programme and administration of the various tests were to be conducted as an additional programme to the regular B.Ed. course. Administration of the various pre-tests and post-tests as well as training programme to be conducted in between, required the implementation in a specific time period in order to maintain the continuity and also the control over the experiment.

The existing time table of B.Ed. course is full of activities such as practice lessons, micro teaching, regular lectures, practical work, educational visits and tests and so many others. Hence, it was thought essential to estimate total time in hours
required for conduct of these field trials. This would help to plan the suitable days and dates from the current academic year of B.Ed. course. The estimations were made on the basis of experiences in pilot studies.

The various activities involved in the experiment and estimation of time needed for them are given in Fig. 3.5.
Fig. 3.5: The list of activities to be conducted in the field trials and estimation of the time required.

<table>
<thead>
<tr>
<th>Activities to be conducted in the field trials</th>
<th>Estimation of time required in clock hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Collection of personal information of the student-teachers, with the help of a questionnaire</td>
<td>1</td>
</tr>
<tr>
<td>2. Administration of intelligence test</td>
<td>1</td>
</tr>
<tr>
<td>3. Administration of creativity test</td>
<td>1</td>
</tr>
<tr>
<td>4. Instructions to the student-teachers regarding experiment</td>
<td>1</td>
</tr>
<tr>
<td>5. Implementation of the training programme to the experimental group</td>
<td>20</td>
</tr>
<tr>
<td>6. Collection of reactions from the student-teachers involved in experimental treatment</td>
<td>1</td>
</tr>
<tr>
<td>7. Administration of test of problem solving skills</td>
<td>1</td>
</tr>
<tr>
<td>8. Administration of creativity test</td>
<td>1</td>
</tr>
<tr>
<td>9. Knowledge of results and discussions with the student-teachers</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total time required</strong></td>
<td><strong>29 clock hours</strong></td>
</tr>
</tbody>
</table>
As described in the Fig. 3.5, the field trials required participation of the student-teachers for 29 clock hours. The college timetable could provide maximum one hour extra each day. Omitting the Saturdays, Sundays and other holidays, the experiment would take one and a half month.

The year plan of the college was scrutinized to find out suitable timing to conduct field trials continuously for one and a half month. Considering the reactions of the student-teachers involved in the pilot study, suggestions from colleagues and observations of the researcher it was decided to select such time period when -

i) the student-teachers are fresh to participate in the programme.

ii) the student-teachers are not busy with school lessons, practical work or examinations.

Keeping in view all these practical considerations, ultimately period between June 20 to August 10 was thought to be most appropriate to conduct field trials without any interruptions.

Another important consideration was decision about the timing of the day, for the field trials.
All the tests were to be administered on the whole sample, i.e. both control and experimental groups. Hence, those could be well adjusted during the routine time table of the college. But the training programme of 20 sessions of one hour each, special instructions regarding the training programme as well as collection of the reactions of the student-teachers after the training involved only the experimental group.

The training programme was conducted as an additional programme along with microteaching programme of the college. The usual time table of the college in this time period, includes microteaching sessions for three hours and one theory lecture to all the student-teachers. Microteaching programme is conducted in small groups of ten student-teachers assigned to one staff member. Considering these points a special time table was made during the conduct of the experiment as given below:
**Fig. 3.6** : Time tables of control and experimental groups during conduct of the experiment.

<table>
<thead>
<tr>
<th>Time</th>
<th>Programme</th>
<th>Time</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 9.30 a.m. to 12.30 p.m.</td>
<td>Microteaching sessions</td>
<td>11.30 a.m.</td>
<td>Training session of the experiment</td>
</tr>
<tr>
<td>2. 12.30 p.m. to 01.00 p.m.</td>
<td>Recess</td>
<td>12.30 p.m. to 01.00 p.m.</td>
<td>Recess</td>
</tr>
<tr>
<td>3. 01.00 p.m. to 01.50 p.m.</td>
<td>Compulsory lecture</td>
<td>01.00 p.m. to 01.50 p.m.</td>
<td>Compulsory lecture</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>02.00 p.m. to 05.00 p.m.</td>
<td>Microteaching sessions</td>
</tr>
</tbody>
</table>

The time table was convenient for the following reasons:

1) Control group spent 4 hours and 20 minutes, while experimental group spent 5 hours and 30 minutes everyday due to additional training programme. Regular time table of the college engages the student-teachers for 5 hours and 30 minutes. So, the programme was not exhaustive to the experimental group.
ii) The timing was convenient for all the student-teachers from experimental group to attend the training sessions without being late.

iii) The student-teachers from control and experimental group met each other for only one compulsory period every day. This was helpful in minimising the interactions in both the groups and hence, minimised the possibility of contamination/diffusion of experimental treatment.

iv) As the training sessions were arranged in the beginning of the day, the student-teachers were fresh and motivated to learn.

v) The fixed timings of the training sessions, i.e. 11.30 a.m. to 12.30 p.m. everyday helped in developing mental set for experimental trials.

3.3.2 Seating arrangement

The following points were considered while making seating arrangements in the field trials -

i) All the student-teachers should be able to see and listen to the researcher while teaching.

ii) The researcher should be able to observe and interact with every student-teacher in the classroom.
The characteristics of the seating arrangement were as given below:

i) All the student-teachers were facing the researcher.

ii) The observer could observe the researcher and all the student-teachers as well.

iii) All the student-teachers could observe the blackboard as well as projection of transperancies on the screen.

iv) Worksheets and review sheets were kept near the back door on two separate tables, so that the student-teachers could collect copies for themselves while entering.

v) The student-teachers could work independently and the researcher could contact each and every student-teacher individually.

The training programme involved some group activities. The student-teachers were divided into six groups of almost ten student-teachers in each for the group activities. Necessary changes were made in the seating arrangement for the group activities to enable the student-teachers to interact with each other in the group. Audio recording of the responses by using separate tape recorders in each group was tried, but it did not work out due to noise of other
groups. Hence, the group leaders were informed to record manually the various responses and report to the whole class at the time of discussions.

3.3.3 Instructions to the student-teachers

Success of the field trials depends upon creating and maintaining the motivation of the subjects involved in the study. This was achieved by giving clearcut instructions to all the student-teachers as well as additional instructions to the student-teachers involved in the experimental treatment.

3.3.3.1 Instructions given to all the student-teachers

Attempts were made to control error variance that could be created due to Howthorne effect by giving clearcut instructions to both the groups as given below;

i) Relevance and importance of the study in simple words,

ii) The groups to which they belong,

iii) Dates and timings of the testing,

iv) Nature and purposes of the various tests to be administered,

v) Importance of attendance and cooperation of the student-teachers in the success of the study,
vi) Changes in time-table and seating arrangement during the conduct of training sessions of the experimental group.

3.3.3.2 Additional instructions to the student-teachers involved in the experimental treatment

Instructions to the experimental group were given before the training sessions started, regarding the training programme. These instructions included the following main points:

i) Nature and importance of the training programme in general.

ii) The detailed time-table of the training sessions.

iii) Role of the researcher and the student-teachers in the training sessions.

iv) Nature of the activities to be conducted in the training sessions, as well as homework activities.

v) When to collect and how to use instructional material specially developed, such as worksheets and review sheets, during each training session.

vi) Importance of audio recording of the training sessions as well as observation by an external observer.

vii) Seating arrangement during various sessions.
viii) Willing cooperation required from the student-teachers for the success of the treatment regarding —
regular attendance, punctuality, spontaneous and free responding during the sessions, and efforts to avoid contamination / diffusion of experimental treatment.

3.3.4 Collection of data before the training

Sessions

The data collection before the training sessions was done with respect to personal information of the student-teachers, intelligence and creativity. The following general considerations were kept before—

i) The administration of various tests and questionnaire created minimum disruption to the normal work and time-table of the college.

ii) The administration of the tests was done in three classrooms including maximum 45 student-teachers each. This was helpful in avoiding interactions between student-teachers while testing. The supervisors were made well acquainted with the tests during pilot study. This ensured an uniform, standard procedure throughout the collection of the data.
iii) Detailed instructions were given to the student-teachers regarding days, timings and nature of the tests and also the seating arrangement. This was helpful in smooth conduct of the testing programme.

iv) Efforts were done to minimize external interruptions during testing.

The procedures followed are described below.

3.3.4.1 Collection of personal information

A questionnaire was developed to collect personal information which is described in chapter 4 (4.4). The student-teachers were informed about the questionnaire and use of the information to be done in the study. The student-teachers were assured that the information will be used for the research purposes only, and will not be misused in any other way.

All the student-teachers were provided with the questionnaire and the personal information regarding age, education and teaching experience etc. was collected.

The information was used to study the interaction of different variables such as age,
faculty of graduation and teaching experience on the
development of problem solving skills of the
student-teachers, which will be discussed later
in Chapter 5.

(Please refer to Appendix no. B2 for personal
information of the student-teachers)

3.3.4.2 Administration of intelligence test

Raven's Standard Progressive Matrices was
administered to all the student-teachers, in order
to measure intelligence.

The multiple copies of answersheets containing
columns A to E and rows 1 to 12 were cyclostyled
and provided to each student-teacher.

The test was administered following the
standard procedure of administration of the test, given
in the manual.

The answersheets were scored according to
the procedure given in the manual, i.e. each correct
response would get score 1. These raw scores
represented the intelligence of the student-teachers.
They were used as a covariate and their effect on
the development of the problem solving skills was
partialled out statistically, by ANACOVA technique.
(Please refer to Appendix no.B3.1&2 for the raw scores of the student-teachers on intelligence test.)

3.3.4.3 Administration of creativity test (Pretest)

Marathi adaptation of Torrance Test of Creative Thinking verbal form 'A', was used to collect creativity score of all the student-teachers, before the training programme.

As the question papers of the test contained questions based on pictures, the multiple copies of the test were prepared with the help of offset printing. The question papers contained blank space for writing down the responses.

The test items were to be solved during fixed interval of time. In order to mark the time, the supervisors were provided with bell and stopwatch.

Detailed written instructions were provided to the supervisors and also discussed verbally, to maintain the standard uniform procedure of administration of the test.

While administering the test, the student-teachers were made aware of the critical nature of
the test in the beginning. The specific instructions as well as sample test items were discussed among student-teachers according to the manual. The student-teachers were asked to clear their doubts before attempting the test.

The timings provided for each test item were strictly followed.

The responses were scored with the help of Marathi scoring guide, developed by the researcher, discussed already in Chapter 4 (4.3). The scores represented the creativity of the student-teachers before the training programme. The scores were used as a covariate to partial out the effect of creativity on the development of problem solving skills. & B3.2 (Please refer to Appendix no.B3.1 for the scores of the student-teachers on pretest of creativity.)

3.3.5 Conduct of the training sessions

3.3.5.1 Planning - As already discussed in chapter 4 (4.1) a special training programme was developed for the development of problem solving skills of the student-teachers. The training programme involved twenty sequential training sessions elaborating various steps and techniques of problem solving process. Various activities were included in each session. As
each session was independent and unique in itself, it was difficult to train any other person for teaching. The researcher, being conversent with the content of the training programme and having proper perspective about the process in its totality, decided to teach herself in the training sessions.

Detailed plans of all the sessions were prepared by developing teacher's guide which is already described in chapter 4 (4.1.8). The plans were tried out in the pilot study, and modified with the help of responses of the student-teachers involved as well as observations of the researcher.

In order to maintain uniform working procedure during training programme, careful planning was done regarding the following aspects -

i) Preparation of the researcher, regarding the content to be taught, activities to be implemented, and discussions to be conducted with the help of teacher's guide,

ii) Organisation of the instructional material such as worksheets, review sheets as well as transperancies and other visual aids to be used while teaching,

iii) Seating arrangement in the classroom,
iv) Organisation of audio recording equipments.

All the sessions were audio recorded with the help of tape recorder. Besides the audio recording of the training sessions an independent non-participant observer was appointed, to observe all the sessions. The role of this observer was as given below –

i) To observe whether accuracy and sequence of the content was maintained according to teacher's guide in the training sessions.

ii) To observe and note down the time required for each activity and responses given by the student-teachers verbally during discussions.

As one of the past students of the college was selected as an observer, she was familiar with the college and the researcher. The observer was made familiar with the whole training programme, through several discussions before the field trials.

Regular manual recording through an external observer proved to be useful as an effective external check for the implementation of the future programme. The recordings provided the researcher immediate feedback regarding the session.
3.3.5.2 **Conducting training sessions:** At the time of training session the student-teachers collected worksheets and review-sheets and put their names on them.

Introduction was done regarding the main teaching points of the session in the beginning. Efforts were done to make narration of the content effectively, with the help of various examples and activities, as given in teacher's guide.

All the student-teachers were given proper instructions regarding the activities. Enough time was provided for the individual as well as group activities. All the activities were followed by discussions. The student-teachers were constantly encouraged to participate in the discussions and react freely. The independent observer noted down all the reactions and responses. The discussions provided immediate feedback to the student-teachers, regarding their thinking process.

The main points were summarised with the help of review sheets. The work sheets were collected at the end. Attendance was recorded with the help of worksheets collected. Worksheets including homework
activities were collected next day in the beginning of the session.

3.3.5.3 Feedback: The responses and reactions noted down by the observer and recorded by the audio tape recorder were taken into consideration, before planning for next training session. As it was difficult to go through and analyse all the written responses in worksheets of each and every student-teacher, everyday, some responses were analysed by random selection of the worksheets to provide feedback to the student-teachers regarding thinking process. The analysis could also provide feedback to the researcher regarding instructions to be given to the student-teachers, teaching and time provided for the activities. Necessary changes were done in the plan of next training session, on the basis of this feedback.

3.3.6 Collection of data after the training sessions

The data were collected after the training sessions with respect to creativity and problem solving skills of the student-teachers. The same general considerations were kept before as discussed in (3.3.4) in the present chapter, while administering the tests.
3.3.6.1 Administration of test of problem solving skills

The procedures of administration of the tests are discussed below:

The problem solving skills of the student-teachers were measured with the help of a test of problem solving skills developed by the researcher, as discussed in Chapter 4 (4.2).

The question papers contained blank spaces for writing down the responses. As the test items were to be solved during fixed interval of time, the supervisors were provided with bell and stop watch, to mark the time.

Detailed written instructions were provided to the supervisors to maintain uniformity in the procedure of administration of the test.

The student-teachers were made aware of the critical nature of the test in the beginning, through instructions. The student-teachers were asked to clear their doubts before starting. The timings provided for each test item were strictly followed.

The responses were evaluated and scored with the help of scoring guide of the test, developed by
the researcher, described already in chapter 4(4.2).
The scores represented the problem solving skills
of the student-teachers. The scores were used to
study the effect of training programme on the
development of problem solving skills.

(Please refer to Appendix no.B3.1/ for the scores
of the student-teachers on test of problem solving
skills.)

3.3.6.2 Administration of creativity test (Post test)

Marathi adaptation of Torrance test of
creative thinking, verbal form 'A', was used to
collect creativity score of all the student-teachers,
after the training programme.

The same procedure as discussed in (3.3.4)
in this chapter was followed to administer the test.

The scores represented the creativity of the
student-teachers after the training programme. The
scores were used to study the gains of the student-
teachers regarding creativity, as an effect of
training programme.

(Please refer to Appendix no.B3.1/ for the test
scores of the student-teachers on post test of
creativity.)
3.3.6.3 Administration of the Opinionnaire to collect reactions of the student-teachers involved in the training programme

In order to collect reactions of the student-teachers involved in the experimental treatment, regarding the training programme, an opinionnaire was administered. It contained open-end questions, asking reactions and suggestions regarding various aspects of the training programme. The nature of the opinionnaire is discussed in Chapter 4(4.5).

The student-teachers involved in the training programme were given the opinionnaire after the training programme was over, and before the administration of the test of problem solving skills. As the student-teachers were supposed to give free reactions regarding the various aspects of the training programme, writing their name on the sheets was not obligatory. The student-teachers were asked to take enough time to think on various aspects and react.

The responses were analysed for evaluation of the training programme from trainees' point of view, which will be discussed later in Chapter 6.
3.3.7 **Programme and sequence of the different activities involved in the field trials**

In order to give the reader the proper perspective about the nature of the field trials the time schedules of different activities are given in Fig. no.3.7 below -
Fig no 3.7: Time schedule of the activities involved in the field trials.

<table>
<thead>
<tr>
<th>Date</th>
<th>Group A (Control group)</th>
<th>Group B (Experimental group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 21-6-90</td>
<td>Collection of personal information with the help of a questionnaire</td>
<td></td>
</tr>
<tr>
<td>2. 22-6-90</td>
<td>Administration of intelligence test</td>
<td></td>
</tr>
<tr>
<td>3. 25-6-90</td>
<td>Administration of creativity pretest</td>
<td></td>
</tr>
<tr>
<td>4. 2-7-90 to 1-8-90</td>
<td>-</td>
<td>Conduct of 20 training sessions</td>
</tr>
<tr>
<td>5. 3-8-90</td>
<td>-</td>
<td>Collection of reactions with the help of a questionnaire, regarding training programme.</td>
</tr>
<tr>
<td>6. 4-8-90</td>
<td>Administration of test of problem solving</td>
<td></td>
</tr>
<tr>
<td>7. 7-8-90</td>
<td>Administration of creativity post test</td>
<td></td>
</tr>
</tbody>
</table>
3.4 References


6. Torrance, 39.