CHAPTER VII

SUMMARY, CONCLUSIONS AND SUGGESTIONS
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7.0 Introduction:

The present study developed a special training programme to develop problem solving skills in the student-teachers. The effectiveness of the training programme was tested experimentally. The previous chapters elaborated the development of the problem, related literature, design of the study, development of the tools, conduct of the experiment, and quantitative as well as qualitative analysis of the results.

The present chapter summarises the previous chapters and arrives at conclusions.

The main points discussed are as given below:

7.1 Development of the problem.
7.2 Related researches.
7.3 Methodology of the study.
7.4 Development of the tool.
7.5 Main results and conclusions.
7.6 Educational implications.
7.7 Suggestions for further researches.
7.1 **Development of the problem**

The first chapter discussed the problem.

7.1.1 **Emergence of the problem**:

Society today is in a process of rapid change due to various reasons such as changing philosophy, technological development and expansion of communication process. This thrust of change in the various fields needs change in individuals to adjust satisfactorily with society and to contribute to the progress of the society. The escalation of change threatens mankind with new problems demanding immediate recognition and innovative solutions. Hence, more attention should be paid to the development of problem solving skills in individuals.

Development of problem solving skills in students, who are the future citizens, demands teachers, who are well acquainted with the process and techniques of problem solving. This understanding of the problem solving process, on the part of the teachers needs special training. The beginning should be done in the field of teacher education, through conscious efforts.
7.1.2 Title of the study:

"An experimental investigation of the development of problem solving skills in student-teachers of one B.Ed. college in Pune, through special training programme."

7.1.3 Objectives of the study:

i) To study the effect of the training programme on the development of problem solving skills in the student-teachers.

ii) To study the effect of the training programme on the development of creativity in the student-teachers.

iii) To study the effect of graduation of different faculties on the development of problem solving skills.

iv) To study the effect of the previous teaching experience of the student-teachers on the development of problem solving skills.

v) To study critically the effectiveness of the training programme, in the light of feedback from the student-teachers.
7.1.4 Definitions of the terms used:

i) Problems - Openend problems generally related to educational field.

ii) Problem solving skills - Following cognitive skills involved in the problem solving process -

a) Exploring dimensions of the problem.

b) Analysing and redefining the problem.

c) Generating probable solutions.

d) Evaluating and elaborating ideas by practical implications.

iii) Measurement of problem solving skills - Raw composite scores on the test of problem solving skills prepared by the researcher.

iv) Student-teachers - Student-teachers from S.N.D.T. College of education for women, Pune-38.

v) Special training programme - A training programme consisting twenty sessions of sixty minutes prepared by the researcher by integrating various principles and techniques given by other experts, to develop cognitive skills involved in the problem solving.

vi) Intelligence - Raw scores achieved by the student-teachers on Raven's Standard Progressive Matrices.
vii) Creativity - Raw composite scores achieved by the student-teachers on Marathi adaptation of Torrance test of Creative Thinking, verbal form 'A'.

viii) Experienced student-teachers - Student-teachers having at least one year's teaching experience in primary/secondary/higher secondary schools.

7.1.5 Scope and limitations of the study:

i) The sample was an incidental sample, hence, the conclusions of the present study are valid in case of this sample only.

ii) The training programme is a short term training programme consisting of a few openend educational problems spaced over twenty sessions.

iii) The test of problem solving skills used for evaluation, was a teacher made test.

iv) The effect of some variables such as intelligence, creativity, teaching experience and faculty of graduation on the development of problem solving skills was studied. The study did not involve other personality variables.
7.2 Related researches:

Second chapter surveyed the related literature and related researches, with respect to problem solving skills and creativity.

With the help of factorial analysis, Guilford (1967) proposed that problem solving in one of the complex mental abilities and has considerable overlap with creative production. Torrance (1974) also treated creativity and problem solving together and defined problem solving in terms of various processes involved which are used as guidelines in the present study for the development of training programme and test to measure problem solving skills.

An important concern of educational researchers with respect to problem solving and creativity is whether and to what extent these skills are trainable. A number of studies have been undertaken regarding this issue in U.S.A. and other countries, though very few in number, in India.

Various studies such as Parnes (1958,1959), Torrance (1959,1977), Covington, Crutchfield and Davies (1966) showed that training of problem solving and creativity is possible through special training programmes.
Studies involving teachers were also surveyed. Studies by Torrance et al. (1960), Rusch, Denny and Ives (1965), Joyce Juntune (1979) and Shaw and Cliatt (1986) showed that the teachers can be trained and that the training of teachers increased creative thinking behaviour on the part of the students.

There are very few experimental studies involving the training of problem solving skills and/or creativity, in India, such as studies by Nirpharake (1977), Pillay (1978) and Deshamukh (1979).

There are no studies cited in Buch (1974, 1979, 1987) including training of the student-teachers in problem solving and creativity, in Indian context.

Hence, a strong need was felt to undertake research in this respect.

The present study attempted to develop a training programme and study experimentally, the effect of it on the development of problem solving skills. It also tried to study the effect of some important variables such as intelligence, creativity of the student-teachers on the development of problem solving skills.
7.3 **Methodology of the study**

Chapter three discussed the design of the study and the conduct of the field trials.

7.3.1 **Method**:

Considering the objectives of the study, experimental method of research was selected.

7.3.2 **Sample**:

The sample was incidental sample. It consisted of 116 Marathi medium student-teachers from S.N.D.T. College of Education for Women, Pune-38. The sample was further randomly divided into control and experimental group of equal size.

7.3.3 **Variables in the research**:

i) **Independent variable** - The independent variable was the specially developed training programme in Marathi prepared by the researcher to develop problem solving skills in the student-teachers.

ii) **Dependent variable** - The dependent variable was the measurement of problem solving skills in terms of raw composite scores on the test of problem solving skills, prepared by the researcher.
iii) **Control of extraneous variables**: Attempt was made to control extraneous variables in order to ensure the internal validity. Two important variables related to problem solving skills, i.e., intelligence and creativity were controlled by using the statistical technique - 'Analysis of covariance.'

All other variables such as age, sex, testing situations, time, place were controlled through uniform procedure to both the groups during the experiment.

In order to minimise error variance, randomisation was used for assignment of the student-teachers to the two treatments.

7.3.4 **Hypotheses**:

For testing the objectives of the study, the statistical hypotheses in null form were formulated as given below:

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

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

iv) 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 hypotheses**

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

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

In order to test the hypotheses the following experimental design was chosen.

1) To study the effect of training programme on the development of problem solving skills, the design selected was Randomised post test only control group design with two covariates. The diagramatic representation of the design is given in fig.7.1 below:

**Fig.7.1 : The design of the experiment.**

<table>
<thead>
<tr>
<th>Groups by random assignment</th>
<th>Scores of the student-teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First covariate(X) Intelligence score</td>
</tr>
<tr>
<td>Group A (Control group) N = 58</td>
<td>$X_1^a$</td>
</tr>
<tr>
<td></td>
<td>$X_{58}^a$</td>
</tr>
<tr>
<td>Group B (experimental group) N = 58</td>
<td>$X_{1b}$</td>
</tr>
<tr>
<td></td>
<td>$X_{58b}$</td>
</tr>
<tr>
<td>Total N=116</td>
<td></td>
</tr>
</tbody>
</table>
ii) To study the effect of training programme on the development of creativity of the student-teachers, the same test of creativity was administered before and after the treatment, to both the groups. The design was pretest-posttest control group design.

7.3.6 Tools used for evaluation

i) Raven's Standard Progressive Matrices was used for the measurement of intelligence of the student-teachers.

ii) Marathi adaptation by Dr. Kothurkar of Torrance test of Creative Thinking, verbal form A, was used for measurement of creativity, before and after the treatment.

iii) The test of problem solving skills developed by the researcher was used for measuring the problem solving skills.

iv) A questionnaire was developed to collect the personal information of all the student-teachers.

v) An opinionnaire was developed to collect reactions of the student-teachers from the experimental group regarding various aspects of the training programme.
7.3.7.1 Tools used for statistical analysis

i) Statistical technique analysis of variance was used for testing hypotheses no. (i), (ii), (v), and (vi).

Two way analysis of variance was used for testing hypotheses no. (iii) and (iv).

ii) Analysis of covariance was used to partial out the masking influence of two covariates and confirming the results regarding the first hypothesis.

iii) The Scheffe test was used to test the significance of the difference between multiple means, after the application of analysis of variance.

7.3.7.2 Qualitative analysis was done with the help of specially developed criteria for each test item of test of problem solving skills, and Opinionnaire.

7.3.8 Conducting the field trials

Third chapter also described the conduct of the field trials.

Scheduling of the different steps involved in the whole research programme were as given below:

i) Random assignment of the student-teachers to experimental and control groups.

ii) Collection of personal information from both the groups.
iii) Administration of the intelligence test to both the groups.

iv) Administration of the creativity test to both the groups.

v) Implementation of the training programme to experimental group.

vi) Collection of reactions regarding the training programme, from the experimental group with the help of an opinionnaire.

vii) Administration of the test of problem solving skills to both the groups.

viii) Administration of the creativity test to both the groups.

7.4 Development of the tools:

Chapter no. four described the development of the tools. Two important tools are given below:

7.4.1 Development of the training programme

Objectives of the training programme in terms of cognitive skills to be developed were decided first. Keeping in view these objectives, the training programme was developed having following special features -
i) Process approach was implemented, thus giving more emphasis on the development of the cognitive skills involved in problem solving skills, rather than on the final solution.

ii) Attempts were made to integrate various principles and techniques useful in different steps of problem solving suggested by various psychologists and researchers such as -
   a) Techniques useful for sensing the problems and defining the problems by Torrance, Bono.
   b) Techniques for analysing the problems by Bono, Osborn.
   c) Techniques for generating many ideas by Osborn, Gordon, Allen, Zwicky, Bono.
   d) Techniques for evaluating and elaborating ideas by Bono.

iii) It was a sequential programme in line with the different developmental stages of problem solving, consisting of twenty sessions of sixty minutes each.

iv) Various open-ended problems related to varied educational situations were deliberately included in the activities in the training programme. These activities were planned for active
participation and application of information received, on the part of the student-teachers, to solve these problems. Special worksheets were prepared for the student-teachers, to record their attempts in this respect.

v) Review sheets were prepared to provide brief summary of each session, including techniques and principles taught, in the sessions.

The training programme was modified with the help of pilot study.

7.4.2 Development of the test to measure problem solving skills

i) The test was specially constructed to test various component skills of problem solving such as sensing the problem, analysing the problem, defining the problem, generating alternative solutions, developing criteria for evaluation of the ideas and selecting appropriate idea which may lead to solution.

The test items did not demand specific content knowledge, of any curricular subject.

ii) The test was in Marathi language.
iii) The test included nine open-ended questions, related to one main problem.

iv) Evaluation regarding the problem solving skills was done with the help of a detailed scoring key. Fluency, flexibility and originality of the relevant ideas was judged with respect to the test items based on divergent thinking, and appropriateness of the responses was judged with respect to the test items based on convergent thinking.

Test retest reliability, inter scorer reliability and correlation with Torrance test of creative thinking were judged in pilot study.

7.5 **Main results and conclusions (regarding the sample under consideration)**

Fifth chapter discussed the statistical analysis of the numerical data, while sixth chapter described the qualitative analysis of the responses. Main results and conclusions based on the analysis are as follows:

i) The mean scores of the experimental group on the test of problem solving skills were highly significant at .01 level as compared to those of the control group. Hence, the null hypotheses no.1 was rejected.
It was concluded that the highly significant scores of the experimental group regarding problem solving skills are due to the treatment, i.e. the training programme for developing problem solving skills, prepared by the researcher.

ii) Analysis of covariance partialled out the masking effect of intelligence and creativity, on the development of problem solving skills. The obtained 'F' ratio were highly significant at .01 level.

This further confirms that the training programme was definitely successful in developing problem solving skills in the student-teachers, irrespective of their initial differences regarding intelligence and creativity.

iii) The gains of the mean scores of the experimental group, on creativity test were highly significant at .01 level, as compared to those of the control group. Hence, null hypothesis no.2 was rejected.

It can be concluded that the creativity of the student-teachers could also be developed with this training programme.
iv) The mean scores of the experienced and inexperienced student-teachers do not differ significantly. Therefore, null hypothesis no.3 was rejected.

It can be concluded that teaching experience of the student-teachers does not affect the development of problem solving skills, significantly.

v) The mean scores of the student-teachers coming from different faculties of graduation, such as arts, commerce and science, do not differ significantly from each other. Hence, hypothesis no.4 was rejected.

It can be concluded that the development of problem solving skills is independent of the faculties of graduation, offered by the student-teachers.

vi) The mean scores of the student-teachers from experimental group were significantly high at .01 level, as compared to those of control group, with respect to component abilities of problem solving skills such as fluency, flexibility and originality.
It was concluded that the training programme could effectively develop divergent thinking in the student-teachers.

The mean scores of the experimental group with respect to convergent thinking was significant at lower level of significance, i.e. .10 level, as compared to those of control group.

It was concluded that the training programme was less effective in developing convergent thinking, in the student-teachers.

vii)The qualitative analysis of the responses showed that the experimental group in comparison to control group could think of more number of relevant responses, variety of responses and unusual responses while deciding the goals, finding out the problems, generating alternative solutions, generating criteria for evaluation, and guessing the consequences of the implementation of the solution.

It could also be seen that the experimental group was superior as compared to the control group in giving appropriate and complete responses while analysing the problem, defining the problem, selecting alternative by evaluation and developing plan of implementation of the solution.
viii) Analysis of the responses of the experimental group to the opinionnaire showed that, overall the student-teachers appreciated the various aspects of the training programme.

7.6 **Educational Implications**

The present study definitely proved that the problem solving skills could be developed in the student-teachers, irrespective of their initial differences regarding intelligence and creativity.

Hence, it has specific implications to the teacher education and also general implications to teaching of problem solving skills.

7.6.1 **Specific implications**

1) Preservice training: It is suggested that a short term training programme would be desirable to include as a part of the syllabus, or as an enrichment programme in B.Ed. course, to develop problem solving skills in the student-teachers. The detailed lesson plans and activities developed in the present training programme may provide a useful guideline, in planning and conducting such a programme.

2) Inservice training: Workshops should be conducted as a part of inservice training programme for the teachers, including various techniques and principles of problem solving, to be used in classroom teaching. A series of seminars and conferences can also be organised regarding this theme.
7.6.2 General implications to educational field

The whole educational process should be geared in such a way to develop problem solving skills in the students. In this respect following aspects of the educational process should be considered.

i) Educational Policy decision makers and Curriculum designers should keep the development of problem solving skills, as an aim of education and syllabus and text books should be oriented towards this aim.

ii) Teachers should encourage students to think, generate various ideas and evaluate their own ideas through posing openend problems in the classrooms. The student should be made aware of the development of their own thinking process.

iii) The students should be assigned problems to solve, demanding creative thinking, by way of home work.

iv) Evaluation procedure should be reformed to test the development of problem solving skills and creativity in the students, alongwith the achievement in specific content of the subjects.
v) Administrators of the educational institutions should encourage the students to participate in various problem solving and creative activities through different cocurricular activities such as students' self governments, various projects etc.

vi) The script writers for various educational programmes on media, should take into account the importance of problem solving approach while writing educational programmes for children.

vii) The parents should be made aware of the importance of independent thinking and problem solving on the part of the students through special orientation programme as well as through programmes on various media.

7.7 **Suggestions for further researches**:

The present study proves that even a short term training programme is beneficial to develop problem solving skills, in the student-teachers. But it should be further supplemented by various replica studies and studies involving other aspects of the problem. A number of topics for further research emerged out of the present study, as stated below:
1) The present study judged the effectiveness of the training programme on the development of the student-teachers. It would be desirable to study whether the teachers trained through such programme can inculcate problem solving skills in their students through classroom teaching, by conducting field trials in the schools.

ii) The present study was limited to an incidental sample, consisting of female student-teachers only. For increasing the external validity of the findings, the studies can be undertaken involving sufficiently large, representative sample, involving male and female student-teachers from various regions of Maharashtra.

iii) The training programme used in the present study was a short term programme involving a few educational problems.

The rationale used in the programme may be extended further to develop long term training programmes for different age levels and involving a large number of problems related to various fields of knowledge. Implementation of such training programmes would increase the generalizability of the results with respect to the development of problem solving skills as a whole.
iv) There is need for construction and standardization of various Marathi tests to evaluate the development of various component abilities involved in problem solving, for various age levels.

v) The effect of various personality variables such as motivation, attitudes, interests of the persons on the development of problem solving skills may be studied.

vi) The present training programme was less effective in developing convergent thinking in the student-teachers. More practice should be given regarding those specific aspects of the training programme and the effectiveness should be judged by replica studies.

vii) The present study took into consideration only the immediate achievement of the problem solving skills. The studies may be undertaken to study the retention and transfer of problem solving techniques and principles with the help of various delayed tests.