CHAPTER I

INTRODUCTION

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INTRODUCTION

Education has been considered as the most important input and the most potent instrument for the development of an individual. It is the key to national prosperity and welfare and that no investment is too great for it. It is evident that education has a very important role to play in the economic and social development of the country, in the building up of the truly democratic society, in the promotion of national integration and unity, and above all for the transformation of individual in the endless pursuit of excellence and perfection.

The students in a classroom have different socio-economic status, aptitudes, interests, attitudes etc. and among them have different IQ levels. In a classroom situation where the students are varied in learning levels, (i.e., average, below average and above average) most of the time teachers teach for the average, neglecting the above average and below average in their hurry to finish the syllabus. In the classroom the above average feel bored and the slow-learners remain passive and day-by-day become poor in the subject.

According to the Secondary Education Commission (1952 - 53) "the present practice of mechanically applying the same methods to dull, average as well as bright children is responsible for much of the ineffectiveness of the instruction given in schools. If these various groups of children are allowed to proceed at their own appropriate pace and the method, approach as well as the curricular load are properly adjusted, it will be good for all of them. It will save the dull children
from discouragement and the bright children from a sense of frustration”.

The Education Commission (1964-66) says “suitable provision should, however be made for the education of the dull, who on account of their slower rate of mental development, cannot learn at the ordinary pace of normal children. In the ordinary classes where instruction is traditionally geared to the needs of the average child, the dull have to work under great hardship. They need individual attention, special remedial help and probably also a modified curriculum to suit their rate of learning”.

An individual differs from another individual in terms of interest, attitude, aptitude, achievement etc. As a result of the impact of educational technology a few ideas have gained currency in education in order to cater to these individual differences. As the number of pupils is very large, it is not practicable to prepare individualized instructional materials to suit everyone’s need. Mastery Learning Strategy can meet all these problems adequately. It is an individualized instruction within the context of group instruction. Recent researches conducted in advanced countries show that mastery learning is one of the most effective technique for teaching difficult and ability subjects.

1.1 THE SETTING OF THE PROBLEM

"The present education system - consisting of examinations, syllabi, teaching methods and instructional materials - has formed a ground conspiracy to persuade everyone involved in it that learning is to be equated with rote memorization." This is how Benjamin S. Bloom
epitomizes pungently the current educational situation, as it strikes an intelligent and perceptive critic.

In the ordinary 'passive' school, untouched by the light of the new and the life giving ideas, the teacher talks most of the time, because he has somehow to 'cover' certain topics through his classroom lessons; he makes or tries to make, the curricular content as easy for the children as possible, and when the dreaded examination approaches, he enters into a more or less conscious battle of wits with the examiners and makes a guess at questions which are important from the examination point of view. The students on their part are naturally, almost inevitably, encouraged to memorize laboriously isolated facts and bits of information that can be disgorged in an examination, which is designed mainly to test these things.

But if you are out to test memory, only memory will be used and trained. If, however education is concerned with the thrill, the adventure and the joy of learning, of grappling with ideas, of realizing the essential purposes which are implicit in the different subjects of study, it puts an entirely new slant on the methods of work and learning. The examiner would then formulate questions, which call, for instance, for problem solving, for organization of ideas, for application of knowledge to practical problems and situations.

Critics of current educational practices say that present methods of instruction are not preparing students for the requirements of the work force. While able in textbook procedures, students lack the expertise to solve the 'ill-defined problems' they experience in the real world situations. Despite this, today's competitive world centers around
problem solving, requiring innovative thinking and technological expertise.

Important of Physics

“Science was not a pleasant diversion and abstraction but was the very texture of life, without which our modern world would vanish away. Politics led me to economics, and this led me inevitably to science and the scientific approach to all our problems and to life itself. It was science alone that could solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people.”

This excerpt from Jawaharlal Nehru’s address at the Indian Science Congress, held at Calcutta in December 1937, ten years before independence, aptly sums up the vision that our political leaders and scientists had of Science for the up-liftment and progress of the Nation.

Physics is a major subject that has a great influence on the society in all spheres. None of the fronts, social, human, environmental or economic can be thought of as far as development is concerned, without Physics. Physics background plays a major indirect role in inducing rational thinking, youthful enthusiasm, self-control, inexhaustible curiosity, self-discipline and boldness – all basic elements for creativity. Physics, when taught in school, must be shown as a connected fabric of knowledge in which some thing learnt in one place proves useful somewhere else and something discovered later throws light back on something worked with earlier. But today the real pleasure of learning
Physics is missing in the classrooms. In today’s educational system, though the syllabi are very rich in contents, the students’ priority is to equip themselves with informational content alone and the real understanding of the subject becomes secondary.

**A rationale for emphasizing Problem Solving**

The emphasis on problem solving accomplishes several key educational goals. It first makes learning more interesting by providing an optimal level of challenge. Students are motivated to learn when the learning task embodies an appropriate level of ambiguity and challenge. Second, problem solving makes knowledge come alive, thus increasing the likelihood that the information will be remembered. The inert knowledge that might otherwise lie dormant becomes translated to useful applied knowledge. Telling students that electricity will flow only if the circuit is complete is teaching inert knowledge; asking students to light up a bulb using cells and connection wires makes the inert knowledge come alive.

The problem solving approach, appropriately presented, helps students understand when to use certain processes; that is, knowledge is ‘contextualized’. Finally, an emphasis on problem solving is more likely to result in the mastery of processes that can be used again and again. Problem solving helps “knowing that” become transformed into “knowing how”.

Anderson et al. (1971) are of the opinion that “science is the activity through which scientists solve problems by using scientific method.” Emphasis should be given to the development of process-
oriented problem solving skills. This will enable the student to develop the ability in applying the processes and principles of science to a wide range of problems, social as well as scientific.

The assumption that underlies our entire educational system is that knowledge gained in school will not only be available in the future but will also be applied in some degree to the solution of new problems as they arise in future school and life situations. A predominant purpose of formal education in schools is to facilitate learning outside them. Nevertheless, often what is learned in school contributes very little to children and youths solving their future problems. This necessitates improvement in our teaching procedures so that transfer of formal learning to other situations will be enhanced to a much greater degree than at present.

**The Conventional Strategy**

The term Conventional Strategy in this study is used to denote the classroom procedures for teaching-learning process associated with the changed new school curriculum of the state of Kerala. The new curriculum emphasizes Problem Solving approach in the mode of transaction of the curriculum as well as in the presentation of content in the textbook. Thus the Conventional Strategy denotes the strategy, as specified by SCERT, Kerala for teaching and learning science in the classroom, based on collaborative learning and problem solving approach.
Mastery Learning Strategy to foster Problem Solving Ability

Bloom found that only about 20 percent of the students in a class generally learn excellently what the teacher set out to teach. Under these conditions, the distribution of achievement among students at the end of the instructional sequence looks much like a normal or bell shaped curve. Seeking a strategy that would produce better results, Bloom outlined the ‘Mastery Learning Strategy’, which makes use of the feed back and corrective procedure. Bloom believed that by using this strategy, nearly all could learn excellently and truly master the subject. (Bloom 1971).

Bloom emphasized the need to focus instruction in mastery learning classrooms on higher level learning outcomes, not simply basic abilities. He noted

I find great emphasis on problem solving, applications of principles, analytical abilities and creativity. Such higher mental processes are emphasized because this type of learning enables the individual to relate his or her learning to the many problems he or she encounters in day-to-day living. These abilities are stressed because they are retained and utilized long after the individual has forgotten the detailed specifics of the subject matter taught in the schools. These abilities are regarded as one set of essential characteristics needed to continue learning and to cope with a rapidly changing world. (Bloom, 1978 p.578)
Research studies show that mastery learning is highly effective when instruction focuses on higher-level outcomes such as problem solving, drawing inferences, deductive reasoning and creative expression (Arredondo and Block 1990, Mevarech 1985, Soled 1987).

1.2 NEED AND SIGNIFICANCE OF THE STUDY

The education throughout the world has for many centuries emphasized a selective function. Much of the energy of the teachers and the administrators has been devoted to determining the students to be dropped at each major stage of the education programme. Quite in contrast to the notion of using schools for selection purposes is the view that education has as its primary function the development of the individual. Under this view, the central task of the schools is to develop those characteristics in students, which will enable them to live effectively in a complex society. (Bloom et al. 1971)

A major goal of education is to help students become more effective problem solvers, that is, people who can generate useful and original solutions when they are confronted with problems they have never seen before. Thus Education implicitly includes problem solving. Education is in fact training each child to cope with the problems of every day life situations.

Does it not need that each child be equipped to live successfully in the society? In other words does it not require all children to be successful problem solvers?

It is the sincere wish of every teacher to make ‘all or almost all’ his students ‘master’ the subject at a higher level of understanding. This
earnest desire instigates the search for a strategy, which would make almost all, if not all, the students good problem solvers.

Mastery Learning is a strategy, which can provide almost all students with the successful and rewarding learning experiences. It proposes that all or almost all students can master what they are taught in the classroom (Bloom, 1976). Research studies show that mastery learning is highly effective when instruction focuses on high-level outcomes such as problem solving, drawing inferences, deductive reasoning and creative expression (Arredondo and Block 1990, Mevarech 1985, Soled 1987). In this connection many questions spontaneously emerge in the minds of all concerned. 1. What is the real impact of Mastery Learning Strategy in Problem Solving Ability? 2. How does Mastery Learning Strategy effect Problem Solving Ability in the two sex groups; boys and girls? 3. Is this strategy more suitable to the average, above average or below average students with regard to their level of intelligence? 4. What steps should be taken by the teacher especially through Mastery Learning Strategy for the improvement of Problem Solving Ability of pupils. These and many such questions will find reliable answer only through serious sincere, systematic and scientific research. The present study is a humble attempt in this direction.

1.3 STATEMENT OF THE PROBLEM

Present study is entitled as “EFFECT OF MASTERY LEARNING STRATEGY ON PROBLEM SOLVING ABILITY IN PHYSICS OF SECONDARY SCHOOL STUDENTS”.

1.4 DEFINITION OF KEY TERMS

The key terms used in the study are defined operationally in the present context as follows.

1.4.1 MASTERY LEARNING STRATEGY

Mastery Learning Strategy is an instructional strategy, which assumes that given sufficient time and appropriate instruction including alternative strategies, almost all of the students can master almost all of the content taught in the class. For the present study it implies that strategy, by which at least 80 % of students shall master at least 80% of the content of the first four chapters in Physics of IX standard.

1.4.2 PROBLEM SOLVING ABILITY

Problem Solving Ability is the cognitive capability of the problem solver to perform physical or mental operations based upon his knowledge so as to achieve the goal of solving a problem. In the present study, Problem Solving Ability implies the cognitive capability to perform physical or mental operations based upon the content of the first four chapters in Physics of standard IX in order to solve conceptual problems. This is measured as the score of the Problem Solving Ability with three components namely, Comprehending the Problem, Clarifying the Problem and Finding Solution to the Problem. The subcomponents of Comprehending the Problem are 1. Sensing a Problem, 2. Defining the Problem and 3. Analysis of the Problem in to discrete elements. The subcomponents of Clarifying the Problem are 1. Ability to discriminate between the most relevant and closely related concepts, 2. Using

1.5 OBJECTIVES

The objectives of the present study are presented below as one general objective and a set of specific objectives.

General Objective

To find out the effect of Mastery Learning Strategy on the Problem Solving Ability in Physics of secondary school students.

Specific Objectives

1. To find out the effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on Problem Solving Ability in Physics of students of Standard IX.

2. To find out the effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on the first component of Problem Solving Ability (Comprehending the Problem) in Physics of students of Standard IX.
3. To find out the effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on the second component of Problem Solving Ability (Clarifying the problem) in Physics of students of Standard IX.

4. To find out the effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on third component of Problem Solving Ability (Finding Solution to the Problem) in Physics of students of Standard IX.

5. To study the Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability for the total sample.

6. To study the Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability for girls of the total sample.

7. To study the Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability for boys of the total sample.

8. To study the Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed any effect of
Instructional Strategy, on the Components of Problem Solving Ability for total sample.

9. To study the Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability for girls of the total sample.

10. To study the Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability for boys of the total sample.

1.6 HYPOTHESES

1. There will be significant effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on Problem Solving Ability in Physics of students of Standard IX.

2. There will be significant effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on Problem Solving Ability component 1 viz; Comprehending the Problem, in Physics of students of Standard IX.

3. There will be significant effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as
covariates, on Problem Solving Ability component 2 viz; Clarifying the Problem, in Physics of students of Standard IX.

4. There will be significant effect of Instructional Strategy (Mastery Learning Strategy/Conventional Strategy), with Nonverbal Intelligence, Verbal Intelligence and Previous Achievement as covariates, on Problem Solving Ability component 3 viz; Finding Solution to the Problem, in Physics of students of Standard IX.

5. There will be significant Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence on those Components of Problem Solving Ability upon which there existed an effect of Instructional Strategy, for the total sample.

6. There will be significant Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence on those Components of Problem Solving Ability upon which there existed an effect of Instructional Strategy, for girls of the total sample.

7. There will be significant Main effects and Interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence on those Components of Problem Solving Ability upon which there existed an effect of Instructional Strategy, for boys of the total sample.

8. There will be significant Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed
any effect of Instructional Strategy, on the Components of Problem Solving Ability, for the total sample.

9. There will be significant Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability, for the girls of the total sample.

10. There will be significant Main effects and Interaction effects of Instructional Strategy and Previous Achievement, if there existed any effect of Instructional Strategy, on the Components of Problem Solving Ability, for the boys of the total sample

1.7 METHODOLOGY

The present study is an experimental one and the design applied here is pre-test post-test equivalent groups design. Two class divisions from the same school were taken for the experiment. The classes selected for the study were selected on a double blind priority basis. The two classes and the sex groups were tested using Multivariate ANOVA for Nonverbal Intelligence, Verbal Intelligence and Socio-Economic Status and were found to be matching so as to be considered as homogeneous groups. Out of the two study groups, one was assigned to be control group and other – the experimental group on a random basis.

1.7.1 SAMPLE

The sample for the present study comprised of 74 students from two divisions, 9Q and 9G of Feroke Government Ganapet Vocational Higher Secondary School, Feroke.
1.7.2 DESIGN OF THE STUDY

The design of the study is summarised in the table 1.1. It shows the interventions made on the control group as well as the experimental group in the different stages of the study.

**TABLE 1.1**

**Design of the study**

<table>
<thead>
<tr>
<th>STAGE</th>
<th>EXPERIMENTAL GROUP</th>
<th>CONTROL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>Teaching through Mastery Learning Strategy</td>
<td>Teaching in the Conventional Strategy</td>
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</tbody>
</table>

1.7.3 VARIABLES OF THE STUDY

Variables are the conditions or characteristics that the experimenter manipulates, controls or observes. The independent variables, dependent variables and the controlled variables of the present study are detailed below.
Dependent Variable

The dependent variable in the present study was Problem Solving Ability in Physics of students of standard IX.

Independent Variable

The independent variable for the present study was the Instructional Strategy (Mastery Learning Strategy / Conventional Strategy).

Controlled Variables

The controlled variables were Non-verbal intelligence, Verbal Intelligence, Socio-Economic Status, Previous Achievement and Sex

1.7.4 TOOLS USED FOR MEASURING DIFFERENT VARIABLES

1.7.4.1 Raven’s Standard Progressive Matrices

Non-verbal Intelligence of the subjects were measured by administering the Raven’s Standard Progressive Matrices Test. This non-verbal test is intended to estimate the subjects’ ability to discern and utilize a logical relationship presented by non-verbal materials.

1.7.4.2 Verbal Intelligence Test based on triarchic theory

To test the Verbal Intelligence the Verbal Intelligence Test based on Triarchic Theory developed by Dr.V. Sumangala and Sholy Joseph (2005) of the Department of Education, University of Calicut was used.
1.7.4.3 Socio-Economic Status Scale

The scale developed by Kuppuswami was modified by K.S. Pillai in 1973. The criteria adopted for giving weightage to the level of income was further modified by Dr. Sivarajan and Subrahmaniadas (1998) with the consent of the experts in educational research and The Department of Economics and Statistics, Government of Kerala.

1.7.4.4 Standardised Achievement Test developed by the investigator

An achievement test for the first four chapters of Physics of the IX standard was developed and standardised by the investigator. The pretest scores of this test were used as the measure of Previous Achievement. The difference in the scores of the posttest and the pretest of this achievement test served as the measure of achievement in Physics of the students of standard IX.

1.7.4.5 Problem Solving Ability Test in Physics developed by the investigator

A Problem Solving Ability test was prepared for the first four chapters of Physics of the IX standard and was standardised by the investigator. The difference in the scores of the posttest and the pretest of this Problem Solving Ability Test served as the measure of Problem Solving Ability in Physics of the students of standard IX.

1.7.5 TOOLS USED FOR INSTRUCTION

1. Lesson Plans in the conventional format. This would mean that the lesson plans were prepared in the new constructivist format as
illustrated in the Teachers’ Hand Book in Physics for Standard IX of SCERT, Kerala.

2. Pre-conceived alternate learning experiences, including corrective measures and enrichment experiences. This would mean a repertoire of anecdotes, examples, illustrations and strategies relevant to the subject matter pertinent to this study which would be used in the event of re-teaching or enriching students during the Mastery Learning Cycle.

1.7.6 STATISTICAL TECHNIQUES USED

The statistical techniques for the analysis of the data in the present study were:

1. Multivariate ANOVA for ascertaining the homogeneity of study groups.

2. ANCOVA to find out the effect of Instructional Strategy on Problem Solving Ability.

3. Three way ANOVA with 2X2X2 factorial design to find out the main and interaction effects of Instructional Strategy, Nonverbal Intelligence and Verbal Intelligence on Problem Solving Ability in the total sample and the sub samples based on sex.

4. Two way ANOVA with 2X2 factorial design to find out the main effects and interaction effect of Instructional Strategy and Previous Achievement on Problem Solving Ability in the total sample and the sub samples based on sex.
1.8 SCOPE AND LIMITATION OF THE STUDY

The study focuses on the highest form of learning – the problem solving. Any form of instruction and any form of instructional system has the goal of manifesting problem solving behaviour in the pupil. As a method of teaching, it enjoys the highest prestige when compared to other methods of teaching, especially in science and mathematics (Vaidya, 1994). Even though studies on Mastery Learning Strategy are in plenty and generally suggest that it supports achievement, studies on measuring Problem Solving Ability are really scarce. The intangible area of cognition – thinking and problem solving- is a less explored one with more of assumptions and hypotheses with no solid proof. One has to tread with extreme caution and vigil while exploring this less-known zone. Considering the widely acknowledged relationship of Problem Solving Ability with the better-known aspects of cognition namely, Achievement, Nonverbal Intelligence and Verbal Intelligence the researcher has moulded the testable construct of Problem Solving Ability. Moreover all the aspects identified as the subcomponents of Problem Solving ability could not be taken into account while constructing the tool to test the Problem Solving Ability of the students. Considering all such restraints, the study had the following limitations.

1. The study would be confined to a single school, which would act as the sample for the entire population of the secondary schools.

2. The scope of the Problem Solving Ability is delimited to fourteen subcomponents of Problem Solving Ability, which are viable to be assessed through a paper pencil test.
3. The time span of the experiment would be three months, which may enable to cover only four units of Physics namely, Colours of Light, Motion, Force and Gravitation.

1.9 ORGANISATION OF THE REPORT

There are five chapters included in this thesis. Chapter I details on the setting of the problem, need and significance of the study, statement of the problem, definition of the key terms, objectives of the study, hypotheses of the study, scope and limitation of the study and the organization of the report.

Chapter II presents the theoretical overview of Mastery Learning Strategy and Problem Solving Ability along with review of related studies in the field of Mastery Learning Strategy, Problem Solving Ability and the subject Physics.

Chapter III describes the methodology, which details the variables of the study, design of the study sample, data collection procedure and statistical technique used in the study.

Chapter IV gives an analysis of the data along with its interpretation.

Chapter V elaborates upon the findings, conclusions, educational implications and recommendations based on the inferences.