CHAPTER 2
CHAPTER II

PROBLEM SOLVING: THEORETICAL PERSPECTIVE

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HISTORY OF PROBLEM SOLVING

Man has been facing many problems since many years ago. Imagining the past man has developed in the present. Every man has to suffer from birth to death, and he struggles to solve the problems. When he gets the solution of the problem, he creates certain types of mental positions. The problems and solution lies in the root of progress and degrade. The man is surrounded by the problems of residence, clothes, and food. He is also surrounded by the problems of environment, health, and mental peace. He struggles to solve all kinds of problems.

Problem solving is a matter which has been running from past, Vedas, Upanishada, Mahabharata, and Ramayana. They are the best examples for problem solution.

During the war, Arjun felt deeply pained. A problem raised in his mind. He finds his Guru, cousins, and his relatives. He had a problem to kill the relatives in the
battle field. So he left his Gandiva and Lord Krishna came and persuaded him his real religion. Then he made compromise with his mind. This compromise is nothing but the holiest book GITA. Gita shows the solution of many problems.

We Indian had a problem to get freedom from the slavery of Britishers. We were not able to exile with the help of weapons. So Gandhiji started non violent struggle. Residence, clothes and food are main problems. Among them Gandhiji opposed foreign clothes. He started movement and encouraged people to wear Khadi. People made holi of foreign cloth. So the Britishers suffocated with the behaviour of Indians. And at last they gave freedom to us.

Abraham Lincoln had a problem of civil war. He was the leader of his group. So at night time he went to see the wounded soldiers. He visited the enemy soldiers. One man said, Mr. President, how can you destroy your enemies? Abraham Lincoln replied, Do I not destroy my enemies when I make them my friends? In this way he solved the problem of civil war.

We find many problems in our society. They are like unemployment, dowry-system, over population, pollution, housing, eating and clothing. These are the main problems now-a-days. The problem of disunity in religion is in full swing these days. Disputes with neighbours, land quarrels
and division of natural property are the main problems for us.

Parents are harrased by many problems like children's education, their results of examination, their employment in future, choice of academic faculty etc.

Many formal and informal institutions have their problems of maintenance and development.

In the current education system we find the problems of copying in examination, maladministration in results, admission in schools and colleges, newness in the syllabus and physical facilities in school and colleges.

Society is tired of high rent and corruption to get employment in schools and colleges. We can't expect better education from a teacher who has given a large amount to get the job. Can we?

Thus problem and the history of problem solving is very old and it is on and on these days.

It is expected that by finding the solution of genuine problems human beings, society, institutions and nation may progress and preserve the culture, nature and save the mankind.

2.2 CONCEPT OF PROBLEM SOLVING

We consider the problem solving approach most complicated in respect to mankind. We shall view problem solving as a form of principle learning in which lower-order
principles are applied in the learning of higher-order principles. In this view successful problem solving results in the acquisition of new knowledge just as does the successful learning of concepts and principles. Problem solving is a gain in substantive knowledge. We shall also consider techniques of problem solving which are sometimes called creative thinking, and learning by discovery.

We defined learning as a relatively permanent change in a behavioural tendency which results from reinforced practice. We can also describe the learning event as consisting of the learner, the stimulus situation and the response. We can see that both the definitions of learning and the description of the learning event apply to problem solving. To understand this point consider the matchstick problems invented by George Katona (1940).

Problem solving is closely related to principle learning (Gagne, 1964, 1965c) since it combines two or more previously learned principles into a higher-order principle. And, like concept and principle learning, problem solving represents acquisition of substantive knowledge. Gagne, (1964) uses this example. A beginning algebra student is given a problem, multiply \( X^2 \) and \( X^3 \) which he has not seen before. To solve this problem he must have learned two principles: Multiplying a number by means adding that number \( n \) times, and an exponent \( r \) represents multiplying the number by itself \( r \) time. The combination of these
principles produces the solution of the problem and the learning of higher-order principle. To multiply identical variables with exponents, multiply the variables by itself the number of times represented by the sum of the two exponents. If a student obtains the right answer to this problem, we usually infer that he has learned the higher-order principle without requiring him to state it. We confirm our inference by having him solve other problems of the same class problems which involve multiplying variables with exponents.

This discussion of problem solving as the learning of higher-order principles distinguishes between problem solving as the acquisition of knowledge and problem solving as the learning of very general techniques which can be applied to a wide variety of problems. As much as we would like to believe in some general problem solving strategies of wide applicability, the research we have available does not convince us of their existence.

Several theories suggest how problem solving occurs in the individual. Since the theory of Irving Maltzman (1955) is consistent with our view of problem solving as complex learning. A basic principle in this theory is that of stimulus and response hierarchies. Maltzman describes divergent and convergent mechanism. Convergent and divergent mechanisms combine to produce habit family hierarchies.
In other words habit family hierarchies vary in strength and occupy greater or lesser position of dominance, just as responses and stimuli vary in dominance. Maltzman believes that problem solving may involve the selection of habit family hierarchies as well as the section of specific response sequence within a hierarchy.

In solving a problem the individual is in the situation of mediated generalization. Initially, the correct response is low in a single hierarchy or the correct habit family hierarchy is low in a compound hierarchy. The strength of correct response or hierarchy must increase for him to solve the problem. According to Maltzman's theory, the originally dominant but incorrect response or hierarchy will gradually be extinguished as a result of repeated failures to solve the problem. In the meantime, through a process of mediated generalization, the strength of responses is low in the hierarchy will increase in strength. In mediated generalization effects upon one member of a hierarchy may influence other members and finally increase the strength of the initially weak but correct member. The effects we refer to are the effects of reinforcement. Through mediated generalization, when one member of a hierarchy is reinforced all individual members of that hierarchy receive added strength.

We have now viewed problem solving as principle learning and in terms of habit family hierarchies. We shall
now take another view of this most complex learning.

To understand the concept of problem solving, we can also view problem solving as a form of transfer of learning in which experience in one task influences performance on another task.

Ellis (1965) uses this example to explain the problem solving as a form of transfer of learning.

"American visitors to England occasionally report that they experience difficulty in driving on the left side of the street because of their established habit of driving on the right. What happens in some instances is the tendency to travel momentarily to driving on the right or to vacillate between right and left, even though the rules to driving in England are clearly understood.

In a similar vein, a common experience of individuals who begin to drive a car with automatic transmission, after having driven cars with standard transmission, is to depress a nonexistent clutch pedal. In both these situations we see that earlier learned habits, or modes of responding, can affect performance on some subsequent task that in a general way describes transfer of learning."

If we consider second task in a series of two tasks as a problem, we can view problem solving as a transfer of learning.

Problem solving is an essential process in learning
generalization.

According Polya's suggestions:

The programme that Polya proposes for teaching problem solving has two aspects: abundant experience in solving problems and serious study of the solution process. He expresses the need for the first of these in this way: "Solving problems is a practical art, like swimming or skiing, or playing the piano; you can learn it only by imitation and practice." (1962, p.vi.)

Both Katona (1940) and Gagne (1964) emphasize that a major distinction between problem solving and other learning is that problem solving has high generalizability, or transferability. In problem solving the single solution to the single problem is not important. The correct solution must be an abstraction from the products of responding and not responses themselves. Successful problem solving should result in immediate transferability.

According to Laycok S.R. and Munro B.C.:

"A problem exists for an individual when he is unable to reach the desirable goal by means of his present patterns of behaviour. Problem solving, then, refers to the methods employed by individual as he attempts to achieve this

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goal. Usually problem solving involves some form of restructuring of experiences; it involves learning."

Above views suggest that generally there are four clearly distinguishable phases in problem solving behaviour.

1. This individual must recognize and understand the problem, the problem must be defined.

2. He must explore the field in which the problem is found.

3. He then analyses the problem. As a result of definition and exploration a plan evolves, often including the establishment of a series of sub-goals leading to the final solution. If a plan does not emerge, the individual must re-define the problem.

4. The individual acts on his plan; he solves the sub problems and finally the main problem.

Associated with these phases of problem solving are emotional responses or states of the problem solver (anxiety, anger, satisfaction and so forth) which, of course, influence his progress, towards the goal.
2.3 FACTORS AFFECTING THE PROBLEM-SOLVING

Teachers in a democratic society should be acutely aware of the nature of problem-solving and its affecting factors so that they can give effective guidance to students in the development of this significant ability. Problem-solving is a process of thinking and learning. It is necessary to know the factors affecting this method of learning. Some factors affecting the problem-solving are as under:

2.3.1 Daydreaming

Daydreaming is a mental process in which the mind "wanders freely," but it is not oriented towards some particular goal. The individual is probably engaged in recalling and imagining, and he may be visualizing situations, but he is not typically conscious of seeking a specifically defined goal. The expression "He is lost in thought" may, of course, mean that he is concentrating deeply upon some problems, but it may simply mean that his "mind" is wandering freely as a result of immediate and objective stimuli. If thinking involves visualization and perception without immediate present stimuli, we say that the individual is engaged in autistic thinking or daydreaming.

Daydreaming as a desirable mode of response should not be summarily dismissed. In his book "The Sleepwalkers" Koestler (1959) indicates that important discoveries have
been made when a person was not "sticking to the subject", when accidental rumination rather than logical thought was the prevailing mental activity. There can be values in sleep-walking in the midst of reality.

2.3.2 Reasoning

The word is widely used to describe what many psychologists are referring to when they use the word "thinking". In fact, many psychologists avoid the word "thinking" and use "reasoning" in its place. Reasoning is the process involved in working toward the solution of a problem, the answer to which is not immediately supplied by past experience. There are also some factors involved in reasoning, they are as under.

2.3.2.1 Maturation

Different types of problems of different degrees of difficulty may be resolved by the process of reasoning. A young child may assemble jointed sticks to reach an object that is otherwise beyond his reach, but he would find the solution of an algebra problem much too difficult. This difference in ability to solve problems indicates that an important factor in reasoning is maturation. It takes time for the brain and perceptual power to develop to the point where relationships can be perceived. Moreover maturation must be accompanied by the accumulation of experience.
The part played by maturation in problem solving is of much more than academic interest to teachers. Problems appropriate to the pupil's developmental level aid him in acquiring confidence. He grows in the ability to attack more difficult problems and learns the value of the systematic approach to difficulties. Maturation is the most important factor involved in reasoning to solve the problem.

2.3.2.2 Experience

Maturation and experience are inseparable aspects of problem solving. All reasoning depends on information, as well as on the brain power necessary to utilize that information. People are often considered good thinkers simply because they have experience and information that enable to deal constructively with a situation. Thus readiness for problem solving is dependent to a very large extent upon a background of experience. The dependence of reasoning on experience suggests widespread teaching practices that are inimical to reasoning.

The role of experience has been summarized in four steps (1) children should have continuous experience; (2) experiences should be recorded; (3) experiences should be related through pupil activity; (4) experience should be meaningful so that pupils will achieve insight (Blackwood, 1951). The study of any problem should not stop with
answer from a textbook; it should include training in the use of encyclopedias and other reference books and emphasize the value of consulting experiences of experts.

Problem inappropriate to the pupils' level of experience do not stimulate reasoning. The necessity that the teacher observes his pupils to see that problems are meaningful to them has been exceptionally well. If the word "Problem" is substituted for "hypothesis" in the foregoing passage, the teacher will see that what is a problem to him is not necessarily pertinent for the pupil who has had less or different experience.

2.3.2.3 Data

It must be clearly understood that reasoning in educational psychology and in all other areas must always depend on facts; the more pertinent the facts, the more direct and incisive the reasoning. Reasoning depends upon facts means given data. Scientific investigation whether in the realm of natural sciences, education or psychology—point to the fact that ample data are requisite to problem solving. Scientists emphasize the solution to problems must necessarily be hidden somewhere in or among the data. If the answer is not discovered, there are only two explanations: (1) The data are as yet insufficient and (2) The investigator lacks the insight to see the answer. There is no inherent contradiction between learning fact and
learning to think. We would safely say that the aim of education is to foster problem solving ability. This inclusive aim can only be accomplished if three factors—maturation, personal experience and the systematic gathering of knowledge—are considered. Only then will pupils gain the preparation to face problems that are not specifically included within the school curriculum, and only then can teachers presume that they have fulfilled their duty in a democratic society.

2.3.3 Creativity

Creativity is also a main factor affecting problem solving. Torrance define creativity as "the process of sensing gaps of distributed missing elements; forming ideas of hypotheses concerning them; testing these hypotheses; communicating the results, possibly modifying and retesting the hypotheses". He intends, in this definition, to include adventurous, off-the-beaten-track thinking. Creativity involves a search for new meaning and solution that combine, invent and synthesize. It is a restructuring of perceptual field as the result of sensing some kind of deficiency. The creative person is divergent and adventuresome. When a student tries to solve any problem, his creative nature

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takes place. Creative students are eager to find the solution of a problem.

2.3.4 Tentative Answer

It is said that the completely logical person is not a man of action, a statement based on the assumption that the completely logical person requires absolute answers to problems before he is willing to act on the fact that there are no ultimate, unalterable answers. The logical person knows that there are not all the data gathered, not all the situations have been defined, and not all the events in an individual's life have been accounted for. Because all the data are gathered, not all the situations have been defined and not all the events in an individual's life have been accounted for. Because all the alternatives explored, it is necessary to act on tentative conclusions. These tentative conclusions may be regarded as best current guesses, and because they are based on some data, they will be better than stabs in the dark. But experiences, evaluation, and changes in accompanying conditions will alter the conclusions, which in turn become a set of improved tentative answers that form the basis for ensuing action.

Reasoning demands that action be checked but not stopped. As individuals trying to achieve our own maximum potential and as teachers trying to help pupils towards
better adjustment, we must stress the necessity of learning to act on tentative conclusions. It must be realized that there is a need for balance between what might be done about a problem and what is done about it. Logical and tentative answers must be put into practice. There may be no ultimate solution; but there is, in all probability a satisfactory one.

2.4 STEPS IN PROBLEM-SOLVING

When one reflects on the many inventions, practices and situations resulting from reasoning, it is quite obvious that problem solving cannot easily be resolved into a series or orderly steps. Too many factors and processes are involved to permit more than an academic statement. Certain steps will be discussed in this section, but it must be remembered that in a reasoning process the steps may be rearranged or two or more steps may be taken simultaneously. Nevertheless, it is helpful to understand what the steps are, even though they are taken in reserve or mixed order.

Step-1 A Felt Need

The first step, before the individual projects himself into a problem-solving situation, is a felt need. According to John Dewey, "The difficulty may be felt with

sufficient definiteness as to set the mind at once speculating upon its problem solution, or an undefined uneasiness and shock may come first, leading only later to a definite attempt to find out what is the matter."

**Step-2 Locating or Recognizing a Problem situation**

A problem is not a problem because of external conditions alone. The payment of income tax may be a problem for an adult. The payment of the tax may actually in some way interfere with the child's easy adjustment, but is not a problem until recognized as such. A problem, therefore, is an obstacle to adjustment that is recognized by the individual. The more clearly an individual can state the nature of his difficulty, the more likely he is to solve it. The pupil must be allowed to wrestle with situations before he can see the inherent obstacles.

**Step-3 The Accumulation of Data**

A prime responsibility of teachers is to instill in pupils a respect for factual knowledge and an appetite for its acquisition. The tendency to allow prejudice, tradition, slogans, and cliches to interfere with reasoning processes must be avoided. Reasoning cannot begin with a conviction.

Gathering data to solve a problem is not an easy undertaking. But there is no substitute for this tedious
and time-consuming task. In retrospect, much of the time spent will seem to be wasted, because much of the assembled information in evitably turns out to be inappropriate to solve the problem. But it must be repeated that suggestions for the answer will always come out of the data.

Authorities in the field of research state that the "Original mind is the informed mind." Competence in research—knowing what is worth investigating, knowing how to select productive methods, and being able to foreseen the most likely outcome of study is the result of being well informed. The accumulation of knowledge in any area contributes to competence.

As suggested by Francis, pupils may recognize the importance of information and its continued acquisition. Teachers have apparently grossly neglected the matter of helping pupils record that information. Recognized scholars as a general rule do not depend too heavily on their memories—they "make a note of it." 4

There is no substitute for gathering data in a problem solving process, but there are ways of making the laborious process interesting and effective rather than tedious. Habits of orderliness and thoroughness are just

as self-perpetuating as habits of sloppiness and superficiality. If the pupil achieves a satisfaction of accomplishment from thorough job of data gathering, he will be establishing an important aspect of problem solving skill in his reaction patterns.

**Step-4 Formulating a Hypothesis**

A hypothesis is simply a theory or a tentative guess about the probable outcome of a particular situation, and it is based on a certain amount of factual information. As an individual matures and acquires experience that enables him to evaluate his data, his hypothesis will be altered and improved. Whether the hypothesis is stated or brought out by a question such as "What do you think will be the result?" it is up to the teacher to stress the point that the hypothesis is a theory to be accepted or rejected; it is not something that must be supported.

The fact that steps in reasoning do not necessarily follow a sequential order is illustrated in the formulation of the hypothesis. The initial formulation may indicate the need for further data; further data, when gathered, may necessitate a reformulation of the hypothesis. At this step, the biased reasoner will tend to cling to his original theory; the student of superior reasoning ability will keep an open mind, regarding it as tentative valid in the light of present data, but always subject to alteration. Teaching
methods as well as teacher's attitudes toward problems are of consequence in establishing the conditions that may lead pupils to formulating hypothesis.

**Step-5 Testing the Hypothesis**

If the problems have meaning for the students, then excellent training is provided. If, on the other hand the problem is in exercise from a manual, its solution may provide little or no exercise in problem-solving. It is necessary for the teacher to stress the probing process, to encourage the pupil must accept the problem as his own and actively seek the answer, test the hypothesis, and formulate conclusion rather than merely following each of the steps outlined in a manual. Problem-solving is an active process and must be of necessity involve more than routinized steps.

Testing, whether theoretical or situational, gives additional information or data about the problem. The new information may result in an alteration of hypothesis. In either case, the various steps in problem solving, repeat, and synchronize.

**Step-6 Making a Generalization**

Testing the hypothesis is often the final step in the solution of a problem. However, higher forms of
reasoning demand still another step—making a generalization. The generalization is an attempt to give the discoveries that have been made wider application. Attention may be directed to forming a generalization by such questions as "What other situation would this solution seem to fit?" "How could the procedures used for gathering and evaluating data be used in another problem?" or "How can the results of your inquiry be briefly stated?"

This final step is an attempt to consolidate the conclusion in order to conserve the meaning. It is a verbal description of the salient information that has been obtained. The fact that this final step is often neglected is illustrated by the fact that children and adults often attack a problem with no apparent reference to previous problem-solving experience.

None of these steps in problem solving is beyond the level of ability of school pupils. The power to hold an idea in mind long enough to test it and use of discard it is evidenced from the age of two years. By the sixth year, reasoning ability is frequently noticeable. As time, experience, and encouragement play their parts, the ability to reason gains in vigour and quality.
Davis and Houtman has suggested four steps in creative problem solving in the form of chart as under.

2.5 PROBLEM SOLVING IN EDUCATION

There are many methods of learning and teaching in our modern education system. Among many methods problem-solving is the most complex kind of human learning. Problem-solving approach is of a special value for the educational field. There are many subjects in educational field, such as mathematics, science, language, social science etc. In other words in education we have to use the school subjects as the media for problem solving approach. In the present study the investigator has decided to use the above four major subjects as the media for preparing his different sets of problem for experimental treatments. In a way there is an important role of problem solving in these various subjects.

2.5.1 Problem Solving in Mathematics

The growth of mathematics from the time of Euclid has been significantly influenced by efforts made to solve

FIGURE 12.2. A four-step sequence in creative problem solving. (Davis & Hattman, 1988, p. 120)
challenging problems in such familiar areas as geometry, number theory, algebra and probability. Problem solving is still a major force in the modern growth of mathematics. Journals dealing with mathematics and the teaching of mathematics devote considerable space to problems and their solutions. During the past fifteen years tremendous efforts have been made on a national scale to improve the mathematics curriculum of secondary schools.

Before 1955 the usual custom in the first algebra course was to introduce verbal problems in connection with solving equations of the first in one variable. The teacher might say, "I am thinking of a number. When I multiply the number by 3 and then add 5, may answer is 17. Which number am I thinking of?" After presenting a few problems of this kind, the teacher would probably insert one in which the answer was not an integer but a rational number.

The difficulty of guessing this number would provide the teacher with a reason for having the students select a variable for the unknown number. Then the given statements would be expressed in the form of an equation, which could be solved easily. Finally, the teacher would emphasize the importance of checking the answer in statement of the problem.

The introductory work with such problems included considerable practice in expressing phrases in terms of
variable and translating English sentences into algebraic symbolism. Attention would also be given to find out the key equations for various types of problems, such as the geometric, age, coin, mixture, investment, work and digit.

Problem solving is important to the development of mathematics. A famous educator said, "We learn to do by doing." A parallel thought is that "We learn to solve problems by solving problems." We really don't know enough about the teaching of problem by solving problems. We do know that the capacity to conjure up new ideas and the ability to look at old ideas in new ways are more fruitful in problem solving than great skill in logic. The ability to solve nontrivial problems has not been given to most of us. It is unfortunate that the time needed to attend to such problems is rarely available in most schools.

2.5.2 Problem Solving in Science

The subject of science has special value in education. There are many problems as pollution, population, trees cutting, water problem etc. We have to face many problems of health, food, living situation, environment, and daily life. From the beginning of life, science has major role in every stage. In such situation problem solving is proper method of learning from the primary and secondary school level. Main intentions in science are gifted by scientists through this approach. By Problem
solving approach students try to think about given many problems and they develop their skills. At the time of classroom teaching in science students ask many questions. Mainly they ask Why?, how? and what?. Learning by problem solving in science effects perfectly in student's minds. They observe happening events and incidents surrounding them and they try to get the solution through this method of learning—problem solving. There are many problems in physics, chemistry and biology at secondary school level curriculum. Space and electronic science has special value to this complex learning method. This method is also useful to the teachers in classroom teaching. Teachers can teach many problems of air pressure, atomic energy, chemical reaction, physical changes, growth, space, nuclear, atom, elements, solutions, medicines, mechanics etc., through this method of learning. Particularly in science teaching, teacher must try to teach some units through this approach, so students can develop their mind and scientific skill. In the era of science and technology there is a need for scientifically developed youth in our country.

2.5.3 Problem Solving in Language

THERE are many problems of writing, speaking, learning correct language. Some times students face correct reading problems in language also.
2.5.4 Problem Solving in Social Science

Man is a social animal. There should be many social problems in each human life. From the school level, students try to think about their social problems as like adjustment to class friends, family problems etc. Particularly for girls there are many problems at secondary school level.

2.6 Hurdles in Problem Solving:

Problem Solving is complex learning. It is a difficult method. It is not suitable for all students. There are some hurdles in problem solving. They are as under:

(a) Stereotype thinking
(b) One way thinking
(c) Boredom
(d) Language of the problem
(e) Imitation
(f) Escapism
(g) Lack of Concentration.