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8

GOING BEYOND THE REALITY: THINKING AND REASONING

Suppose, you are going to the airport to pick up your friend. Before you leave home, you will decide what route you will be following. You may not follow the shortest route because it will be a rush hour and you may have to face traffic jams at several places. Thus, before you start for the airport you will consider various options available to you. You would like to avoid roads that are under construction, roads that are too busy at that time and so on. Your decision to follow a particular route will depend upon the consideration of such problems that you are likely to encounter. Thus, even a simple problem like this one requires use of thinking and reasoning. The solution to the problem emerges after processing information that is available to you from the environment and past experiences. In this lesson you are going to learn about important aspects of thinking and reasoning.

OBJECTIVES

After studying this lesson, you will be able to:

- understand the nature of thinking;
- explain different components of a thought process;
- describe the stages of problem solving;
- explain the types of reasoning; and
- describe the relationship between language and thought.

8.1 NATURE AND COMPONENTS OF THINKING

Thinking is a mental activity, usually initiated by a problem. It follows a sequence of internal (mental) steps that involve a variety of activities such as judgment, abstraction, inference, reasoning, imagining, and remembering etc. Thinking is a cognitive process in which we use symbols as representations of objects and events. It is a constructive process as we construct something new. Thinking relies on a variety of mental structures such as I) concepts, ii) schemas, and iii) mental imagery. Let us consider these mental structures.

Components of Thought Process

(i) Concepts

We have the capacity to abstract the essential characteristics of objects, events, human beings, or whatever we perceive and experience. For example, whenever we see an apple we categorize as "fruit"; when we see a cat we categorize it as an "animal", and so on. Whenever we encounter a new object we tend to categorize it and take the same action toward it as before. For example, when we see a dog in the street we categorize it as an "animal" and like any other animal we take the same behavioural action towards it (e.g., avoid it). Similarly, when we encounter a new social situation, we try to categorize it on the basis of past experience and take appropriate action. This is considered as one of the basic aspects of thinking.

Concepts are mental structures. The categories we form are called concepts. They are the building blocks of thinking. They allow us to organize knowledge in systematic ways. Most words (except proper nouns) represent concepts as they refer not to a single object or event but to a whole class. For example, the word "house" refers to a class of buildings with common features. It has rooms, kitchen, toilet, store, etc., and is used for living by people and families and has certain facilities. The word "building" is more general than house. The word building is a larger concept that includes houses, offices, markets, etc. Concepts represent objects, activities, ideas, living organisms. They also represent properties (e.g., green, or large), abstractions (e.g., honest, love) and relations (e.g., bigger than).

Learning of concepts utilizes the psychological processes of *generalization* and *discrimination*. For example, when a child learns the concept dog, he/she may generalize the term initially to include all small animals (e.g., cat). But from parental corrections and process of learning, the child learns to make finer discrimination until the concept is correctly formed. At this moment it was only the family dog. However, the child may generalize the concept to include other dogs of different breeds and sizes. The child may further refine the concept and distinguish between pet dog and street dog, friendly dog or aggressive dog, etc.

Concepts may be *concrete* (e.g., a dog, table, tree, etc.) or *abstract* (e.g., honesty, democracy, justice, etc.). The child acquires the concrete concepts much earlier in life and later on abstract concepts. Studies by Piaget indicate that the child first learns object concepts (e.g., ball) and develops more abstract concepts only as he grows older.

Activity 8.1
Concept Formation

Take 20 white cards of 8 × 12 cms in size. Choose three shapes (say, triangle, square, and circle) and three colours (say red, green, and blue). On each card draw different shapes below (say triangle and square) and above these two shapes in the middle, draw another shape (either triangle or square) as shown in Figure 8.1.

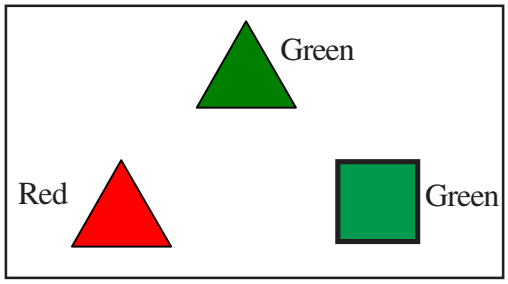

Figure 8.1: *A sample stimulus card*

The two shapes below are to be different in shape as well as colour and one above should have the shape of one and colour of the other. Take care that the size of the shapes are cut from the same size square. In this manner prepare 29 such cards, all having different combinations of shapes and colours.

Randomly place the cards in a pack. Keep the pack of cards on the table and pick one card at a time, place it before the participant (child) and ask to match the upper shape with one of the two given below. Do not indicate anything about shape or colour. Present the card to the participant one by one and encourage the child to respond as quickly as possible.

Record the responses of the respondent in terms of the response, i.e., colour (C) or shape (S). If the participant matches red triangle with green triangle, then the participant is matching on the basis of shape, so put a tally under shape (S). On the other hand, if the participant matches the green triangle with green square, then the matching is on the basis of colour, so place a tally under colour (C).

In this manner, present all the 20 cards one by one and record the responses. Count the total tallies under colour (concept) and shape (concept). The analysis of your observations will indicate the processes of concept development in the child.

In the activity you will observe how children classify 'colour' and 'shape' in terms of concepts. This will reflect their level of concept formation. Research indicates that children first develop the concept of colour followed by shape. Classifying objects, events or ideas into common classes minimizes the time and effort required in processing information. It is very helpful in thinking process.

We not only learn to classify objects and events in terms of their features or properties (e.g., colour, shape, size, etc.) but also abstract the conceptual rules associated with the property. For example, we not only learn to classify the colour of traffic light (red, green, amber) but also the conceptual rules by which these colours are related. That is, if the light is red, "stop"; if amber then "get ready to stop or move"; if green, "then go". It is amazing that we learn so many conceptual rules, store them, retrieve on demand, and use them in our day to day interactions in our environment.

(ii) Schemas

Schemas are more complex than concepts. Each schema contains many distinct concepts. For example, each of us possesses a **self-schema**, a mental framework holding lot of information about ourselves (as we perceive ourselves to be). This self-schema will include many different concepts about ourselves. For example, you may consider yourself as intelligent, attractive, healthy, hard working, and pleasant. All these separate concepts make up a self-schema. Such schemas are important building blocks for thinking.

(iii) Mental Imagery

Thinking also involves the manipulation of visual, auditory or other images. Here we may focus on visual images. It has been found that mental manipulations preformed on images of objects are quite similar to those that may be performed on the actual objects. Once we form a mental image of any object, person or situation, we perceive it and think about it just as we would if it actually existed. Sometimes we could refer to it as we see things in our "mind's eye." For example, if you have to remove a large table out of the room having a narrow door, you will mentally rotate (mental image) the table and think a way out to solve the problem.

It has been found that we usually think in words (words represent the concepts, e.g., table). At other times we rely on mental images, such as visual image of the table. In the above stated problem one could physically try to manipulate the table to find a way out. But a more mature person will try to find solution through mental rotation (thinking). In the introductory part of this chapter you read about the planning of a route to go to the airport. The individual could think in words or plan the route through mental imagery. That is, create a mental picture of the route to the airport and decide.

INTEXT QUESTIONS 8.1

1. Fill in the blanks with appropriate words:

(a) Thinking is a _____ process in which we use symbols.

(b) We _____ objects encountered in our life.

(c) Children learn _____ concepts earlier than _____ concepts.

(d) Learning of concepts involves _____ and _____.

(e) Classifying objects into common classes makes _____ _____ easier.

8.2 PROBLEM SOLVING

Problem solving is an important cognitive activity. It is so central to the process of thinking that many people use it interchangeably with thinking. A moment's reflection will make it clear that all our day's activities involve problem solving. The problem may be simple or complex. The simple problems are of routine nature as deciding what to eat in the breakfast. There could be a complex problem as deciding which career to choose. Problem solving refers to thinking directed towards solving a specific task/situation. This type of thinking has three stages starting from the stage of occurrence of a problem followed by a set of mental operations, leading to the solution of the problem.

Stages and Strategies of Problem solving

A problem signifies a situation that requires a solution. It has three stages or steps as stated below:

1. Initial State : A problem
2. Operation : Actions
3. Goal State : Solution

Let us explain these three stages with a concrete problem. Suppose you get an unexpected bill to pay. Receiving the bill represents the initial state, the problem. Your goal is to find money to pay this unexpected bill without disturbing the original family budget. This leads to deployment of certain operations for solving the problem. Some problem solving operations or steps are more desirable than others.

For example, withdrawing money through credit card happens to be a more acceptable solution than borrowing from a friend. By choosing the most acceptable operations or steps, you move from the initial problem state to the goal state, when the problem is solved. Problems may differ with respect to the levels of complexity but steps involved remain the same. For more complex problems the second stage requires more time in order to carry out a number of mental operations.

8.3 MENTAL SET IN PROBLEM SOLVING

A **Mental Set** is a tendency on the part of an individual to respond to new problem in the same manner that he or she used earlier to solve a problem. Previous success with a particular rule provides a kind of **mental rigidity** which hinders **creativity**.

Sometimes a mental set can enhance the quality and speed of perceiving and problem solving, but under certain conditions it can also restrict or inhibit the quality of our mental activity or thinking. However, in solving our day to day and other complex problems we often rely on past learning and experience with similar or related problems. You will appreciate the phenomenon of mental set better if you do Activity 8.2, called *Luchins* water jar problems.

Activity 8.2

Mental Set and Problem solving

Present to one of your friends the following set of problem to solve. Give the following instructions:

There are 7 problems in the table given below. There are 3 empty jars (A, B and C) available and enough water in a container. With the help of the given jars you are required to produce the required quantity of water. How to arrive at the solution is explained with the help of problem NO. 1. given in Table 8.1.

You have three empty jars that can hold 21 ml (A), 127 ml (B) and 3 ml (C). With the help of these three jars you are required to produce 100 ml of water. So, fill jar B with water and pour out enough water from jar B to fill jar A. After pouring water from jar B to A, you are left with 106 ml in jar B. Now, pour out enough water from jar B to fill jar C twice, you will be left with 100 ml of water in jar B. Now, go ahead and solve the remaining 6 problems.

Table 8.1: *The Water Jar Problem*

Problem No.	Volumes of empty jars (ml)			Required quantity
	A	B	C	
1.	21	127	3	100
2.	14	163	25	99
3.	18	43	10	5
4.	9	42	6	21
5.	20	59	4	31
6.	14	36	8	6
7.	28	76	3	25

The participants will be able to obtain the solution by following the same steps (B – A – 2C). However the 6th problem is critical, in that the solution can be worked out by the method used earlier and also by using a straight and simple method of pouring water from jar A to jar C (i.e., A – C). However, because of the mental set (formed through the solution of earlier 5 problems) the individual becomes mentally blind to the simpler and different solution. The 7th problem is the second critical problem. In this problem the person is not able to arrive at the solution by using the earlier method (B – A – 2C). It is interesting to observe the time taken by the person in solving the problems from number 2 to 7. The participant will take maximum time in solving problem 7, because he cannot solve the problem with the help of the earlier set.

INTEXT QUESTIONS 8.2

Mark the following statements True or False:

(a) Problem solving takes places through stages. True/False

(b) Mental set may hinder problem solving. True/False

(c) Schema consists of one concept. True/False

(d) Images make mental manipulation difficult. True/False

8.4 REASONING AND DECISION MAKING

Reasoning

Reasoning is a mental process. Reasoning is involved in logical thinking, problem solving, and decision making. In reasoning, information from the environment and

the stored information in the brain are used to arrive at some conclusion or goal. The individual follows certain rules in reasoning and decision making. We can classify reasoning into two main types **Deductive reasoning**, and **Inductive reasoning**. Let us consider these two types briefly.

(a) Deductive Reasoning: In deductive reasoning the person tries to deduce or draw conclusions from a set of initial assertions or **premises.** An example of deductive reasoning, known as **syllogism**, which contains two premises and a conclusion is drawn:

All A are B (premise)

All B are C (premise)

Therefore: All A are C

It is an example of a valid syllogism.

Let us consider an example of invalid syllogism

All A's are B (premise)

Some B's are C (premise)

Therefore: Some A are C

This is an example of invalid conclusion.

In deductive reasoning, we typically go from general to the particular. We apply the same general rule as all human being are mortal. Ramesh is human. Ramesh is mortal.

(b) Inductive Reasoning: In comparison to deduction reasoning, the process in inductive reasoning is reversed. In this case we go from available evidence to generate a conclusion about the likelihood of something. In inductive reasoning, we consider a number of different instances and try to determine (induce) what general rules cover all instances. Let us explain inductive reasoning with the help of an example.

Suppose you are not able to locate your scooter keys. You try to look at place where you generally keep your keys, you don't find them there. You use inductive reasoning to search your memory – "I took out the scooter keys and with another key I opened the entrance door and entered the house. Immediately, on entering I found the telephone bell was ringing. I proceeded to receive the call. I had to note down a message. I took out the pen from my pocket and noted down the telephone number on the telephone diary. I must have kept the keys near the telephone. "you proceed there to search the keys and find them there".

Most cases of scientific research involves inductive reasoning. Scientists and lay persons consider a number of instances and try to determine what general rule covers them all. For example a boy of 15 years age is moody, aggressive, impatient, hyperactive – he is a teenager. The general statement that "he is teenager" attempts to cover his behaviour in a more general statement.

Decision Making

In everyday life we often make personal, economic, social and political decisions, which could have far reaching consequences. When you decide to take up physics as a subject for specialization in your studies you are making a decision which could have far reaching consequences in your life. We often make decisions which are of routine nature, like what to eat in the breakfast or which movie to go. While making decisions we consider certain variables that are important in taking a decision. For example, someone closely related to you has been hospitalized and the doctor, after examining the patient, recommends surgery to save the life of the patient. Before you take a decision to go ahead with what the doctor has recommended, you will consider a number of alternatives. These alternatives could be : to have a second opinion, to consider alternative method of treatment, whether the patient can withstand surgery, doctor who will conduct the surgery, hospital where surgery is to be done, finances involved and so on. After considering the relevant points you will take a decision.

8.5 JUDGEMENT AND DECISION MAKING

Judgement and decision making are interrelated processes. Judgement involves evaluation of information about the world (objects, events, persons etc.) while decision requires choices. Let us make the distinction clear with the help of an example. The judge hears the arguments and examines the evidences provided by the lawyers and on hearing the arguments gives his judgement in the case. On the other hand, decision making is a kind of problem solving in which quite a few alternatives are available and one has to make a choice. For example, you have to go to airport and there are three routes available to you. You will consider the different good and bad points about each of the three routes and make a decision.

INTEXT QUESTIONS 8.3

Mark the statements True or False:

(a) Reasoning helps to go beyond the available information. True/False

(b) Induction moves from general to specific. True/False

(c) Deduction moves from specific to general. True/False

8.6 LANGUAGE AND THOUGHT

Imagine what would have happened if we did not have language to express what ever we wanted to express. Without language it would not have been possible to express our feelings and communicate with others. The process of acquiring language is very interesting. The child by the age of six months first starts saying "ma..ma..ma" (babbling) and it is an enjoyable sound both for the child as well as the parents and others. Slowly, the child learns to say mama and papa and gradually other mono-syllables start appearing and later could starts comparing two or more words to communicate his/her needs etc.

Initially the child learns to communicate in the language being used at home, called mother tongue. Later, the child learns a formal language (say English) at school. The child may then learn two languages. The progress from ultering "ma…ma…ma" to the attainment of mastery over language is a fascinating journey. Some people become creative writers, poets and novelists. What sets us apart from non-human-beings is the use of language.

Use of Language

Children progress rapidly from two-word utterances to more complex sentences. By the time they are three, many children are constructing complex sentences like "I want this doll because she is big". Thus, in the course of development infants start from cry, coo, and babble and gradually become linguistically socialized so that they become effective participants in conversation with others and are able to communicate well.

Language is a vehicle of thought and a tool for all kinds of social interaction. Language conveys intentions, feelings, motives, attitudes and beliefs, etc.

Language and Communication

We communicate information by using a system of symbols. Language is one such symbol system. It has two basic characteristics: the presence of **symbols** and **communication.** Symbols represent or stand for something else. For example, home, school, office, temple, etc. these are all buildings. However, these buildings represent something that has a meaning more than what the 'building' carries. Home is a place where a family lives and school is a building where education is imparted to the children. When these words (e.g., school, home) are associated with certain functions, they acquire meaning and we recognize those words and use them for communicating with others. So, when you say to another person that you are going to the temple, you are communicating that you are going to a place (building) for worship.

Language also helps us in describing abstract ideas or thoughts (e.g., beauty,

democracy) in addition to the concrete objects of everyday use and experience. Through language we are able to express our abstract thoughts.

We also communicate with others through the use of our body parts, called gestures and postures. Such type of communication is called non-verbal communication. It may be noted that a sign language is also a form of human language.

Language and Thinking

Often people have wondered whether language is essential for thinking. Is thinking possible without language? Most of our thinking does involve words. It is well established that language and thought are related. Watson called thinking as "inner speech". If language is essential for thinking then an obvious question that arises is what happens to those in whom there is no language or the people whose language is not well developed (say young children). It has been argued that such people can use sign language and understand each other's thoughts. For example, deaf people can think and communicate in sign language. One can say that language is an essential tool of thinking, but it can not be said that thinking is not possible without language.

Language is helpful in thinking and at the same time language works as a vehicle of thought. That is, whatever we think it is communicated through language.

WHAT HAVE YOU LEARNT

- Thinking is a mental or cognitive process that often starts with a problem situation.
- Thinking involves many types of mental structures such as concepts, schemas, and mental imaging.
- Concepts are class names based on categorization. Formation of concepts involves generalization and discrimination. Concepts can be concrete and abstract.
- Schema refers to a mental structure consisting of several concepts and imagery.
- Problem solving is an important aspect of thinking. It starts with a problem, moves with certain mental operation and finally reaches to a solution that terminates the problem.
- The mental set developed by a person may create rigidity and become an obstacle in problem solving.

- Reasoning is a mental process for drawing inferences. There are two main types of reasoning i.e., deductive and inductive. Deductive reasoning moves from general premises to specific conclusions. In contrast, inductive reasoning consists of drawing general conclusions from specific information.
- Decision making is a common cognitive process relevant to every day life in which we take into account a variety of factors and make planning of a course of action. Judgement requires evaluation of information available.
- Language is a vehicle of thought. Language helps to communicate with the help of symbols. Language is of particular help in communicating abstract ideas and thoughts.
- While we do think through language, language is not essential for thinking. Deaf people do think, although they may not have language.

TERMINAL EXERCISE

1. Define a concept and describe how concepts are formed.
2. What are the main components of thought process?
3. Describe the steps in problem solving and use an example to illustrate the same.
4. What is the importance of language for thinking.

ANSWER TO INTEXT QUESTIONS

8.1 (a) cognitive (b) categorize (c) concrete, abstract
(d) discrimination, generalization (e) information processing.

8.2 (a) T (b) T (c) F (d) F

8.3 (a) T (b) F (c) F

HINTS TO TERMINAL EXERCISE

1. Refer to section 8.1
2. Refer to section 8.1
3. Refer to section 8.2
4. Refer to section 8.6