INTELLIGENCE, CREATIVITY AND EDUCATION

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Reviewer

Dr Sitesh Saraswat

Reader, Bhagwati College of Education, Meerut

SYLLABI-BOOK MAPPING TABLE
Intelligence, Creativity and Education

Syllabi	Mapping in Book
UNIT-I **The Structure of Intelligence:** An Examination of Various Theories of Intelligence. A Review of Some Intelligence Tests.	**Unit 1:** The Structure of Intelligence **(Pages 3-40)**
UNIT-II **Nature and Scope of Creativity:** The Major Aspects of Creativity, the Creativity Process. The Creative Product, the Creative Person and the Creative Situation, Relationship between Creativity and Intelligence. Need to Foster Creative Thinking Process, Discovering Creative Potentialities and Teaching for Creativity, Problem Solving and Creativity.	**Unit 2:** Nature and Scope of Creativity **(Pages 41-78)**
UNIT-III **Creative Learning Methodology:** Understanding Creative Learning, Learning to Learn, Learning with Joy, Developing Creativity through Games, Four Pillars of Creative Learning. Exploring Creativity through Education, Development of Creativity. The Environmental and Psychological Factors. The Role of Teacher in Developing Creativity in Students.	**Unit 3:** Creative Learning Methodology **(Pages 79-120)**
UNIT-IV **Problems of Creative Children:** Problems in Maintaining Creativity, Problems when Creativity is Repressed. Fostering, Creativity, Brain and the Creative Act, Artificial Intelligence, Multiple Intelligence Metacognition, Paradigm Shifts, Barriers to Creativity and Creative Attitudes.	**Unit 4:** Problems of Creative Children **(Pages 121-155)**
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INTRODUCTION

Several researchers and scholars have provided different definitions of intelligence. It is most commonly known as a person's capacity to act logically, in full understanding and with self-awareness, emotional knowledge and planning. A concept most widely studied in humans, the term intelligence is derived from the Latin verb *intelligere*, meaning (literally) to comprehend or to perceive. Creativity, on the other hand, operates alongside intelligence. Scholarly interest in creativity and its operations (especially in the field of education) has been increasing over the past decade and many theories have emerged in this field.

This book *Intelligence, Creativity and Education* introduces the students to the stages of intellectual development, creativity development and compatibility between them at various levels of Education, and is divided into five units. This book has been written in the self-instructional mode (SIM) wherein each unit begins with an 'Introduction' to the topic followed by an outline of the 'Unit Objectives'. The detailed content is then presented in a simple and an organized manner, interspersed with 'Check Your Progress' questions to test the understanding of the students. A 'Summary' along with a list of 'Key Terms' and a set of 'Questions and Exercises' is also provided at the end of each unit for effective recapitulation.

UNIT 1 THE STRUCTURE OF INTELLIGENCE

Structure

1.0 INTRODUCTION

To quote Prof. Percy Nunn, 'You are forever you, and I, I'. It has been amply demonstrated by many psychologists that all persons do not have the same intelligence and all cannot do the same work with the same speed and efficiency. The assumption that given the same opportunities, all men will be equally successful, is based upon faulty foundations. The intelligence tests are of a great use in the schools. To be a successful teacher, one must know one's pupils thoroughly and one must possess an instrument with which one can measure the intelligence of one's pupils and one must know the proper use of that instrument.

For instance, the Binet's rod of mental measurement is an instrument for the teacher to find out the exact calibre of the minds of his pupils. Intelligence tests help to discover whether a child is backward or dull or intelligent. It is not possible to gauge the intelligence of children without the use of mental tests. The children's

intelligence cannot be estimated from the marks obtained by them in their school subjects. A child of 12 years and another of 14 years may be put on the same level if they obtain the same number of marks. But this is a defective method. Obviously, the child of 12 years is more intelligent than the child of 14 years in this illustration. Similarly, a child may be more industrious but comparatively dull and may score more marks than another child, who may in fact be more intelligent but less industrious. In this unit, we will discuss the various aspects of intelligence in detail.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain the concepts and types of intelligence
- Describe the important theories of intelligence as given by Thurstone, Guilford, and Throndike Piaget
- Discuss the concept of emotional intelligence and multiple intelligence
- Discuss how to measure intelligence

1.2 CONCEPT, NATURE AND TYPES OF INTELLIGENCE

There is no agreed definition of intelligence. In fact, there are as many definitions of intelligence as there are writers on the subject. P. B. Ballard (1913) has observed: 'While the teacher tried to cultivate intelligence and the psychologist tried to measure intelligence, nobody seems to know what intelligence was.' On account of the different ways in which intelligence is interpreted, it has become less acceptable and more exposed to criticism by psychologists. Nevertheless, it is traditionally acknowledged by the parents and the teachers that intelligence is the most important single variable which affects success in school and in life. In general terms, intelligence means the manner with which an individual deals with facts and situations. Intelligence is the aggregate or the global capacity of the individual to act purposefully, to think rationally, and to deal effectively with the environment. To quote Prof. R. R. Kumria: 'Call it practical wisdom; call it common sense; call it genius, it is just the same in different names and grades.'

1.2.1 Fourfold Classification of Definitions of Intelligence

A variety of definitions of intelligence have been suggested by the psychologists, which can be classified into at least four distinct groups.

The first group of definitions places the emphasis upon the adjustment and adaptation of the individual to his total environment or to its limited aspects. According to this group, intelligence is general mental adaptability to new problems and to new situations of life.

The second group of definitions of intelligence stresses the ability to learn. The more intelligent a person, the more readily and extensively he is able to learn and enlarge his field of activity and experience.

The third group of definitions maintains that intelligence is the ability to carry on abstract thinking. This implies the effective use of ideas and efficiency in dealing with symbols, specially numerical and verbal symbols.

The fourth category refers to the operational definitions.

These categories of definitions are not, and perhaps cannot be mutually exclusive. They intersect and overlap at many points.

I. Ability to adjust

1. *Binet* (1905)—'Ability of an individual to direct his behaviour towards a goal.'
2. *Boyniton*—'It is an inherited capacity of individual which is manifested through his ability to adjust and reconstruct the factors of his environment in accordance with the most fundamental needs of himself and his group.'
3. *Burt* (1949)—'It is the power of readjustment to relatively novel situations by organising new psycho-physical coordination.'
4. *F. N. Freeman* (1937)—'Intelligence is represented in behaviour by the capacity of the individual to adjust himself to new situations, to solve new problems, to learn.'
5. *Johnson*—'It stands for an ability to solve the general run of human problems to adjust to new situations.'
6. *J. Piaget* (1926)—'Adaptation to physical and social environment.'
7. *Peterson*—'It is a mechanical means for adjustment and control.'
8. *Pinter* (1921)—'The ability of the individual to adapt himself adequately to relatively new situations to life.'
9. *Stern* (1941)—'Intelligence is a general capacity of an individual, consciously to adjust his thinking to new environment.'
10. *Van Wagemen*—'It is the capacity to learn and to adjust to relatively new and changing conditions.'
11. *William James* (1907)—'It is the ability to adjust oneself successfully to a relatively new situation.'
12. *William McDougall* (1923)—'It is the capacity to improve upon native tendency in the light of past experience.'

II. Ability to learn

13. *Buckingham* (1921)—'Intelligence is the learning ability.'
14. *Calvin*—'It is the ability to learn.'
15. *Spearman* (1927)—'Intelligence may be thought of in terms of two abilities i.e., "g" or general and "s" or specific.'

16. *Thurstone* (1946) defines intelligence in terms of five primary abilities (discussed in the following pages).

17. *Woodrow*—'It is the capacity to acquire.'

III. Ability to do abstract reasoning

18. *C. Spearman* (1927)—'General intelligence which involves mainly the education of relations and correlates.'

19. *E. L. Thorndike* (1931)—'We may define intelligence in general as the power of good responses from the point of view of truth or fact.'

20. *Gates and Others* (1955)—'It is a composite organization of abilities to learn, to grasp broad and subtle facts, especially abstract facts, with alertness and accuracy, to exercise mental control and to display flexibility and sagacity in seeking the solution of problems.'

21. *Henry Garrett* (1946)—'The abilities demanded in the solution of problems which require the comprehension and use of symbols, i.e., words, numbers, diagrams, equations, formulae.'

22. *J. M. Hunt* (1966)—'The technique that a child acquires for processing information supplied by his senses.'

23. *L. M. Terman* (1921)—'An individual is intelligent in proportion as he is able to carry on abstract thinking.'

24. *Munn*—'Intelligence is the flexibility or versality to the use of symbolic processes.'

25. *P. E. Vernon* (1927)—'All-round thinking capacity or mental efficiency.'

IV. Operational Definitions

26. *Boring* (1948)—'Intelligence is what intelligence tests.'

27. *Dockell* (1970)—'Intelligence might be taken to mean "ability", i.e., what a person can do at a moment.'

28. *D. O. Hebb* (1949) describes three situations in which the term intelligence could be used.

29. *D. W. Wechsler* (1950)—'Intelligence is the aggregate or the global capacity of the individual to act purposefully, to think rationally and to deal effectively with the environment.'

30. *G. D. Stoddard* (1943)—'Intelligence is the ability to undertake activities.'

31. *Hein*—'Intelligence activity consisting in grasping the essentials in a situation and responding approximately to them.'

32. *P. E. Vernon* (1927)—'Intelligence is what intelligence test measures.'

33. *Well*—'Intelligence is the property of recombining our behaviour pattern as to act later in novel situations.'

1.2.2 Historical Review and Evaluation of Definition of Intelligence

A. Binet (1905), a French psychologist, was the first to take interest in intelligence. He defined intelligence as the ability of an individual to direct his behaviour towards a goal, to make adaptation in his goal-oriented behaviour when necessary, to know when he reached the goal. Comprehension, invention, direction and censorship: intelligence lies in these four words. A. L. Terman (1916) defined intelligence as an individual's ability to carry on abstract thinking. In the words of Thompson, 'the definition presented by Terman probably reflects most adequately our present functional definition of intelligence'. E. L. Thorndike (1926) further elaborated the definition given by Terman. He defined intelligence in terms of three somewhat independent dimensions: (i) attitude, (ii) breadth, and (iii) speed. In 1946, L. L. Thurstone identified the following more or less mutually exclusive components of intelligent behaviour.

S, or *space factor*: the ability to visualize flat or solid objects, heavily involved in mechanical aptitude.

N, or *number factor*: ability in the carrying-out of the rather simple numerical exercise similar to those used by a cashier.

V, or *verbal comprehension factor*: ability to deal with verbal concepts, e.g., verbal reasoning, and vocabulary availability.

W, or *word fluency factor*: ability to produce words in a restricted context, i.e., a child may be fluent even though he has a small vocabulary.

M, or *memory factor*: ability to store and reproduce perceptual-conceptual materials.

Induction factor: facility in discovering the principle or rule that applies to a series of problems.

Deduction factor: only a small amount of evidence for—ability to apply a given principle to a series of specific problems.

Flexibility and speed to closure: ability to interpret instructions quickly. Facility to size up a problem situation quickly; flexibility is the ability to abandon one configuration in favour of a more promising one.

G. D. Stoddard and B. L. Wellman (1934) offer a seven-category definition of intelligence:

'Intelligence is the ability to undertake activities that are characterized by:

   (1) Difficulty,

   (2) Complexity,

   (3) Abstractness,

   (4) Economy,

   (5) Adaptiveness to a goal.

   (6) Social value, and

(7) The emergence of originals and to maintain such activities under conditions that demand a concentration of energy and a resistance to emotional force.'

J. P. Guilford (1950) thinks that these definitions ignore the important concept of creativity and thus provide a narrow approach to intelligence

D. Wechsler (1950) concludes that general intelligence is more than a combination of the cognitive functions identified by Thurstone and others.

In Wechsler's view, general intelligence is influenced by certain conative factors like drive, will, perseverance and persistence; by certain emotional factors like anxiety and impulsiveness; and by other more general personality characteristics.

G. Thompson (1975) sums up the discussion in these words: 'There is no absolute definition of intelligence. A theoretical construct may be changed at any time. According to the law of parsimony, the simplest yet most fruitful definition will eventually prevail. Thurstone's approach to the definition and measurement of children's intelligence is challenging. Whether this approach will be more valuable than those of Binet and Terman is of course unknown.'

Intelligence and scholars of ancient India

Kautilya defines it as the ability for work.

According to Visnusarma, it is the power which enables human beings to control the world.

The *Brahmasutra* tells us that intelligence is the gift of God and it is fixed at birth.

The *Agnipurana* prescribes diet for infants to help the growth of their intelligence.

Agadhabuddhi or intelligence that cannot be measured or superior intelligence.

Mahabuddhi or great intelligence, *malin buddhi* or dull intelligence

Sthirabuddhi or calm intelligence.

Atpabuddhi or little intelligence.

In ancient India, intelligence was measured through conversation, physical features, gestures, gait, speech, changes in the eye and facial expression.

1.2.3 Chief Characteristics and Generalizations on Intelligence

Intelligence cannot be increased or decreased. The amount of intelligence that a person possesses is inherited and fixed. The amount though fixed does not reveal itself at the start of life. With the growth of the child, the amount inherited by a child also grows. The general belief is that the growth of intelligence stops and it reaches its limit at the age of sixteen or seventeen. It is true that a man of forty knows more than he was a boy of sixteen. But this does not mean that the amount of intelligence

possessed by him has increased. This may be due to his experience. As regards his intelligence, his position remains the same.

- **Intelligence and influence of environmental factors:** It is certainly justifiable to assume that love, affection, concern and generosity judiciously bestowed on growing children, have very desirable effects. Poor environments retard development of intelligence.

  The growth of intelligence of certain children may be checked due to certain unfavourable circumstances and when these are removed, intelligence begins to grow and functions normally.

- **Intelligence, adjustment and inventions:** An intelligent person has the ability to adjust himself to the changing circumstances with ease, efficiency and speed. He has the capacity to assimilate ideas very quickly and clearly. He can cope with new situations very successfully. All the inventions of the world can be attributed to persons of very high intelligence.

  The unintelligent or the dullard fails to think of new situations. They are always guided by others. They lack originality.

- **Distribution of intelligence:** The majority of the school children, say about 60 per cent, are found in the IQ range 90–110 and are referred to as 'normal' or 'average'.

- **Intelligence and sex differences:** Generally speaking, the research studies show that the average scores of the sexes are strikingly similar.

- **Intelligence and race differences:** Every racial and cultural group contains some gifted children. Franz Boas states, 'if we were to select the most intelligent, imaginative, energetic and emotionally stable third of mankind, all races would be represented'.

1.2.4 Three Broad Areas of Intelligent Behaviour

Thurstone has suggested that we may recognize at least three broad areas of intelligent behaviour:

 (i) **Abstract Intelligence:** He defined this as the 'ability to understand and manage ideas and symbols, such as, words, numbers, chemical or physical formulas, legal decisions, scientific principles and the like…' In the case of students, this is very close to what is called scholastic aptitude.

 (ii) **Mechanical Intelligence:** This includes, 'the ability to clean, to understand and manage things and mechanisms, such as a knife, a gun, a moving machine, and automobile, a boat, a lathe'.

 (iii) **Social Intelligence:** This is the 'ability to understand and manage men and women, boys and girls to act wisely in human relations'.

Intelligence Curve

If we plot a measure of intellectual development against chronological age from birth to adolescence using a random subject we will obtain S = shaped curve (Figure 1.1).
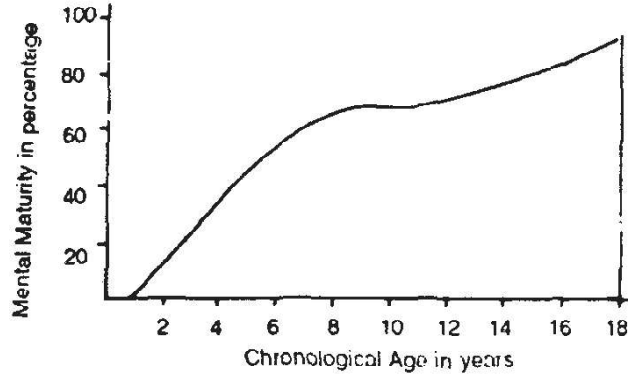
Fig. 1.1 Intelligence Curve

The following points come to light from the curve:

1. During early childhood, there is a period of relatively rapid growth of intelligence followed by a slower rate during adolescence.

2. During childhood, the curve is more or less linear.

3. Mental development reaches almost at its maximum during early adult years.

Non-definable nature of intelligence

Some argue, 'we can measure electricity without being able to define its precise nature. But we can put electricity to use and measure it. So we can use and measure intelligence.'

Intelligence and different occupations: Usually scholars, executives in business and government and scientist possess high abstract intelligence.

A successful civil engineer presumably possesses high abstract as well as high mechanical intelligence. Similarly, other types of engineers possess a combination of like abilities.

A successful criminal lawyer possesses high abstract as well as social intelligence.

Mechanics, expert carpenters and plumbers possess above normal mechanical intelligence.

Of course, these are crude generalizations.

1.2.5 Types of Intelligence

The various types of intelligence are as follows:

1. Naturalist intelligence

This type of intelligence designates the human ability to discriminate among living things (plants, animals) as well as sensitivity to other features of the natural world (clouds, rock configurations). This ability was clearly of value in our evolutionary past as hunters, gatherers, and farmers; it continues to be central in such roles as botanist or chef. It is also speculated that much of our consumer society exploits the

naturalist intelligences, which can be mobilized in the discrimination among cars, sneakers, kinds of make-up, and the like.

2. Musical intelligence

Musical intelligence is the capacity to discern pitch, rhythm, timbre, and tone. This intelligence enables us to recognize, create, reproduce, and reflect on music, as demonstrated by composers, conductors, musicians, vocalist, and sensitive listeners. Interestingly, there is often an affective connection between music and the emotions; and mathematical and musical intelligences may share common thinking processes. Young adults with this kind of intelligence are usually singing or drumming to themselves. They are usually quite aware of sounds others may miss.

3. Logical-mathematical intelligence

Logical-mathematical intelligence is the ability to calculate, quantify, consider propositions and hypotheses, and carry out complete mathematical operations. It enables us to perceive relationships and connections and to use abstract, symbolic thought; sequential reasoning skills; and inductive and deductive thinking patterns. Logical intelligence is usually well developed in mathematicians, scientists and detectives. Young adults with lots of logical intelligence are interested in patterns, categories, and relationships. They are drawn to arithmetic problems, strategy games and experiments.

4. Existential intelligence

Sensitivity and capacity to tackle deep questions about human existence, such as the meaning of life, why do we die, and how did we get here.

5. Interpersonal intelligence

Interpersonal intelligence is the ability to understand and interact effectively with others. It involves effective verbal and nonverbal communication, the ability to note distinctions among others, sensitivity to the moods and temperaments of others, and the ability to entertain multiple perspectives. Teachers, social workers, actors, and politicians all exhibit interpersonal intelligence. Young adults with this kind of intelligence are leaders among their peers, are good at communicating, and seem to understand others' feelings and motives.

6. Bodily-kinesthetic intelligence

Bodily-kinesthetic intelligence is the capacity to manipulate objects and use a variety of physical skills. This intelligence also involves a sense of timing and the perfection of skills through mind–body union. Athletes, dancers, surgeons, and craftspeople exhibit well-developed bodily kinesthetic intelligence.

7. Linguistic intelligence

Linguistic intelligence is the ability to think in words and to use language to express and appreciate complex meanings. Linguistic intelligence allows us to understand the order and meaning of words and to apply meta-linguistic skills to reflect on our

use of language. Linguistic intelligence is the most widely shared human competence and is evident in poets, novelists, journalists, and effective public speakers. Young adults with this kind of intelligence enjoy writing, reading, telling stories or doing crossword puzzles.

8. Intra-personal intelligence

Intra-personal intelligence is the capacity to understand oneself and one's thoughts and feelings, and to use such knowledge in planning and directioning one's life. Intra-personal intelligence involves not only an appreciation of the self, but also of the human condition. It is evident in psychologist, spiritual leaders, and philosophers. These young adults may be shy. They are very aware of their own feelings and are self-motivated.

9. Spatial intelligence

Spatial intelligence is the ability to think in three dimensions. Core capacities include mental imagery, spatial reasoning, image manipulation, graphic and artistic skills, and an active imagination. Sailors, pilots, sculptors, painters, and architects all exhibit spatial intelligence. Young adults with this kind of intelligence may be fascinated with mazes or jigsaw puzzles, or spend free time drawing or daydreaming.

CHECK YOUR PROGRESS

1. What is the Binet's rod of mental measurement?
2. How did A. Binet define intelligence?
3. How does Thurstone define abstract intelligence?
4. Name any three types of intelligence.

1.3 THEORIES OF INTELLIGENCE

Psychologists have attempted to understand the structure of intelligence (SoI) for which they have formulated several theories. Among the important theories, the following deserve special mention.

1. Spearman's Two-Factor Theory or Electic Theory

In 1904, Spearman, an English psychologist produced strong evidence based on his own researches that there was one fundamental ability underlying all cognitive functions. According to him, every task involving intellectual activity depended upon a general ability or 'g' factor and a separate ability or 'specific' factor. This view is popularly known as two-factor theory of intelligence, i.e., 'g' factor and 's' factor. This 'g' factor represents native intelligence. Thus, when we respond to any situation or perform an intellectual task, our general mental ability or 'g' factor is responsible for part of our reactions and our specific ability in that particular task is responsible for the rest.

There is a large number of specific abilities, such as, ability to draw inferences, ability to complete sentences, ability to continue series of numbers, the ability to code messages.

2. Thurstone's Group Factor Theory or Anarchic Theory

L. L. Thurstone, an American psychologist, propounded the group factor theory of intelligence. According to him, intellectual activity is neither an expression of numerous highly specific factors as claimed by Thorndike, nor the expression primarily of a general factor which prevails in all mental tasks as Spearman believed. Instead, as revealed by factor analysis, certain mental operations have in common a primary factor which gives them psychological and functional unity and which distinctly separates them from other mental operations. These mental operations are said to constitute a group 'A', similarly, another group of mental operations have their own unifying primary factor and may be said to constitute a group 'B', and so on. Thus there are a number of groups of mental abilities, each of which has its own primary factor.

Thurstone proposed seven factors and called them 'primary mental abilities'. These are:

(i) M—*Memory:* To be able to learn and retain information. Also to be able to recall the learned material.

(ii) N—*Number:* To be able to understand quickly and with accuracy simple arithmetic computations.

(iii) P—*Perceptual:* To be able to identify objects quickly and accurately.

(iv) R—*Reasoning:* To be able to perceive and utilize abstract relationships. To be able to put together past experiences in the solution of new problems.

(v) S—*Spatial:* To be able to deal with objects in space.

(vi) *Verbal:* To be able to understand and utilize verbal ideas.

(vii) W—*Word fluency:* To be able to think of words rapidly.

Spearman's theory is also known as the '*electic theory*' because it harmonizes elements from all the main types. Thurstone's theory is also known as the '*anarchic theory*', because he conceives of mind as consisting of a number of independent facilities.

3. Unitary Theory or Monarchic Theory

According to Monarchic attitude, intelligence is regarded as an adaptiveness which enables a creature to adjust itself to the changing environment. This is a popular view which regards intelligence, as a unitary (monarch) faculty that determines the level of man's achievement in any intellectual enterprise he may take. Accordingly, inborn all-round mental efficiency is a sign of intelligence. Newton could have been a poet as well, had he turned his mind to poetry.

Intelligence is a single unit
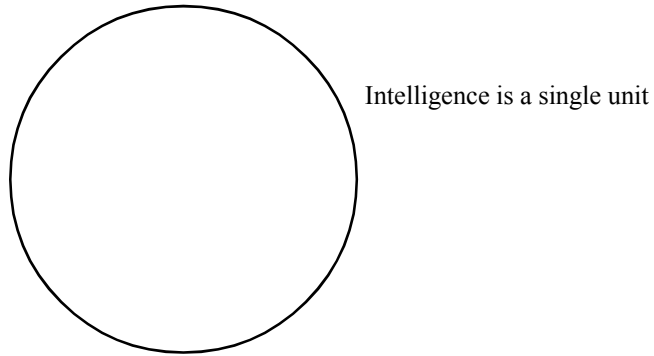
Fig. 1.2 *Unitary Theory of Monarchic Theory of Intelligence*

4. Oligarchic Theory

This theory is criticized by the advocates of Oligarchic Theory. They say a person cannot be expert in all fields. Moreover, they cannot be mentioned in any single factor which means intelligence.

This theory is sometimes known as sampling theory of intelligence. Oligarchic theory was put forward by Prof. Thompson. According to this theory, intellectual abilities belong to certain groups. This theory maintains that cognitive abilities are manifestations not of a single commanding faculty, but of a few main intellectual powers or a group of abilities. For example, a child who is intelligent in one group of knowledge may not be intelligent in the other group. But he may be equally intelligent in the various subjects of that particular group (Figure 1.3).

SCIENCE GROUP

PHYSICS   GEOLOGY

CHEMISTRY   ZOOLOGY

BOTANY   BIOLOGY

HUMANITY GROUP

ECONOMICS   HISTORY

PUBLIC ADMINISTRATION   POLITICAL SCIENCE

SOCIOLOGY   ECONOMICS
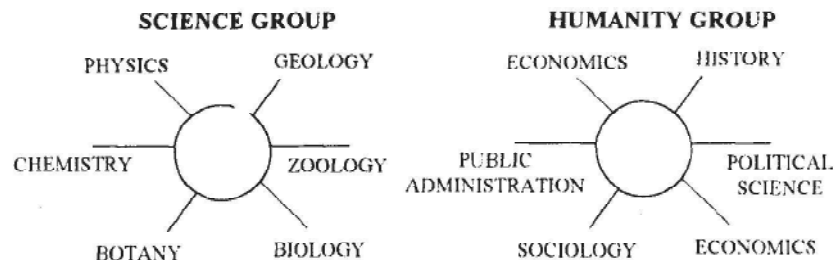
Fig. 1.3 *Oligarchic Theory of Group Factor Theory of Intelligence*

Educational implications of theories of intelligence

Spearman's Theory is criticized on the main ground that it fails to take into account sufficiently for specific types of abilities and towards the later years of his life. Spearman himself had begun to realize the existence of group factors.

Thorndike's Theory accords undue weightage to abstract intelligence. Guilford Theory of Intelligence seems to be the most comprehensive theory as it attempts to take into consideration all possible aspects of intellectual activity. This theory has several educational implications.

The SOI model provides knowledge about the specific ability of the students to guide them in the right direction. An analysis of the students' abilities by the

guidance worker can suggest a reliable base on which future learning could be based.

The SOI model is useful in finding out the reasons of the unsatisfactory performance of the students in spite of their adequate intelligence.

The model points out that for understanding human learning and higher mental processes of thinking, problem-solving and creativity, etc., some drastic modifications would be needed in our theory of curriculum construction and methodology of instruction.

The model has explored 120 intellectual abilities and this enables us to find out whether or not we are paying adequate attention to each of them. If not, how to improve.

The model guides us to devise enrichment programmes for the creative and the gifted children.

The model discards the ideas of transfer of learning and stresses that learning of specific skills should be our focus of attention.

1.3.1 Thurstone's Theory of Intelligence

Louis Leon Thurstone made significant contributions in many areas of psychology, including psychometrics, statistics, and the study of human intelligence by developing methods for scaling psychological measures, assessing attitudes, and test theory, among many other. The statistical techniques developed by Thurstone are his most enduring contribution to psychology.

Thurstone stressed that g was a statistical artifact that resulted from mathematical procedures used to study it. Thurstone found that intelligent behaviour does not arise from a general factor but emerges from seven independent factors which he called *primary abilities*—word fluency, verbal comprehension, spatial visualization, number facility, associative memory, reasoning, and perceptual speed. When Thurstone analysed mental test data from IQ samples of people with similar scores, he found that they had different primary mental abilities.

However, when Thurstone administered his tests to an intellectually heterogeneous group of children, he was unable to find that the seven primary abilities were entirely separate, rather he found evidence of g. Thurstone made a mathematical solution that resolved these contradictory results and his final version of his theory was a compromise that had the presence of both a general factor and the seven specific abilities. This helped to lay the groundwork for future researchers who proposed hierarchical theories and theories of multiple intelligences.

Thurstone is responsible for introducing the standardized mean and standard deviation of IQ scores instead of the Intelligent Test system introduced by Binet. He is also responsible for developing the Thurstone Scale.

Thurstone's work in factor analysis led him to formulate a model of intelligence center around 'Primary Mental Abilities' (PMAs), which were independent group factors of intelligence that different individuals possessed in varying degrees. Thurstone

opposed the singular general intelligence that were part of the scores of all psychometric tests and was expressed as a mental test. In 1935 Thurstone, along with Thorndike and Guilford started the journal *Psychometrika* and also the Psychometric Society. He became the society's first President in 1936. Thurstone's contributions to methods of factor analysis has contributed in establishing and verifying the psychometric factor structures that came later, and has influenced the hierarchical models of intelligence in use in intelligence tests such as WAIS and Stanford-Binet IQ Test.

It was suggested that there were equally important factors or aptitudes in addition to 'G'. The multifactor theory is based on factor analysis and statistical procedure that attempts to describe as simply as possible the main factors that account for the relationship among several different tests. L. L. Thurstone was the first psychologist who used this procedure by correlating the results from approximately 60 separate tests. The factor analysis of the resulting correlation yielded the following abilities that provide the basis for the construction of the primary mental abilities (PMA) test. According to this theory, intelligence neither consists of two factors as proposed by Spearman nor multifactors as developed by Thorndike.

The six primary factors emerged are as follows:

1. Number factor (N)	Ability to do numerical calculations rapidly and accurately.
2. Verbal factor (V)	Found in test involving verbal comprehension. Verbal factor may take two forms: (*i*) Verbal fluency, which is the ability to deal with relationships expressed in words. (*ii*) Verbal comprehension, which refers to on
3. Space relations (S)	Involved in any task in which the subject manipulates an object imaginary in space.
4. Memory (M)	Involving the ability to memorize quickly and retain for a longer time.
5. Reasoning (R)	Found in tasks that requires the subject to discover a rule or principle.
6. Word fluency (W)	Involved whenever the subject is asked to think of isolated words at a rapid rate.
7. Perceptual speed	It is the ability to find out quickly similarities and differences in groups of designs.

Today there is rather general agreement among the psychologists that there are many intellectual dimensions. However, there remains a factor that might be called general scholastic aptitude, a conclusion supported by the fact that factors on such tests as the PMA are not completely independent but are correlated to some extent with each other. Despite the analytic nature of the multifactor approach, it is still based on a limited conception of intelligence since little weight is given to social intelligence, mechanical and to abilities in special fields such as athletic, music and drama.

1.3.2 Guilford' Theory of Intelligence

This three-dimensional theory was developed by Guilford and his associates in the psychological laboratory at the University of Southern California in 1966. The work on Guilford's Theory of Structure of Intellect began on this theory in 1956.

Guilford conceives of intellectual functioning as having three dimensions: (i) operations, (ii) content and (iii) products. *Operations* are processes involved in intellectual behaviour—cognition, memory, divergent thinking, convergent thinking and evaluation. The *content* of these operations may be figural, symbolic, e.g., letters, numbers, semantic, e.g., words or behavioural, e.g., information about other persons, behaviour, attitudes, needs, etc. The *products* may be—units, classes, relations, systems, transformations and implications. Thus, the model contains 120 cells (5 operations × 4 contents × 6 products); each of which represents a distinct factor which is measured by a separate test (Figure 1.4).
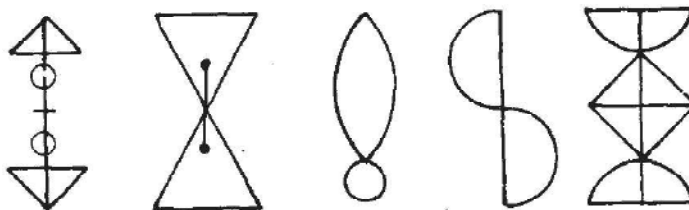
Fig. 1.4 *Guilford's Module of Intelligence*

Guilford suggests that the five processes act on the four units to produce one of six cognitive products. The six products are units of a single word or idea, classes, a relationship between or among units or classes, systems, an organized sequence of ideas, transformations, a change or redefinition or a unit or class, and implications, predictions of the future.

Guilford believes that each person is a unique composite of a great many different intellectual abilities. Each intellectual functioning involves three components: a cognitive operation, specific content and a specific product.

Some of the elements of the structure of intellect are as follows:

- **Cognition:** It refers to discovery, rediscovery or recognition.
- **Memory:** It is a primary mental process. It means the retention of what is recognized.
- **Divergent thinking:** This implies thinking in different directions, seeking and searching some variety and novelty.
- **Convergent thinking:** In this type of thinking what results is the right or best answer.
- **Evaluation:** It is about reaching decisions or making judgments about the information received.

This model of Guilford is not a basic model. It can be compressed and expanded. When compressed, intelligence consists of only 18 factors (3 × 2 × 3 = 18), i.e., instead of six products, we have three; five operations can be reduced to

two (for example, convergent and divergent thinking are one, memory can be deleted, evaluation is based on cognition and as such is one). As such five operations get reduced to two, and four contents to three.

When expanded by breaking, each of the products, operations and contents, intelligence composes of $(8 \times 12 \times 10) = 960$ mental abilities.

However, Guilford says that S—R bond is the real thing. Eysenck also proposed compressing in his own way. According to him, intelligence consists of nine factors. There are three products, three contents and one process or operation $(3 \times 1 \times 3 = 9)$. This can be safely compared to Thurstone's model, which states that there are seven primary abilities.

A second way of classifying the intellectual factor is according to the kind of material or content involved. It involves the following factors:

- **Visual content:** It is concrete material, which is perceived through our senses, i.e., size, form, colour, etc.
- **Symbolic:** It consists of letters, digits and other conventional signs.
- **Semantic content:** It is in the form of verbal meanings or ideas, which we get from others.
- **Behavioural content:** It means social behaviour in society.
- **Auditory:** This relates to factors relating to the senses.

When a certain operation is applied to a certain kind of content, following products are to be involved:

- **Units:** Understanding the meaning of words, visuals, auditory and symbolic units.
- **Classes:** It means classification of words and ideas.
- **Relations:** It implies discovering relations between various concepts and objects.
- **Systems:** The ability to structure objects in space, to structure symbolic elements and to formulate problems.
- **Transformations:** The ability to look into the future lines of development or to suggest changes in the existing situations.
- **Implications:** The ability to utilize present information for future ends.

Educational implications of the SI model

The educational implications of the SI model are as follows:

1. The SI model has explored 150 intellectual abilities and this enables us to find out if we are paying adequate attention to each of these. If not, it explains how to improve.

2. The model provides knowledge about the specific ability of students to guide them in the right direction.

3. The model points out that for understanding human learning and higher mental processes of thinking, problem-solving and creativity, significant modifications

would be needed in the theory of curriculum construction and methodology of instruction.

4. The model guides us to provide enrichment programmes for creative and talented students.

5. The model is useful in finding out the reasons of unsatisfactory performance of a student in spite of his high level of intelligence.

6. The model discards the idea of transfer of learning and stresses that learning of specific skills should be the focus of our attention.

1.3.3 Piaget's Theory of Intelligence

The processes lie under the adaptive behaviour from birth to adolescence. Piaget studied developmental process of understanding knowledge and working of the child's mind. His system can be of great value to assess teaching, structure and sequencing of subject matter in the curriculum and organization of various activities in and outside the classroom.

Basic concepts: schema, assimilation and accommodation

Piaget was interested in the developmental process and the change in behaviour. The concept of schema applies to the sensorimotor behaviour of the infant. The infant sucks the breast of his mother; looks at the objects of environment; listens to different voices in his environment; and finally tries to comprehend, conceptualize the articles, animals, space and many other cognitive structures. The process of conceptualization is closely dependent upon the sequences of behaviour employed by the infant to adapt to the environment. Although a particular scheme derives its name from the behaviour sequence it describes, it implies some internal organizational disposition that enables the sequence to adopt itself to a variety of conditions. According to Piaget, sensorimotor sequence and cognitive structures are of the same class because they are continuous processes. As the development proceeds, each scheme enlarges and changes and is coordinated with other schemes to form more complex schemes.

The sensorimotor schemas develop out of the reflex behaviour of the infant. They are reduced and internalized as they continue to function and are gradually converted into cognitive schemes. As the sensorimotor schemas are converted to the more covert and symbolic structures, they become generally synonymous with the processes known as concepts, generalizations, principles, constructs and plans.

Piaget believed that schemas (cognitive structures) exist in primitive form at conception and progressively develop during the lifetime in certain systematic ways. According to him, cognitive structures contain all the necessary energy for their emergence and development without requiring some motivating force.

The schemas acquired in infancy are exercised and changed in later life. The process of change is accounted for by the psychological processes constantly at work called 'assimilation and accommodation'.

At the sensorimotor level, when the infant acquires grasping schema, he picks up things and objects and grasps them. This scheme of grasping objects is called

assimilation. Suppose, the grasping schema is inadequate, the object is too small, it must change in order to manage the new situation. This is accommodation at work. The play activities of infants are the examples of the process of assimilation. The infant will take a stick and assimilate it to his available schema, making it into a horse, cow or man. The example of accommodation is imitation of others. In the process of imitation, the child suppresses the available scheme and strives to establish a new schema. The structures or the schemes change from one stage to another by the process of equilibration. Through the processes of assimilation and accommodation, the organism attempts to adapt to the environment to maintain balance with the changing environment.

Piaget's developmental stages

Jean Piaget advanced a new theory of development of cognitive abilities. He proposed that cognitive development proceeds through an orderly sequence of stages. The important concept of his theory of cognitive development is not the age at which the child moves from preferred mode of response to another but the fixed progression from one stage to another. The child cannot adopt the strategies of a later stage at an early stage of development without having first acquired and exercised the strategies of the earlier stage.

Ausbel commenting upon the development stages of Piaget writes: 'Piaget's stages are identifiable, sequential phases in an orderly progression of development that are qualitatively discriminable from adjacent phases and generally characteristic of most members of a broadly defined age range.'

The stages of cognitive development are related in that they represent forms of adoption but these forms are qualitatively different; that is the adaptive functions are transformed as the child moves from one stage to the next. This theory of development is quite different from the theory of associationists which emphasizes the gradual accumulation of responses.

Stages of cognitive development

Jean Piaget divides the stages of cognitive development into the following categories:

1. **The period of sensorimotor adaptation (since birth to 2 years):** The period from birth to 2 years is marked by an extraordinary development of the mind. The infant starts from reflex domination and reaches the stage of sensorimotor schemas. The development of this period is very important for future life.

   The intellectual development at this age is marked by four fundamental characteristics: (*a*) object concept formation, (*b*) coordinated space, (*c*) objectified causality and (*d*) objectification of time.

   The objects exist in the psychological world of an adult irrespective of their physical presence before the adult but in the world of the child they only exist when they are physically present and the child looks at them, grasps them and acts with them. As soon as they move out of his range of acting, grasping and listening, they stop existing for the child. In the first year of life, the child

develops the concept of permanence of objects. He then attempts to retrieve an object that disappears from his range of action.

The second characteristic of coordinated space is integrated with the formation of the object concept. The spatial world at first is totally uncoordinated. By the end of 2 years, the child develops the concept which is characterized by relationship among objects and between objects and his own body.

The infant does not have any real sense of duration at the beginning of life. By the middle of first year of life, a rudimentary sense of duration is present, but it is entirely a subjective phenomenon. By the end of the first year, the infant frees himself from this personal concept of time, and the beginning of objective existence of time takes place.

2. **The development of symbolic and preconceptual thought (2 to 4 years):** At the end of the sensorimotor period, the child starts dealing with the world by means of ideational representations. By imitation and other forms of behaviour, he demonstrates that he is capable of extending his world beyond here and now. These actions of the child indicate the use of symbols. By the age of 4 years the child develops way of representing the environment in the absence of perceptual cues and will build a set of symbolic schemes.

3. **The period of intuitive thought (4 to 8 years):** At this stage, the child is able to use concepts as stable generalization of past and present experiences. His reasoning is not logical and is based on intuition rather than on systematic logic. The intuitive thought of the child is mainly concerned with stages or static configurations and neglects transformation. The child talks about this or that momentary static conditions but he cannot adequately link a whole set of successive conditions into an integrated totality by taking into account the transformations which unify them and render them logically coherent.

4. **The period of concrete operations (8 to 12 years):** Concrete operation means that stage of cognitive development when the child is able to direct his attention away from the static conditions and can focus on the whole set of successive changes that occur in the process of transformation. At this stage, the child can reason well. Transformation could return to its starting point. Piaget has given a long list of operations which make possible the handling of numbers in various relations to each other, the arrangement of objects into classes and sub-classes and the ordering of objects according to one or more attributes. He has coined a term 'grouping' to describe a set of operations.

5. **The period of formal operations (from 12 years to adolescence):** At this stage, the child's thought process becomes quite systematic and reasonably well-integrated. These qualities of the child's thought process are evident when events are present. Reality guides his contemplation of possibility. He starts a form of hypothetico-deductive reasoning. The use of formal operations is what is called the controlling aspects of comprehending.

The child at this stage in his formal thinking can free himself of the here and now in a lawful and systematic way. His wisdom lies in the masterful administration of the

unforeseen. When an adolescent is faced with a problem, he uses formal operations to identify the variables that seem relevant to the solutions, and then considers all the possible combinations of these variables.

1.3.4 Thorndike's Theory of Intelligence

On the basis of trial and error learning, Thorndike propounded some laws of learning.

The law of readiness

Readiness includes all those preparatory adjustments which immediately precedes the action. Reminding the learner of his past experience, mental preparation for the understanding of new things, diverting his attention towards the subject to be learned, the altering of the environment to suit the learning are all included in learning. This readiness creates a desire for learning and thus the learner's mental attitude towards learning.

According to Thorndike: 'When any conduction unit is ready to conduct for it to do so is satisfying. When any condition unit is not in readiness to conduct for it to conduct is annoying. When any condition unit is in readiness to conduct, for it not to do so is annoying.'

The law of readiness states that if the learner is in a state of readiness, which means he is prepared for learning, then the process of learning will be fast and it will be retained for a longer period of time. Thus, readiness means a mental preparation for action. It is the preparatory development or physiological growth. We progress in the process of learning by the motivation furnished by our wants, interests and attitudes. A person cannot perform an activity with ease towards which he is unfavourably dispensed.

The law of effect

Thus, the simple meaning of this law is responses to a situation which are followed by a rewarding state of affairs will be strengthened and become habitual responses to that situation. So when the learner is satisfied and is happy with the learning then he will remember that for a longer period of time than a situation when the learner is not happy and is dissatisfied. If there are some unpleasant experiences associated with learning then the learner will like to forget and ultimately learning will not be effective.

Law of multiple response or varied reactions

The law states that when an individual comes across a situation he acts in a number of ways before arriving at a correct response. A person tries to solve a new problem by diversified responses in behaviour which guide him in attaining success and make learning possible. Thus, the learner reaches the solution by making variations in the responses. If a person keeps on working towards the solution of a problem in a particular manner only and does not change the approach in the case of failure also, then the person will not learn anything. The person who is learning should constantly change his style until he achieves success.

Law of attitude

Learning is conditioned by the attitudes and mental set of the learner. The response of a person in a specific situation is dependent upon his permanent adjustment in a particular setting like culture. For example, an Indian child will touch the feet and give respect to elders while an American child will not have the same gesture of respecting the elders. The response depends upon the cultural learning. The mental set decides not only the response but also the object from which a person will derive satisfaction or dissatisfaction. A bright student is not satisfied when he or she scores less marks, but an average student may have satisfaction by scoring the same marks. Learning takes place just because of attitude. If the learner has the positive attitude towards the task then learning will be better.

Law of analogy

An individual responds to a new situation on the basis of the responses by comparison or analogy. It is also called the 'law of assimilation'. The response from an individual will be similar to the one in which he has behaved previously.

Law of associative shifting

This law indicates that the position of the responses of the learner shifts. This shifting is done in respect of the basic stimulus or some related associative stimulus. For example, a dog starts salivating when he sees food and approaches the bearer with his wagging tail. The result of constant repetition of this phenomenon is that the dog wags his tail on the mere perception of the man and the shape of the dish. Thus, the response originally directed to the food is now shifted to the man and the dish because both these objects are associates of the main stimulus, the food, and we conclude that associative shifting in the response has taken place.

Law of exercise: The law of exercise is divided into two subparts, law of use and law of disuse.

- *Law of use:* According to this law, repeated application of an activity fixes it firmly in the mind. Repetitive application of the activity results in the formation of a habit in the muscles and the nerve fibres of the brain so that there is a facility in its execution in time of need.
- *Law of disuse:* According to Thorndike, 'when a modifiable connection is not made between a situation and response during a length of time that connection's strength is decreased all other things being equal.'

CHECK YOUR PROGRESS

5. Name the psychologist who propounded the group factor theory of intelligence.
6. What is Thurstone's most enduring contribution to psychology?
7. What are the three dimensions that Guilford conceives of intellectual functioning?
8. State the important concept of Piaget's theory of cognitive development.
9. What does the law of associative shifting indicate?

1.4 EMOTIONAL INTELLIGENCE AND MULTIPLE INTELLIGENCE

In this section, we will discuss the concepts of emotional intelligence and multiple intelligence in detail.

1.4.1 Emotional Intelligence

Peter Salovey, professor and psychologist at Yale University and John Mayer, professor and psychologist at the University of New Hampshire were one of the first people to coin the term 'emotional intelligence (EI). In 1995, Daniel Goleman, the leading expert in this field, reported 'IQ is only a minor predictor of success in life, while emotional and social skills are far better predictors of success and well-being than academic intelligence'.

Emotional intelligence is said to be of even greater importance than traditional IQ in learning. It is said that the emotional center of the brain has links with our long-term memory. Today it is even recommended that if learning is enhanced by emotional involvement it can fuel commitment and awaken curiosity. Emotional intelligence and its nurturing is important as they are said to facilitate the understanding of oneself and the emotional states of others. Today, emotion based learning is said to be as important as cognitive learning.

According to Goleman's work, children's emotional and social skills can be cultivated. This will lead to success in his social and personal life. He speaks of the following five crucial emotional competencies basic to social and emotional learning:

1. **Self and other awareness:** Understanding and identifying feelings; knowing when one's feelings shift; understanding the difference between thinking, feeling and acting; and understanding that one's actions have consequences in terms of others' feelings.

2. **Mood management:** Handling and managing difficult feelings; controlling impulses; and handling anger constructively.

3. **Self-motivation:** Being able to set goals and persevere towards them with optimism and hope, even in the face of setbacks.

4. **Empathy:** Being able to put yourself 'in someone else's shoes' both cognitively and affectively; being able to take someone's perspective; being able to show that you care.

5. **Management of relationships:** Making friends, handling friendships; resolving conflicts; cooperating; collaborative learning and other social skills.

The mastery of these five competencies results in the enhanced emotional intelligence.

Individual differences in distribution of intelligence

It is generally agreed upon by almost all psychologists that intelligence increases up to adolescence and declines in old age. These are general trends, but little is known

with sufficient certainty to be widely accepted. The technical and theoretical difficulties, in obtaining a reliable curve of growth and decline of intelligence, are two. One that intelligence at 5 years of age is very different from intelligence at the age of 15 or 55 years and that appropriate tests for different age groups can only said to be comparable in a rather general way. Second difficulty is that cross-sectional studies, that report the result of different age groups tested at one time, often produce results that differ markedly from those of longitudinal or follow-up studies, in which the same individuals are tested at successive stages.

This later difficulty is particularly evident if one attempts to describe the general trend of intelligence through the whole life-span from childhood to old age. The extent to which intelligence in old age declines is still an open question. Many studies have shown that a decline begins in the middle or late teens. Bayley (1955) has argued that, if appropriate tests were available, intelligence could be shown to increase up to the age of 50 years.

Thorndike has pointed out that measures of gains are inherently unreliable, that they are typically almost unrelated to the initial score, that the required assumption of equal units of measurement is rarely met and that there are particular dangers in correlating initial IQ and gain in IQ.

The most thorough and famous cross-sectional study that was designed to plot the trend of intelligence through adult life was that of Jones and Conrad in 1933. They administered Army Alpha to 12,000 subjects ranging from 10 to 60 years of age.

1.4.2 Gardner's Theory of Multiple Intelligence

The theory of multiple intelligence was developed by Howard Gardner Professor of Education at Harvard University. It suggests that the traditional notion of intelligence based on IQ testing is very limited.

Howard Gardner was the first to see the limits of the old way of thinking about intelligence. In his book *Frames of Mind* published in 1983, he proposed that there was not one, monolithic kind of intelligence that was crucial for success, but rather a wide spectrum of intelligences with seven key varieties. His list includes two standard academic kinds, i.e., 'verbal' and 'mathematical logical alacrity'; it also includes 'spatial capacity' often seen in an outstanding artist or architect; the 'kinesthetic genius' displayed in physical fluidity; the 'musical or rhythmical'; the 'personal intelligences'; 'interpersonal skills' and 'intrapsychic capacity.'

Gardner acknowledges that seven is an arbitrary figure. For the variety of intelligences, there is no magic number to the multiplicity of human talents. At one point of time, Gardner had given 20 different varieties of intelligence. Interpersonal intelligence broke down into four distinct abilities, i.e., leadership, the ability to nurture relationships and keep friends, the ability to resolve conflicts and the skill of social analysis.

Gardner's thinking about the multiplicity of intelligence continued to evolve. In 1993, he gave the summary of personal intelligences as follows:

Interpersonal intelligence is the ability to understand other people: what motivates them, how they work, how to work cooperatively with them. Successful politicians, social workers, teachers, clinicians, religious leaders and sales people are individuals who have high interpersonal intelligence. Intrapersonal intelligence is a correlative ability, turned inward. It is the capacity to form an accurate, veridical model of oneself and to be able to use this model to operate effectively in life.

According to Gardner, the core of interpersonal intelligence includes the 'capacity to recognize and respond appropriately to moods, temperaments, motivations and desires of other people'. In intrapersonal intelligence, he included 'access to one's own feelings and the ability to discriminate among them and draw upon them to guide behaviour.'

The theory of multiple intelligence has evolved to focus on meta cognition—that is, awareness of one's own mental processes—rather than on the full range of emotional abilities. Gardner pointed out that many people with IQ of 160 work for people with IQ of 100, if the former have poor interpersonal intelligence and the latter have a high one. The multifaceted view of intelligence offers a richer picture of child's ability and potential for success than standard IQ.

CHECK YOUR PROGRESS

10. Why is emotional intelligence and its nurturing important?

11. Who developed the theory of multiple intelligence?

12. How has the theory of multiple intelligence evolved?

1.5 INTELLIGENCE TESTS

Intelligence tests are used to measure intelligence. It is important to note that intelligence is inferred from a variety of elements, i.e., behaviour and speed of doing things correctly, etc. for which intelligence tests have been devised. An intelligence test is an objective and a standardized measure.

Intelligence is measured through a complicated process. It involves a comparison and establishment of a relationship between C.A. (Chronological Age) and MA. (Mental Age). This relationship is expressed by the term IQ (Intelligence Quotient). When the mental age is divided by the chronological age and the quotient is multiplied by 100, the result is IQ

$$I.Q = \frac{M.A.}{C.A.} \times 100$$

When we want to calculate the mental age of a student all questions assigned to the age are put to him (In the individual scale of Binet a certain number of questions are assigned to that age). If he answers all the questions assigned to that age correctly, his mental age is equal to his chronological age and that child is considered to be an average one. Suppose you have to test a child of C.A. 8 on the

Binet scale. You will start with questions assigned to the sixth year and then go up. The child may be successful in answering correctly all the questions assigned to years 6, 7, 8 and may stop at 9. His mental age will be 8.

Intelligence is measured on the following factors:

1. **Vocabulary**—Choosing a synonym or antonym or near-synonym or near antonym.

2. **Verbal analogies**—e.g., Branch is to a tree as brook is to river.

3. **Sentence completion**—e.g., India has—states.

4. **Arithmetic reasoning**—Simple arithmetic sums.

5. **Number series**—For example, what next? 11, 13, 15 (17, 19, 21).

6. **Picture arrangement**—Arranging disarranged pictures of a story in proper sequence.

7. **Comprehension**—For testing common sense, certain cards or paras are given in which some absurdity is shown.

8. **Similarities**—e.g., In what way cotton and silk are alike?

9. **General information**—From everyday life.

10. **Digit span**—For testing memory, digits are spoken and the subject is asked to repeat them in the same order.

11. **Digit-Symbol substitution**—A code is given and substitution is to be done.

12. **Figure analogies**

13. **Classification**—e.g., which word on the right belongs to the group on the left? Pen, table, book, stone, pencil, radio

14. **Multimental**—e.g., which one of the figures does not belong to the other four.

Development of Mental Tests

Are all persons equally intelligent? Are all the students fit for school instruction? Are all students capable of pursuing the same courses? Are all students fit for all occupations? Is it proper to educate all students in the same way?

These and various such questions have been engaging the attention of the psychologists for the past hundred years or so. Many attempts have been made to measure intelligence possessed by individuals so that necessary arrangements may be made to give them training according to their intelligence. Thanks to the ceaseless efforts of various psychologists whose standardized tests are available which can be used to measure intelligence.

Anne Anastasi observes: 'Psychological testing is a relatively young branch of one of the youngest of the sciences.'

Pre-Binet Position

One of the first problems, which stimulated the development of psychological tests, was the identification of the feeble-minded. French physician, Esqurioi was the first

person to write a two-volume work in 1828 in which over one hundred pages were devoted to feeble-mindedness.

Another French physician who made a valuable contribution was Seguin who in 1837 established the first school devoted to the education of mentally defective children. In 1848, he migrated to America where his ideas gained recognition.

The general aim of the early experimental psychologists of the nineteenth century was the formulation of generalized descriptions of human behaviour and not the measurement of individual differences. Many of the early experimental psychologists received their training in a laboratory founded by Wundt at Leipzig in 1879.

Sir Francis Galton, an English biologist, was primarily responsible for launching the testing movement on its course. In 1882, an anthropometric laboratory, was established by him in South Kensington Museum, London. In this laboratory individuals could be measured in certain physical traits by the payment of a small fee. Galton himself devised most of the simple tests. Galton also paved the way for the application of rating scale and questionnaire methods. One of his disciples, Karl Pearson carried forward his work.

James McKeen Cattell of America occupies a prominent position in the development of psychological testing. He used the term 'mental test' in an article in 1890. This article related to a series of tests which were being administered annually to college students in the efforts to determine their intellectual level. Cattell like Galton felt that a measure of intellectual functions could be obtained through tests of sensory discrimination and reaction time.

Among others, the names of Jastrow, Krae Pelin and Ferrai may also be mentioned.

Binet-Simon Test

The father of intelligence testing is Alfred Binet, a French educator. Binet disagreed with some of his contemporaries who tried to measure general intelligence by testing reaction time, rote memory, sensory activity, or muscular movements. According to him, intelligence could be estimated, only by test of higher faculties like reasoning, comprehension, judement, adaptability, persistence, and self-criticism. Binet worked on these lines and in collaboration with Thephile Simon, published the first intelligence test in 1905. This test had 30 items arranged in order of increasing difficulty. It took about 15 years to complete the test.

Binet tried out these items on children and in 1908, brought out a revised scale which divided the test items into age groups from 3 to 11 years. At some age levels, only 3 questions were asked, at others 5 or 6. With this scale, Binet introduced the concept of mental age. If a child's (whose chronological age is 8) score on a test is equal to the average score of children of 9 years of age, then his mental age will be nine in spite of the fact that his chronological age is eight.

In 1911, shortly before his death, Binet published a second revision of his scale. It omitted some old items and introduced some new ones. He also brought the scale up to adult level. In this revision, he included 5 tests for each age except the 4-year level.

Revised Test of 1916

The first serious revision of Binet-Simon Scales was prepared by Terman at Stanford University and was published in 1916. This revision introduced great many alternatives and new additions. The entire scale was restandardized on an American Sample of about 1,000 children and 400 adults. For the first time the term IQ or 'intelligence quotient' was introduced. IQ has been defined as the ratio of Mental age to Chronological age. To avoid fraction, it is multiplied by 100. Thus:

$$I.Q = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

$$\text{or simply } I.Q = \frac{\text{M.A.}}{\text{C.A.}} \times 100$$

In the 1916 revision, the number of questions was 90.

1937 and 1960 Revisions

In 1937 and 1960, the Stanford University Test was revised by Merril and Terman. It is also known as Stanford-Binet Individual Test of Intelli-gence. It contains 129 questions suitable for a child of 2 years, 2.5 years, 3 years, 3.5 years, 4 years, 4.5 years and then for 5, 6–14 years of ages. There are no questions for 5.5 as it is thought that there is not much difference in IQ of 5 years and 5.5 old child.

Wechsler Scales of 1939 and 1955

The 1937 Stanford-Binet Scale, in spite of its merits was not considered particularly well-suited for adults. It was not standardized on any individual over 18 years of age in obtaining the IQ The Wechsler Scale was published in 1939 for this purpose. The scale was revised in 1955 and a new version Wechsler Adult Intelligence Scale (WAIS) came into existence. The age ranges are from 16 to 64 years.

The Scale comprises the following sub-tests which fall under two broad categories: (a) verbal tests and (b) non-verbal tests.

- **Verbal tests:** These contain the following types: (i) vocabulary, (ii) information, (iii) arithmetic items, (iv) comprehension, (v) similarities, and (vi) digit span.
- **Non-verbal tests:** These include (i) block design (ii) picture arrangement, (iii) object assembly, (iv) mazes, and (v) picture completion.

Comparison between Binet Test and Wechsler Scale

Binet	Wechsler
1. It is primarily for children.	1. Age ranges are from 16 to 64 years.
2. It is a mental age scale. Items are grouped in terms of mental age.	2. It is a point scale. Points arc given for correct responses
3. Selection is made by relation of success by age.	3. Selection is made by function measured.
4. Items are ungraded and unrelated.	4. Items are graded.
5. The test is inflexible.	5. The test is flexible.
6. It is qualitative in evaluation.	6. It is quantitative in evaluation.

Landmarks in the Development of Testing

Robert Owen's Rating Scale	1826
Seguin's Form Boards	1842
Binet-Simon Scale	1905
Goddard Translation of Binet's Scale	1908
Courtis Practice Test in Arithmetic	1909
Thorndike Handwriting Scale	1910
Healy and Fernald Performance Test	1911
Hillegas Composition Scale	1912
Buckingham Spelling Scale	1915
Yerkes Point Scale	1915
Stanford Revision of the Binet-Simon Scale	1916
Army Group Tests, Stenquist Assembly Tests	1917
Sea shore Tests of Musical Ability	1919
Rorschach Test	1921
Strong Vocational Interest Inventory	1927
Hildreth Readiness Test	1933
Murray Apperception Test	1935
Stanford-Binet Revision Scale	1937
Thurstone Primary Abilities Test	1938
Wechsler Scale	1937
Wechsler Adult Intelligence Scale	1955
Revised Version of Stanford Binet Test	1960

1.5.1 Classification of Intelligence Tests

These may be classified under three categories:

1. *Individual tests*: These tests are administered to one individual at a time. These cover age group from 2 years to 18 years. These are: (a) The Binet-Simon Tests, (b) Revised Tests by Terman, (c) Mental Scholastic Tests of Burt and (d) Wechsler Test.

2. *Group tests*: Group tests are administered to a group of people. Group tests had their birth in America—when the intelligence of the recruits who joined the army in the First World War was to be calculated. These are: (a) The Army Alpha and Beta Test, (b) Terman's Group Tests, (c) Otis Self-Administrative Tests. Among the group tests there are two types (i) Verbal and (ii) Non-Verbal. Verbal tests are those which require the use of language to answer the test items. Non-Verbal tests do not require the use of language to respond to the item.

3. *Performance tests*: These tests are administered to the illiterate persons. These tests generally involve the construction of certain patterns or solving problems in terms of concrete material. Some of the famous tests are: (a) Kohs Block Design Test (b) The Cube Construction Tests, and (c) The Pass Along Tests.

Comparison of Individual Tests and Group Tests

Individual Test	Group Test
It is administered to an individual at a time.	It is administered to a group at the same time.
It is costly in terms of administration and time.	It is less costly in terms of administration and time.
A trained tester is required to administer it.	No trained person is required to administer it.
There is face-to-face interaction between the individual and the tester.	There is no such face-to-face interaction
Individual test is more reliable. Guidance can be provided to the individual on the basis of its results.	Group test may be influenced by several factors.
It is useful for small children.	It is suitable for older children and adults.
The tester can motivate the individual by means of praise and encouragement as he can adapt to the needs of the individual child.	It is not possible to do so.
There is very little scope for cheating.	Cheating, on a large-scale is possible.
There is no competition in individual testing.	Speed and reading ability may influence the test score.
No special formalities are observed in individual testing.	Several formalities are observed in administering.
Instructions can be made clear before testing.	A few members of the group may not clearly understand the instructions.

Measuring Special Ability

The IQ obtained as a result of performance on an intelligent test indicates general status only. It does not point to the size of strength or weakness in each of the particular mental abilities that are being measured. For example, two students showing an IQ of 120 on a particular test may have different positions on different sub-tests; one may do very well on arithmetic and poorly on vocabulary, while the other may do well on vocabulary and poorly on arithmetic; yet both score the same total.

Primary Mental Abilities Test (PMA Test)

To correct this sort of error we need tests which indicate differential success of a subject on various mental abilities. The tests of primary mental abilities prepared by Thurstone meet this need. The PMA test for ages 11 to 17 is based on the group factor theory of mental ability which postulates that intelligence is made up of certain distinct and more or less independent mental functions which Thurstone called the primary mental abilities.

The primary abilities as measured by this test are as follows:

1. Number facility
2. Verbal comprehension
3. Spatial perception
4. Word fluency
5. Reasoning
6. Rote memory

Differential Aptitude Test Battery (DATB)

Another test to measure the special abilities is Differential Aptitude Test Battery (DAT). This comprises eight tests:

1. Verbal Reasoning
2. Numerical Ability
3. Abstract Reasoning
4. Space Relations
5. Mechanical Reasoning
6. Clerical Speed and Accuracy
7. Language Usage: Spelling
8. Language Usage: Grammar, punctuation and word usage

General Aptitude Test Battery (GATB)

Another test of the differential aptitude type is the General Aptitude Test Battery (GATB), developed by the United States Employment Service. It consists of 15 tests which cover 9 factors, such as intelligence, verbal aptitude, numerical aptitude,

spatial aptitude, form perception, clerical perception, motor-coordination, finger dexterity and manual dexterity.

These sophisticated test batteries mentioned above give a much more clear picture of, what special abilities a person has than the general intelligence tests.

1.5.2 Use of Intelligence Tests

Some of the important areas in which intelligence tests may be employed are given here:

I. **Selection of students to a school:** In good schools there is always rush for admission. All the applicants though eligible for admission cannot be admitted. Intelligence tests help to meet out this difficulty.

II. **Classification of pupils:** Intelligence tests help us to make a sifting at the time of first admission to school at the age of five or six. Secondary education is the next stage where another check can be provided.

III. **Detection of superior and inferior intelligence:** Some pupils have very superior intelligence while others not. They move at different rates. All these cannot be given instruction together. Many methods have been suggested to give instruction to the superior and the gifted. Some favour complete segregation of the gifted and the superior, while others suggest that they should be taught along with the average and an enriched course of study should be prescribed for them. To quote Prof. R. R. Kumria, 'If on the other hand gems of purest ray serene' are allowed to be unfathomable caves, the blame of this criminal neglect lies at the door of the parents and teachers who are making the future generation—they should pick and choose the vanguard and the rearguard of the nation. Tarring all with the same brush is not only a psychological absurdity but a political blunder.'

Dr. Rice's classification of the Intelligence Quotient of the Indians is as under:

Classification	*Punjabi I. Q.*
Genius	165 and up
Very superior	140-165
Superior	120-140
Average	85-120
Dull	70-85
Borderline	55-70
Feeble-minded	Below 55

IV. **Selection of courses:** Different subjects require different degrees of intelligence. Some call for a higher order of intelligence and the others of a low. A nation-wide study conducted in the United States gave the following Median IQ of the High School boys in different courses:

Courses	Median IQ
Technical	114
Scientific	108
Academic	106
Commerce	104
Trade	92

Burt found the following correlation between:

Intelligence and composition	...	...	.63
Intelligence and reading	...	...	.56
Intelligence and arithmetic (Problems)	...	...	.55
Intelligence and spelling	...	...	.52
Intelligence and writing	...	...	.21
Intelligence and hand work	...	...	.18
Intelligence and drawing	...	...	.15

V. **Selection of suitable occupations:** Burt draws up the following provisional scheme for occupational classification according to the degree of intelligence they require:

Higher professional and administrative work—(IQ 150)—lawyer, physician, architect, teacher (University and Secondary).

Lower professional, technical and executive work—(IQ 130 to 150).

Clerical and highly skilled work (IQ 115 to 130)—Shorthand typist, bank clerk, salesman, electrician, nurse.

Skilled Work (IQ 100 to 115)—Tailor, dressmaker, carpenter, cashier, printer.

Semi-skilled repetition work (IQ 85 to 100)—Barber, welder, minor, painter, baker.

Unskilled repetition work (IQ 70 to 85)—Manual labour, navy groom, packer.

Casual Labour (IQ 50 to 70)—Simplest routine work

Institutional—Under 50—Unemployable

VI. **Award of scholarships:** Various public scholarships are awarded on the basis of the results secured through intelligence tests.

VII. **Determination of the optimum level of work:** The intelligence tests help to measure the student's capacity to succeed in his school work and enable the teachers to make an estimate of the mental level at which the student can be expected to work most efficiently in academic subjects. I.Q is a rough index of the probable learning capacity of the various members of the class. With the aid of this test the teacher finds it easy to adjust his methods to meet the needs of the individual.

VIII. **Assessment of teacher's work:** When the achievement of the pupils in a subject does not correspond to the scores of intelligence tests, it gives indication that the subject has not been properly taught by the teacher and properly understood by the student.

IX. **Discovery of unusual cases:** The lack of intelligence may be the main cause of abnormal behaviour. The intelligence tests help to find other cases of abnormal behaviour.

X. **Intelligence and success in college:** Gates and others think that an IQ of at least 120 is needed to do acceptable college work in a first college with an average expenditure of time and energy.

XI. **Help in diagnosis of backwardness:** Ordinary scholastic examinations fail to discover 'educable abilities'. The failure of a child in the examination is no indication that he lacks intelligence. This failure may be due to defective methods of teaching or it may be due to some temperamental or physical obstacles which might have stood in the way of the child. There may not be any fault with the intelligence of the child, only it has not been allowed to work itself out.

XII. **Evaluation of methods and materials of instruction:** Intelligence tests are helpful in evaluating the results of the experiments conducted by a school in the relative importance of the different methods of instruction, i.e. achievement obtained with different textbooks or with a certain textbook as contrasted with extensive reading material not confined to any one book.

1.5.3 Limitations of the Intelligence Tests

It would be a great mistake to think that these tests are all in all. Intelligence is not the only factor which determines the equipment of a man for the journey of life.

The first limitation of such tests is that they seek to measure intelligence which in itself is not a clear conception to the psychologists and about which they differ among themselves.

Second, intelligence is not the only factor which plays a significant role in the success or failure of a man in a particular vocation. The intelligence tests fail to measure the depth, strength and qualities of a man pertaining to his emotional stability. They also fail to measure his ethical, social and aesthetic qualities which play a significant part in the life of an individual.

Third, intelligence tests fail to take into account the environmental factors and the educational factors many a time and thus give misleading results. These tests may include material with which children of certain socio-economic groups have had more experience than those of other groups.

Precautions to be Taken

While interpreting test results, the teacher, however, should take certain precautions, namely:

1. General intelligence test, especially the group test measures ability to work with abstract ideas and their relationships. This is just one type of ability.

Thus a child who scores low on this test can do well or very well on other practical activities. Children with low intelligence should therefore be encouraged to develop and strengthen their special practical skills.

2. Verbal group test of intelligence is sufficiently dependent upon reading. So a low test score should be interpreted very carefully for a poor reader. Such a child should be tested on an individual test as well as on a non-verbal test.

3. Intelligence test results for socially disadvantaged children should be interpreted with caution.

4. The test interpreter should always keep in mind the standard error of measurement and give due allowance for it.

5. Intelligence tests leave untouched many important aspects such as interests, attitudes and motives, etc.

CHECK YOUR PROGRESS

13. What was the general aim of the early experimental psychologists of the nineteenth century?

14. Who is the father of intelligence testing?

15. List any two characteristics of group tests.

1.6 SUMMARY

In this unit, you have learnt that:

- Comprehension, invention, direction and censorship: intelligence lies in these four words.

- E.L. Thorndike defined intelligence in terms of three somewhat independent dimensions: (i) attitude, (ii) breadth, and (iii) speed.

- In ancient India, intelligence was measured through conversation, physical features, gestures, gait, speech, changes in the eye and facial expression.

- An intelligent person has the ability to adjust himself to the changing circumstances with ease, efficiency and speed. He has the capacity to assimilate ideas very quickly and clearly. He can cope with new situations very successfully.

- Logical-mathematical intelligence is the ability to calculate, quantify, consider propositions and hypotheses, and carry out complete mathematical operations.

- Intra-personal intelligence is the capacity to understand oneself and one's thoughts and feelings, and to use such knowledge in planning and directioning one's life.

- Guilford conceives of intellectual functioning as having three dimensions: (i) operations, (ii) content and (iii) products. *Operations* are processes involved in intellectual behaviour-cognition, memory, divergent thinking, convergent

thinking and evaluation. The *content* of these operations may be figural, symbolic, e.g., letters, numbers, semantic e.g., words or behavioural e.g., information about other persons, behaviour, attitudes, needs, etc. The *products* may be—units, classes, relations, systems, transformations and implications.

- The SI model has explored 150 intellectual abilities and this enables us to find out if we are paying adequate attention to each of these. If not, it explains how to improve.

- Piaget believed that schemas (cognitive structures) exist in primitive form at conception and progressively develop during the lifetime in certain systematic ways. According to him, cognitive structures contain all the necessary energy for their emergence and development without requiring some motivating force.

- Emotional intelligence and its nurturing is important as they are said to facilitate the understanding of oneself and the emotional states of others. Today, emotion based learning is said to be as important as cognitive learning.

- The theory of multiple intelligence has evolved to focus on meta cognition—that is, awareness of one's own mental processes—rather than on the full range of emotional abilities.

- Intelligence is measured through a complicated process. It involves a comparison and establishment of a relationship between C.A. (Chronological Age) and MA. (Mental Age). This relationship is expressed by the term IQ (Intelligence Quotient). When the mental age is divided by the chrono-logical age and the quotient is multiplied by 100, the result is IQ

- Verbal group test of intelligence is sufficiently dependent upon reading. So a low test score should be interpreted very carefully for a poor reader. Such a child should be tested on an individual test as well as on a non-verbal test.

1.7 KEY TERMS

- **Cognition:** It is the mental process of knowing, including aspects such as awareness, perception, reasoning and judgment.

- **Empathy:** It is the capacity to recognize and, to some extent, share feelings that are being experienced by another semi-sentient being.

- **Test:** It is an attempt to learn or prove what something is like or how it will act by studying or doing.

- **Readiness:** It includes all those preparatory adjustments which immediately precedes the action.

1.8 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The Binet's rod of mental measurement is an instrument for the teacher to find out the exact calibre of the minds of his pupils.

2. A. Binet (1905), a French psychologist, was the first to take interest in intelligence. He defined intelligence as the ability of an individual to direct his behaviour towards a goal, to make adaptation in his goal-oriented behaviour when necessary, to know when he reached the goal.

3. Thurstone defined abstract intelligence as the 'ability to understand and manage ideas and symbols, such as, words, numbers, chemical or physical formulas, legal decisions, scientific principles and the like…'.

4. The various types of intelligence are: Naturalist intelligence, existential intelligence and linguistic intelligence.

5. L. L. Thurstone, an American psychologist, propounded the group factor theory of intelligence.

6. The statistical techniques developed by Thurstone are his most enduring contribution to psychology.

7. Guilford conceives of intellectual functioning as having three dimensions: (i) operations, (ii) content and (iii) products.

8. The important concept of Piaget's theory of cognitive development is not the age at which the child moves from preferred mode of response to another but the fixed progression from one stage to another.

9. The law of associative shifting indicates that the position of the responses of the learner shifts. This shifting is done in respect of the basic stimulus or some related associative stimulus.

10. Emotional intelligence and its nurturing is important as they are said to facilitate the understanding of oneself and the emotional states of others.

11. The theory of multiple intelligence was developed by Howard Gardner Professor of Education at Harvard University.

12. The theory of multiple intelligence has evolved to focus on meta cognition—that is, awareness of one's own mental processes—rather than on the full range of emotional abilities.

13. The general aim of the early experimental psychologists of the nineteenth century was the formulation of generalized descriptions of human behaviour and not the measurement of individual differences.

14. The father of intelligence testing is Alfred Binet, a French educator.

15. Two characteristics of group tests are as follows:
    - In all group tests, the items are placed together in separate sub-tests or parts, beginning with the easier and progressing by intervals to the most difficult.
    - Every group test is standardized for a special range of ages or school grades.

1.9 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the different types of intelligence?

2. Define 'multiple intelligence'.

3. Write a short note on Thurstone's theory of intelligence.

4. What are the educational implications of the SI model?

5. What are the advantages of the intelligence tests?

Long-Answer Questions

1. Describe Gardner's theory of multiple intelligence.

2. Write a detailed note on emotional intelligence.

3. Give a detailed account on the Piaget's theory of intelligence.

4. Draw a comparison between Binet Test and Weschsler Test of Intelligence.

5. Explain the concept of intelligence tests and their usage.

1.10 FURTHER READING

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UNIT 2   NATURE AND SCOPE OF CREATIVITY

Structure

2.0 INTRODUCTION

McKinnon defines creativity as 'a process extended in time and characterized by originality and realization'. The other writers consider it useful to distinguish between creative behaviour and original behaviour. Original behaviour is considered that which is comparatively less frequent and uncommon in the given conditions and is typical in those conditions. In this way, the definition of originality is easily translated in behavioural language and is studied in connection with the solution of problems.

On the other hand, creative behaviour is that which is visible to those productions that are considered creative by the associated judges. According to Frank Barron, the making of thoughts is the most common instance of psychic creation. Barron considers the rare contributions as 'creative instances a stronger sense of the term; they not only are the result of creativity but they themselves in turn create new conditions of human existence'. The theory of relativity, according to Barron, 'was such a creative act, and so was the invention of the wheel ... both resulted in new forms of power and human life was changed, thereby'.

J. E. Drevdahl defines creativity as the 'capacity of a person to produce compositions, products or ideas which are essentially new or novel and previously

unknown to the producer.' According to Wilson, Guilford and Christensen, 'the creative process is any process by which something new is produced—an idea or an object including a new form or arrangement of old elements, the new creation must contribute to the solution of some problem'. This unit discusses the concept of creativity and its major aspects and deals with the necessity of creative problem solving methods.

2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Define and explain the concept of creativity
- Discuss the major aspects of creativity
- Evaluate the need to foster creative thinking process
- Discuss how to discover creative potentialities and teach for creativity
- Explain the process of problem–solving and associate problem–solving with the creative process

2.2 CREATIVITY

Creativity can be described as the capacity or ability of an individual to create, discover or produce a new, novel idea or objects, including the rearrangement or reshaping of what is already known to him, which proves to be a unique personal experience. The whole difference between construction and creation is exactly stated by Charles Dickens: 'A thing constructed can only be loved after it is constructed; but a thing created is loved before it exists.'

The term 'creativity' has been defined in the following ways:

According to Spearman, 'Creativity is the power of the human mind to create new contents by transforming relations and thereby generating new correlates.'

According to Drevdahl, 'Creativity is the capacity of a person to produce compositions, products or ideas, which are essentially new or novel and previously unknown to the producer.'

According to Berlett, 'Creativity is an adventurous thinking or a getting away from the main track, breaking out of the mould, being open to experience and permitting one thing to lead to another.'

According to David Ausubel, 'Creativity is a generalized constellation of intellectual abilities, personality variables and problem-solving traits.'

According to Wallach and Kogan, 'Creativity lies in producing more associations and in producing more that are unique.'

According to Wilson, Guilford and Christensen, 'The creative process is any process by which something new is produced an idea or an object including a new form or arrangement of old elements. The new creation must contribute to the solution of some problems.'

According to Stein, 'Creativity is a process which results in novel work that is accepted as tenable to useful or satisfying a group of people at some point of time.'

According to M. J. Levin, 'Creativity is the ability to discover new solutions to problems or to produce new ideas, inventions or works of art. It is a special form of thinking, a way of viewing the world and interacting with it in a manner different from that of the general population.'

According to Paplia and Olds, 'Creativity is the ability to see new things in a new and unusual light, to see problems that no one else may even realize exist, and then to come up with new unusual, and effective solutions.'

Some of the above definitions consider creativity to be purely a function of the mind, a component of the cognitive behaviour, some maintain it to be an attribute of the person, a whole. Some opine that besides being novel, a creative product must be useful from the cultural and social angles. From the analysis of all definitions, creativity can be described as 'the ability to discover or produce a new idea or object, which includes the rearrangement of what is already known'.

Concept of Creativity

Every person thinks in terms of different levels of creativity, and thus, the word 'creativity' remains surrounded by a great deal of confusion. Since a person can behave creatively in many ways, it is not strange that there are many definitions of creativity, but there is no universally accepted definition of creativity.

To give a bird's eye view of the overall function of creativity, its definitions may broadly be divided into five groups. These are as follows:

(i) **Creativity as a talent:** Carl Roger defined the creative process as an action of the rational and novel product. Rhodes defined creativity as a process and a talent found in some individuals.

(ii) **Creativity as a process:** Maslow stated that creativity is a process which is preconscious rather than conscious and included elements of the checking and corrective process. Tayler Chamber described creative thinking as a process which has been considered as bipolar in which the interaction between the person and the environment will be studied.

(iii) **Creativity as novel idea:** Thurston, Stein, and Raina described creativity as a novel idea. Creativity involved responses to that of novelty, statistically frequent to some extent of adoption. It is concerned with something, which is new rather than unexpected or nontraceable.

(iv) **Creativity as a new thinking:** Getzel held the view that creativity consisted of two important components, i.e., convergent thinking and divergent thinking. Convergent thinking refers to intellectual ability whereas divergent thinking refers to the method adopted by individuals to attain their goals and objectives. Torrance described creative thinking as the capacity of sensing the gaps in missing elements, identifying the difficulties, searching for solutions, formulating hypotheses, testing and retesting them and finally, communicating the results.

(v) **Creativity as the capacity to solve problems:** Kilpatrick defined creativity as a problem-solving method. According to him, it is the best method to solve the problems or our daily life. Similarly, according to Guilford, creativity is essentially a problem-solving method.

2.2.1 Creative Performance

A.T. Kearney identified that firms engaged in comprehensive and creative performance measurement realized improvements in overall productivity in the range of fourteen to twenty-two per cent. Taking into consideration the present global competitive scenario, improvement of productivity and profitability on a continuous basis are the order of the day for survival.

This is the reason proactive and progressive corporate enterprises are always concerned about performance measurement. It helps them not only to improve productivity and profitability but also ensures efficiency and effectiveness in utilization of resources for maximization of customer value by shared value.

As there is enough scope for improvement in productivity and profitability, creative managers and researchers are always striving for collection, analysis, and interpretation of qualitative information to measure and compare in order to give the right direction. They develop and redefine a comprehensive performance measurement system to monitor, control, and direct total operations on a continuous basis by incorporating the entire system.

Hence, the scope of performance measurement systems ranges from all activity-based measures to entirely process-based measures. There are three dimensions of creative performance measurement. These are:

1. **Internal performance measurement**: It refers to a comparison of the present level of processes and activities or goals with the previous operations or goals. These measures enable the management to locate the existing gaps and identify deviations in the actual performance in order to meet current and future requirement. There are five broad categories of measuring performance:

   (i) Cost

   (ii) Customer value and service

   (iii) Asset management

   (iv) Quality

   (v) Productivity

   (vi) Control of finance

2. **External performance measurement**: It refers to visualizing from the point of view of the competition and customers. It is necessary to monitor, understand, and maintain the performance to keep the customer happy and loyal as well as remain on competitive terms in the market. Thus, external performance measures involve two major aspects:

   (i) Customer performance measurement

   (ii) Competitive performance measurement

3. **Comprehensive performance measurement**: In recent times, there has been significant increase in focus on performance measurement that offers an integrated perspective. Without an integrated performance measurement system, it is not possible to achieve the corporate objective of maximization of value to all stakeholders and there is every possibility of gaps in it.

For instance, the manufacturer may measure her/his quality as the ability to ship when ordered, while the wholesaler may measure it as the ability to ship when promised. To bridge the gap, a growing number of enterprises are realizing the need for strategic sourcing. That is why the contribution of the sourcing function has increased dramatically in recent years for managing it effectively, because it improves service levels and simultaneously, reduces costs. The need to control and manage costs has become more crucial as suppliers account for higher percentage of a finished product's value.

While developing an integrated performance measurement system, a consortium of firms, universities, and consultants proposed a common framework. The integrated framework incorporates four types of matrices, namely, customer satisfaction/quality, time, costs and assets, which monitors both outcomes and diagnostics for effective performance management. The focus of outcome measure is on the overall process results in terms of customer satisfaction and time management process, whereas diagnostic measures deal with specific objectives within the process.

Despite these bottlenecks in the development and implementation of an effective creative performance measurement, it has become a compulsion for almost every leading firm all over the world. It provides a strategic framework for assessment of a firm's status about competitive position, distinctive capabilities, resource utility, and supply chain collaboration. Most of the progressive and proactive firms view enhancement measurement as a prerequisite to outstanding performance. Consequently, they make investment in comprehensive creative performance measurement programmes that:

(i) Create competitive power because they lead to better decisions and more appropriate behaviour

(ii) Create accurate, detailed, relevant and timely information accessible to the manager for strategic planning and everyday decision-making

(iii) Track a broad range of measures from all supply chain areas, namely, costs, asset management, productivity, service, and the quality

(iv) Create employee metrics that are easily understood by everyone

(v) Create visible trade-off and transparent processes

(vi) Incorporate customer-centric and process-oriented measures

(vii) Create alignment with both corporate strategy and customer expectations

(viii) Document the progress that is being made and that drives learning

(ix) Facilitate the bench-marking and adoption of best practices, wherever they are found; a creative performance measurement system refers to

create, innovate, research, monitor and control the total operations on a continuous basis as well as incorporating the entire process as an integrated system.

2.2.2 Nature of Creativity

Creativity may be said to possess the following characteristics:

- Creativity is universal and not confined to any individual groups, caste, age, location or culture. Every person is capable of demonstrating creativity to some degree.
- Creativity is innate as well as acquired. It is a natural endowment and also influenced by the cultural background, experiences, nurturing.
- Creativity implies the ability of a person to produce something new. It should not be repetition or reproduction or what the individual has been experienced.
- Creativity encourages complete freedom to express a multiple response and action. It is a kind of adventurous thinking.

CHECK YOUR PROGRESS

1. How does M. J. Levin define creativity?
2. What is the difference between convergent and divergent thinking?
3. What four matrices does a common framework for an integrated performance measurement system incorporate?

2.3 MAJOR ASPECTS OF CREATIVITY

Creativity, as Rock, Evans and Klein put it, may be satisfactorily investigated by adopting the following three basic approaches, namely:

 (i) Creativity as a process
 (ii) Creativity as a product
(iii) Creativity as an attribute of one's personality, or creative person

2.3.1 Creative Process

Many psychologists and scholars have studied the creative process in an effort to understand it. Let us summarize some of their findings:

Wallas described the creative process as consisting of four stages:

(a) Preparation
(b) Incubation
(c) Inspiration or illumination
(d) Verification or revision

In the first stage—preparation—the conscious work on the problem is initiated and continued as long as possible. Initially, the problem is defined or analysed and the stage is set for its solution. The facts and materials relevant to the solution are then collected and examined, and the plan of action is formulated.

Then, we start working on the set plan. In between, if essential, the plan of action is modified; we switch over to another method or take the help of other relevant data if those in hand fail to help us. In this way, a continuous and persistent effort is made. In case it appears at some point that we cannot solve the problem, frustration leads us to set the problem aside for the time being.

This kind of deliberate or voluntary turning away from the problem is the beginning of the second stage, i.e., incubation. This stage is characterized by the absence of activity, or in many instances, even of thinking about the problem. We may rest, sleep or engage in other interesting activities. If this is done, ideas which were interfering with the solution of the problem tend to fade. In the absence of such interference, our unconscious begins to work towards finding a solution of the problem, and sometimes, the things we experience or learn in the meantime may provide a clue to the solution (Archimedes found the solution of his problem when he was in his bathtub).

The stage of inspiration or illumination follows. During this stage, the thinker is often presented with a sudden appearance of the solution of his problem. Such illumination may occur at any time, sometimes even while the thinker is dreaming.

The final stage—verification or revision—comes next. During this stage, the illumination or inspiration is checked out to determine whether the solution or idea which appeared through insight is, in fact, the correct one. In case it does not work out, fresh attempts are made to solve the problem. Sometimes, the earlier solution needs slight modification or change to become workable. The creative thinker does not, at any stage, accept a solution as perfect and holds it open to modification or revision in line with subsequent findings.

Rosman mentioned the following stages in the creative process:

- Observation of a need or difficulty
- Analysis of the need
- Survey of all the available information
- Formulation of all the objective solutions
- Critical analysis of these solutions
- Birth of a new idea—the invention
- Experimentation to test the most promising solution, and selection and perfection of the final embodiment by some or all of the previous steps

Torrance and Myers have defined the creative process as consisting of the following stages:

- Becoming sensitive to or aware of problems
- Bringing together viable information

- Searching for solutions
- Communication of the results

Stein has attributed the following stages to the creative process:

- Preparation or education
- Hypothesis formation
- Hypothesis testing
- Communication of the results

However, the stages mentioned by each of the different scholars should not be considered to be rigid and fixed stages followed every time by every creative thinker. One person may arrive at the solution of the problem before experiencing all the previous stages. Another person, on the other hand, may not find the solution even after passing through all stages of the creative process, and may need to repeat the cycle several times before producing anything creative or arriving at an acceptable solution of the problem.

2.3.2 Creative Product

Creativity is investigated, understood and identified through the outcome of the process of relation or the creative products. How creative one is can thus be determined through one's output in the form of ideas, works of art, scientific theories, or even building designs. However, for a product to qualify as creative, certain minimum criteria must be met. Telford, Sawrey, and Mackinnon have proposed originality or novelty and relevance or appropriateness as the two main criteria for judging a creative product.

However, according to these authors, originality or novelty of a product should not be judged independent of the second criterion of relevance or appropriateness. To be relative, a so-called original or novel creation must fit or be useful within its relevant context. It must demonstrate proper relevance to a problem, situation or goal including the purposes of its creator.

In addition to these necessary and essential conditions, a creative product must also fulfill the following conditions:

(a) It must be aesthetically pleasing and give joy and satisfaction to the producer as well as the user.

(b) It should provide new perspectives in some areas of human experience and create new conditions of human existence.

2.3.3 Creative Attribute or Creative Person

Not all individuals are creative. One needs to distinguish between different personality types to differentiate between the creative and the non-creative. Various researchers have done their research on different personality traits and the qualities that set the creative person apart from the non-creative. Some of such researchers of behavioural studies include: Cattell (1968), Torrance (1962), MacKinnon (1962), and Foster (1971). The most common personality traits of a creative person include:

- Originality (of ideas and expression)

- Adventurous persona

- Good memory and a sense of enthusiasm and awareness

- Foresight

- Team spirit

- Decision making

- Interest in vague ideas

- A high degree of sensitivity towards problems

- Eloquence and versatility

- Flexibility

- Ability to use the acquired knowledge to implement plans

- Creative bent of mind

- Diversity of thought and action and the ability to come out of stereotype situations

- Confidence to take up and complete the assigned task

- Calm and relaxed outlook

- High aesthetic values

- Self-respect, self-discipline and a keen sense of justice

- Ebullience

- Awareness of obligations and responsibilities

- Ability to accept tentativeness and tolerate and integrate the opposites

- The capacity to fantasize and daydream

2.3.4 Relationship between Creativity and Intelligence

Most of us have a general concept of what intelligence is but, similar to the intangible concepts of happiness and love, our personal definition of intelligence is influenced by our own understanding of the concept.

We tend to define intelligence in many ways. Some common notions associated with intelligence are:

- The capacity to learn

- The faculty of understanding

- An aptitude in grasping tasks

- General knowledge and wisdom

- The ability to reason

- Mental agility and quick cognitive response

Creativity is another term influenced by our own viewpoint of the world and is open to personal interpretation. However, the term itself is usually described as one's ability to think of original ideas and concepts. Man has devised a number of

instruments to try and test for intelligence. The most notable of them is the IQ test. Creativity has proven to be comparatively harder to test and hence, there are fewer scientific testing instruments to check creativity.

Around the 1950s, scientists began trying to find a link between creativity and intelligence, but all the published correlations between the two concepts were low enough to justify treating intelligence and creativity as distinct cognitive attributes. From long discussions of the use of various tests and inventories for measuring and assessing the mental level of children and adults coming from different environments, the impression probably is that the mental level of an individual in terms of IQ can be determined and that intelligence can be measured.

CHECK YOUR PROGRESS

4. What are the four stages of creativity according to Wallas?
5. What, according to Wallas, leads to the incubation stage in the creative process?

2.4 NEED TO FOSTER CREATIVE THINKING PROCESS

Thinking is the ability to think and judge what we have to do and the way to do it. It is an intellectually disciplined process of actively and skillfully conceptualizing, applying, analysing, synthesizing and/or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

Thinking is all about conditioning. There is no right or wrong way to think, it primarily depends on individual goals. If you really want to change the way you think, it boils down to conditioning. If you feel yourself starting to think negatively, immediately acknowledge that you are thinking negatively and turn your thoughts to positive things. It is also a good idea to assign triggers of some sort to your thinking.

Thinking is the systematic transformation of mental representation of knowledge to characterize actual or possible states of the world, often in service of goals. A mental representation of knowledge is an internal description that can be manipulated to form other descriptions. To count as thinking, the manipulations must be systematic transformations governed by certain constraints. Whether a logical deduction or a creative leap, what we mean by thinking is more than unconstrained associations.

Thinking is a cognitive process. It constitutes a blend of both perception and imagination. Without a clear concept of things in our mind, we will fail to think about them. Though both thinking and imagination are mental activates, they are not identical. Thinking is a mental exploration. It starts with some problem for which a solution is sought, the search being mental and not psychical. If, for example, the

problem is one of arranging furniture in the room, there is nothing to be explored. Thus, this requires imagination and not thinking.

However, if for some reason, the person is incapable of setting the furniture, the problem of finding someone else to do so will arise. This act of finding some other person will require the activity of thinking. Many doubts may occur in the person's mind when selecting the best person for arranging the furniture, and to reach this decision, he examines the merits and demerits of other people. While coming to the conclusion, he is compelled to use not only his imagination but also perceptions, signs, language, and concept.

Thus, imagination is mental manipulation, while thinking is mental exploration. Both have dissimilar instruments and use. Imagination is free, while thinking is a controlled mental activity. Imagination results from a free association of thoughts and images but this association is controlled in the activity of thinking. Thinking is the search of solutions to problems. Even though imagination has some aim, it generally gives little assistance in the solution of problems. Thinking can take place without images and verbal symbols but not imagination. Thus, thinking is at a higher level than imagination. C. W. Valentine has termed thinking as the connected flow of ideas towards an objective.

Woodworth has termed the following five elements of the thinking process as mandatory:

  (i) Objective inclined

 (ii) Efforts for achievement of objective

(iii) Recall of prior facts and experiences

(iv) Planning of prior experiences in a new form

 (v) Mobility of internal language and various images

Famous psychologist James S. Ross has described thinking in his famous book the *Groundwork of Educational Psychology* as follows:

Many writers limit the word 'thinking' by higher mental activities that are found only in man, but this limit appears to be unwanted. There is no new mystery in higher levels that is not included in the less higher mental activities. So, it seems appropriate that a very general definition be made of thinking, for example, 'a mental activity in its cognitive form', or 'a mental process form the viewpoint of mind-based things', though these may not exist in the external world. We can differentiate in that condition, not in the various methods of thinking, but in those different levels that are decided by the nature of cognitive things.

The first level is that of perceptual thinking, which is often defined as 'a mental activity present with the sense organs and the thing affecting it'. However, we should keep in mind that the subject of thinking here is not a thing of the external would but a thing produced by it that is related to the mind. The relation between them is complex and unclear. We cannot keep any physical thing within our minds and examine it.

For example, when someone looks at a pen, it is not the pen that is the object of thinking, but the ether waves come towards the eye resulting in physical and chemical processes and leading to the flow of tissue-based waves in some area of the brain that is reactivated. When the mysterious gap between physical and mental worlds is filled, the object of thinking or the mind-based thing comes in the mind.

This mind-based thing, arising as a result of stimulation of sense organs, is called sensation. It may be seen as a symbol of an external thing, but is not the thing in itself. Again, a 'sensation' is a pure objective imagination, because it is only an aspect of a cognitive thinking. The psychologists described, in the efforts of analysing consciousness, sensation as the final mental element, and the mind was said to be the base of sensations.

In doing so, however, they forgot about the necessary activity of the thinking process. Thus, we should emphasize the point that cognitive thinking is the mind-based activism from the viewpoint of sensation, which has no existence beyond activism.

Types of Thinking

Thinking is of various kinds. Given below are the three most common types of thinking processes:

  (i) **Perceptual thinking:** The chief basis of this thinking is direct perception. This is the lowest level of thinking that is found in infants and animals.

 (ii) **Imaginative thinking:** In this level, no thing or condition is directly present. Lacking perception, this thinking works on the basis of memory.

(iii) **Conceptual thinking:** It is the thinking of the highest order and is based on concepts. It comes after direct perception. In this type of thinking, language is not considered significant.

Tools of Thinking

The means used in thinking are known as the tools of thinking. These tools are mainly the following:

  1. **Objects:** Direct perception is necessary for the thinking of the lowest order and for this, the stimulus should be in the form of a thing.

  2. **Images:** The refuge of images in artistic thinking is necessary.

  3. **Concept(s):** A concept is the basic tool of conceptual thinking. Thus, students should form concepts carefully.

  4. **Symbols and signs:** Symbols have their own significance in high-order thinking. Signs of addition, subtraction, multiplication, and division, the symbols of absent things, the signs and pictures on roads all provide the basis of high-order thinking.

  5. **Language:** Language is another important means of thinking. Better the knowledge of language, the higher the quality of thinking.

Nature of Thinking

The mental solution of problems requires the use of symbols instead of objects. Thinking involves the solution of problems by trial-and-error method. There is a kind of flow in the activity of thinking, one problem leading to the thinking of another by reminding the person of the other problem. Thus, many things come to the thinking mind. The instruments of thinking—images, imagination, signs and indications—are internal. Thinking continues to be an internal activity unless and until it takes the form of verbal thinking.

2.4.1 Instruments of Thinking

Thinking calls for the assistance of percepts, images, concepts, signs and formulae, of which it makes abundant use. Following are the essential instruments of thinking:

(i) **Perception:** Percepts are important factors in thinking and affording material to it. They also stimulate thinking. Suppose you see your friend stealing something. This perception will set you thinking in order to discover ways and means of presenting the friend from this negative act. Many other percepts will assist in this thinking.

You will, with the help of memory, try to recall the perceptions of past behaviour of your friend in order to see the causes which may have set her/him on this path in the hope of discovering ways and means that may be expected to cure him.

(ii) **Image:** Image is another kind of symbol that includes faint recollection of perceptions. Past experiences of an individual move around in her/his mind in the form of images. Images may be recalled through a conscious effort but they also flash in the mind involuntarily.

Many experiments have indicated that images are not quite as essential to thinking as they were previously considered to be. The use of images in thinking depends on small measures influencing the method of thinking, which the individual employs.

Some people use other symbols of thinking instead of images. It is not essential that a singer must have auditory images in order to be good. Thinking, in philosophy and political science, makes better use of words than images. Similarly, subjects like arithmetic make very infrequent use of images. Sometimes, a person experiences difficulty in making the other person comprehend his thoughts just because they differ in their ways of thinking.

(iii) **Concept:** Concepts are abstract forms of past experiences. A concept is a general idea and, as the example makes clear, is founded upon perception. The concept of humanity cannot be formed without the perception of human beings, as humanity is the common element in the perception of human beings. An abstraction of humanity from human beings is necessary in order to proceed from perception to concept.

Concept formed with the help of abstraction is mental. Concepts extend the limits of thinking to include both the past and the future. Reasoning cannot be done without concepts that are not abstract and general. These are the indispensable elements of thinking. Classification of objects is done on the basis of concepts. While it differentiates between various classes of objectors and creatures, it also shows a similarity between an individual of the same class. Conceptual thinking takes place through a few concepts.

Thus, concepts are the symbol of many objects. However, all concepts are not equally extensive. For example, a creature is more comprehensive than human beings, which, in turn, is more comprehensive than Indians, because Indians are included in human beings, who are included in creatures.

(iv) **Symbols:** Concepts mainly make use of symbols in thinking. These symbols are representatives of general thoughts. Whenever our thoughts turn to human beings, the human figure, which occupies our mind is a general figure, not that of any specific person. For instance, a simple image of a dog is a symbol of dogs in general. One or 1 is a symbol of unity while two or 2 symbolizes dualism. The sound of a whistle may be the symbol of a policeman or a watchman. The noise of a fire engine is the symbol of fire. Thus, the use of symbols in thinking saves time and energy.

(v) **Sign:** Symbols and signs are intimately related. Symbols change to sign. In daily behaviour, symbols are used extensively in the form of signs. The whistle of the watchman is a sign of his presence. To be evolved, it is essential to keep an eye on the various aspects of problems and their mutual relationships. This too, needs a developed and mature level of wisdom.

(vi) **Incubation:** Another factor that favours thinking is incubation. If the solution of some problem proves elusive despite strenuous and persistent effort, it is advisable to lay the problem aside and involve oneself in some other activity. While if someone is engaged elsewhere in another activity, the mind ponders over the earlier activity as it has evolved through pondering in that manner.

Nothing definite has come to knowledge about the process of incubation, but it is common experience that if the problem is left in its original state, the solution often comes suddenly or at least, its solution is facilitated when it is taken up again. However, incubation proves advantageous only when the problem is set aside after it has been fully thought over.

Incubation does not imply running away from the problem or avoid collecting adequate material for the problem, because in that case, incubation would prove useless.

2.4.2 Elements Which Obstruct Thinking

Thinking is a mental process that requires alertness, flexibility and motivation, besides a wide range of wisdom. There should be voluntary or independent reasoning in this process. If these factors are absent, or if the opposite conditions are present, thinking

will be adversely affected or hindered. Following are the prominent factors that hinder thinking:

(i) Emotion: Emotions hinder thinking because strong emotion disturbs the mental equilibrium and thereby obstructs thinking. Even if thinking is pursued in an emotional state, it will be extremely one sided and biased. It is not uncommon that people cannot think when they are excited by emotions like anger, sex, fear, hatred, and love. If the emotions are very faint, the speed of thinking will be augmented instead of being hindered. However, for correct thinking, it is better to have control over the emotions

(ii) Suggestion: Suggestion also obstructs thinking because it makes it one-sided. Thinking moves along the path suggested. If, for example, someone is told that he will not live for any length of time and will cease to survive, his thinking will be badly effected, and this might result in him becoming a pessimist. However, it is not essential that suggestions are invariably harmful to thinking. Healthy suggestions can assist thinking. Self-control strengthens self-confidence and assists in thinking about the solutions of problems. Absence of suggestion is, however, considered desirable in pure thinking.

(iii) Prejudice: Prejudice, like the two aforesaid factors has a detrimental effect on thinking, the only point of distinction being the extent of damage (which is more in this case than in the two cases discussed earlier). The word 'prejudice' suggests the meaning, namely some preconceived idea. If we have already accepted some particular person as our benefactor, any harm that she/he may infect upon us will be attributed to some other person without casting any doubt on this person.

The same applies to prejudice, which we may have about some occupations because even if they are suitable, we do not spare a thought when confronted with the choice of one of those professions because we shall ignore their advantages and common disadvantages. It is obvious from these examples that when prejudiced, thinking becomes partial and incorrect. Pure thinking requires the elimination of all prejudices in thinking.

Beside the hindering factors detailed above, there may be many other allied factors, such as ignorance about the laws of logical thinking and defects in personality that influence thinking. If a person has to think correctly and conclusively, he must have some other qualities of mind besides the absence of these hindering elements.

CHECK YOUR PROGRESS

6. What is meant by perceptual thinking?
7. Name the three types of thinking processes.
8. What method is involved in thinking to arrive at a solution for a situation or a problem?

2.5 DISCOVERING CREATIVE POTENTIALITIES AND TEACHING FOR CREATIVITY

Although every one of us in endowed with some aspects of creativity, its distribution is neither equal nor universal and some individuals remain with greater creative potential than others. How can such high creative talent be recognized? In this regard, researchers have established that creativity is not necessarily accompanied by a high level of intelligence. Guilford has clearly made the distinction by proposing the concept of convergent and divergent thinking, the latter being closely associated with crate thinking. Similarly, Getzels and Jackson successfully argued that creativity was independent of IQ, especially at the upper levels.

Therefore, a genius or a gifted person may not have a high IQ as creativity, in its many shapes and forms, is an expression of giftedness and not of a high degree of intelligence. How can the creative individual then be identified?

Behaviour is expressed through its conative, cognitive and affective components, and creative behaviour is no exception. Consequently, an individual is creative to the extent that he can demonstrate creative potential in his thinking, actions and feelings. For a total assessment of creative behaviour, we have to apply a multi-dimensional approach involving the use of the available creative tests and the multiple non-testing devices like observation, interview, rating scale, personality, inventory, situational test, interest inventories, attitude scales, aptitude tests, value schedules and projective techniques. The characteristics and personality traits of a person may provide reliable indications for the identification of creative potential which may be further verified by comparing the performance with standardized creativity tests.

2.5.1 Creativity Tests

Creativity tests may be used in the identification of the creative in the same way as intelligence test is used for the assessment of intelligence. There are many standardized tests available for this purpose.

A list of standardized tests abroad is as follows:

- Minnesota Tests of Creative Thinking
- Guilford's divergent thinking instruments
- Remote Associates Tests (RAT)
- Wallach-Kogan Creativity Tests
- AC Test of Creative Ability
- Torrance Tests of Creative Thinking (TTCT)

A small list of standardized tests in India is as follows:

- Baqer Mehdi's Verbal Test of Creative Thinking (Hindi/English)
- Passi's tests of creativity

- Sharma's Divergent Production Abilities Test (DPA)
- Saxena's tests of creativity

Creativity is a complex blend of a number of abilities and traits, and hence, all the creative tests mentioned above attempt to measure several dimensions of one's creative behaviour through their test items, verbal and non-verbal. The factors or dimensions of creativity commonly measured through these tests are:

    (a) Fluency

    (b) Flexibility

    (c) Originality

    (d) Unusual responses

    (e) Resistance to premature closure

    (f) Elaboration

Let us now try to illustrate components and functioning of the creative tests with the help of two creative tests, one developed abroad and the other in India.

(i) Torrance Tests of Creative Thinking (TTCT)

Creativity tests developed by the American psychologist Ellis Paul Torrance cover both verbal and non-verbal activities performed by the subjects; and is claimed to be successfully used from kindergarten to graduate schools. For testing the non-verbal performance, Torrance developed Torrance Test of Creative Thinking (figural forms A and B), and for the verbal performance, the Torrance Test of Creative Thinking (verbal forms A and B). Form B is the equivalent alternative of Form A in these tests.

The figural forms (employed as a non-verbal testing device) make use of tasks that require drawing and pasting. The activities required in the non-verbal sub-tests are of the following nature:

- **Figure of picture completion test:** In this sub-test, there are some incomplete figures (as shown in figure 2.1). The subject is asked to complete these figures by adding new dimensions or lines for providing new ideas. He is also asked to give suitable titles for the completed figures or pictures.

- **Picture or figural construction test:** In this sub-test, the subject is provided with a piece of coloured paper cut in a curved shape and is asked to think of a figure or picture of which this piece of paper may be a part. He is allowed to add new ideas to make this figure as interesting and meaningful as possible. He is also asked to provide a suitable title for this figure or picture.

- **Parallel lines test:** In this sub-test, there are several pairs of straight lines. The subject is required to draw as many objects or pictures by using each pair. He is also asked to provide a title for each of his drawings.
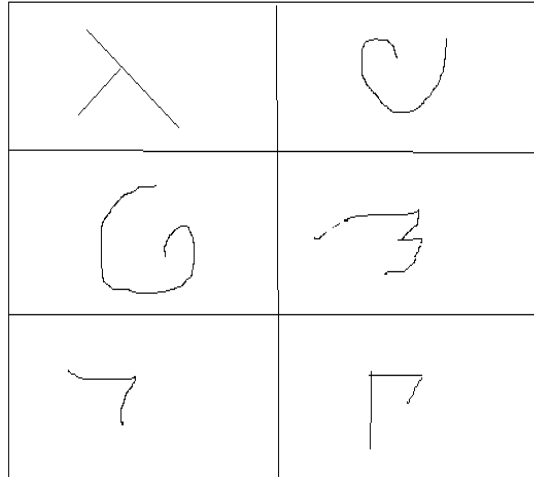
Fig. 2.1 *Sample Items from Torrance Tests of Creative Thinking (Figural Form)*

The verbal forms (employed as a verbal testing device) incorporate tasks which require the use of language. The subject is required to provide written responses to the questions put to her/him. The verbal activities asked to be performed are of the following nature:

- **Asking type:** In these types of activities, the subject is encouraged to reveal his ability to perceive all things which are not normally perceived by others. The help of some pictures may be taken for this purpose. In these activities, the subject may also be asked questions that would enable him to fill in the gaps in his knowledge.

- **Guess causes and guess consequences type:** Both these guessing activities are aimed at revealing the subject's ability to formulate hypotheses concerning cause and effect. While being presented with a picture, the subject may be asked to guess what lies behind the situation in the picture and what its consequences may be.

- **Product-improvement type:** In these activities, the subject is asked to suggest ways and means of improving a toy, a machine or some other such product to make it as interesting and useful as possible.

- **Unusual uses type:** These devices are meant to test the subject's divergent thinking about the number of ways in which a product may be used. Here, the subject has to enumerate as many unusual uses as she/he can think of, for instance, in how many unusual ways can knife or brick be used?

- **Unusual questions type:** In these activities, the subject is required to ask as many unusual questions as she/he can about a picture, scene or verbal description.

- **Just suppose type:** In these activities, the subject is required to predict the outcomes of the creative abilities such as originality, fluency, flexibility and elaboration. An overall high score on the various sub-tests of the Torrance Creative Test gives the tester an idea of the overall creative

potential of his subject. However, for a more reliable and valid appraisal of creative potential, one has to take recourse to other non-testing devices and personality assessment measures.

(ii) Baqer Mehdi's Verbal and Non-verbal Tests of Creativity

This test, developed by Baqer Mehdi, consists of four verbal and three non-verbal sub-tests. The verbal and non-verbal forms are also available separately. Details of some of these tests are given below:

- **Consequence test (time allowed: twelve minutes):** For the following situations, think as many consequences as possible:
  1. What would happen if man could fly like the birds?
  2. What would happen if our schools had wheels?
  3. What would happen if man did not have any need for food?
- **Unusual uses test (time allowed: fifteen minutes):** Write as many novel, interesting and unusual uses for objects as you can think of, viz., a piece of stone, a wooden stick, water.
- **New relationship test (time allowed: fifteen minutes):** Think of as many relationships between the following pairs of words as possible:
  1. tree, house. 2. chair, ladder. 3. air, water.
- **Product improvement test (time allowed: six minutes):** Suppose you start with a toy horse. Think of as many new things or features to make it more useful and interesting.
- **Picture construction test (time allowed: twenty minutes):** In figure 2.2, there are two simple geometrical figures, viz., a semicircle and a rhombus. You have to construct and elaborate pictures using each figure an integral part. For each picture, you have to give a separate title.

(a)   (b)
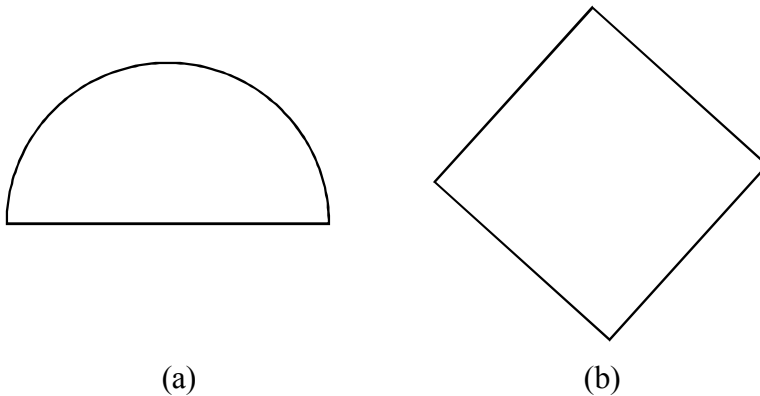
Fig. 2.2 *Creativity Picture Construction Test: (a) A semicircle, and (b) A rhombus*

- **Line figures completion test (time allowed: fifteen minutes):** Ten incomplete line drawings are shown in figure 2.3. You are required to draw meaningful and interesting pictures using each of them and also give appropriate titles.
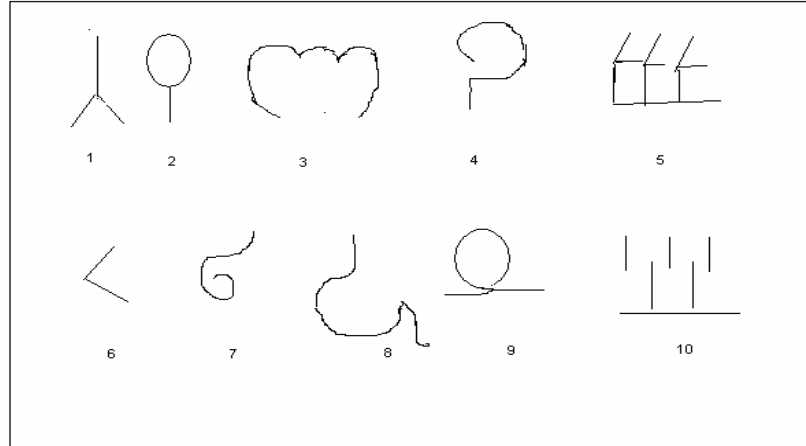
Fig. 2.3 *Creativity Line Figures Completion Test*

- **Picture construction test (time allowed: ten minutes):** Seven triangles and seven ellipses are shown. The person is required to construct different meaningful and interesting pictures by using these figures in multiple associations.

(iii) Passi's Battery of Creativity Tests

B. K. Passi constructed the test of creativity consisting of three verbal and three non-verbal tests. Details of these are given below:

1. **Seeing problem test:** There are four items, (a) shoes, (b) chair, (c) pen, and (d) post-card, for which the candidate is required to write down the defects or problems as he observes concerning these four objects. For instance, for the time-piece or table clock, the defects and problems can be that (i) gets rusty, (ii) makes noise, (iii) breaks easily, (iv) needs winding. Total time for the four items is eight minutes.

2. **Unusual uses test:** There are two cells for: (a) piece of cloth, and (b) bottle, in which all the possible unusual uses of these two items are to be written down as quickly as possible. As for instance, the unusual uses of a match box can be for: (i) toy making, (ii) using as a container, (iii) learning counting. The total time for these two items is eight minutes.

3. **Consequences test:** There are four statements:

   (a) If human beings start flying like birds

   (b) If all houses start flying

   (c) If all people become mad

   (d) If all females turn male

   The candidates are required to write down under each statement all the possible consequences they could think of in eight minutes for all the four statements.

4. **Test of inquisitiveness:** There are certain things covered and put on the table and the candidates are asked to write down all the questions briefly on

the answer sheet when the things are uncovered. The questions can be of any type, but each question must be different and independent and cannot be answered easily on the basis of simple observations. The total time allotted for the test is six minutes.

5. **Square puzzle test:** There are five triangular and five quadrilateral pieces of thick paper or cardboard given to the subject and she/he is required to make a square with the help of these ten pieces. There is no overlapping or blank space left over. The required time is three minutes.

6. **Blocks test of creativity:** There are two boxes, each containing nineteen identical cubes and twelve semi-cubes, each surface of the blocks is painted with different colours. The candidate is required to make as many different patterns or structures of things as possible by using cubes from one box at a time and arranging them on one cardboard in rotation, each time to show the pattern to the tester.

The patterns could be as interesting as possible. The patterns, for example, could be of a blackboard, an arrow or a maze. The pattern is not to be repeated and the blocks could be placed in anyway liked. The total time allowed for the test is ten minutes.

2.5.2 Teaching for Creativity

Creativity needs stimulation and nourishment. Most creative talent, unless it is given proper training, education and opportunities for expression, is wasted. It becomes essential, therefore, for teachers as well as parents to realize the need of creating an environment conductive to full growth and development of the creative abilities of children.

Proper stimulating and nurturing of the traits which help to develop creativity, namely, originality, flexibility, ideational fluency, divergent thinking, self-confidence, persistence, sensitiveness, ability to see relationship and make associations, are essential for this and may be achieved through the flowing practices.

(i) **Freedom to respond:** Most often, teachers and parents expect routine, fixed responses from children, and thus kill the creative spark by breeding conformity and passivity. We should allow adequate freedom to our children in responding to a situation. They should be encouraged to think out as many ideas as they can for the solution of a problem. We must also let them have their own way when they need a particular kind of novel expression.

(ii) **Opportunity for ego involvement:** Feeling like 'this is my creation', 'I have solved it', gives much satisfaction to children. Actually, a child can be expected to put in determined efforts into creative activities only when his ego is involved, i.e., when he feels that a particular creative work is the outcome of his efforts. We should, therefore, provide opportunities to children to derive satisfaction from identifying themselves as the cause of a product.

(iii) **Encouraging originality and flexibility:** Originality on the part of children in any form should be encouraged. Passive submission to the facts, unquestioning mimicry, and memorization by rote discourage creative expression and should, therefore, be checked as far as possible. If children seek to change their methods of learning a task or solving a problem, they should be encouraged to do so.

Adequate training can also be given by making them answer problems like: 'How would you dig the earth if you don't have a spade?', or 'how would you draw an angle if you do not have a proper instrument for drawing it?', or 'how would you cross a river if there is no bridge over it?'

(iv) **Removal of hesitation and fear:** In countries like India, there seems to be a great hesitation mixed with a sense of inferiority and fear in taking the initiative for creative expression. We generally come across comments like 'I know what I mean, but I cannot write (or speak) before others'. The causes of such diffidence and fear should be discovered and eliminated.

The teachers and parents should encourage and persuade such children to express themselves by saying or writing something, anything, no matter how crude it may be.

(v) **Providing appropriate opportunities for creative expression:** A healthy atmosphere, favourable for creative thinking and expression is essential for the stimulation and nourishment of creativity among children. The rate of learning must be balanced with its application, passive receptivity with challenging productivity, and certainty with and adventure. The child should never be snubbed for his curiosity and creativity. There is need of a sympathetic atmosphere in school and at home.

Co-curricular activities in schools can be used for providing opportunities for creative expression. Religious festivals, social get-togethers, and exhibitions can also provide the opportunity for creative expression. Even regular classwork can be arranged in such a way as to stimulate and develop creative thinking among children.

(vi) **Developing healthy habits among children:** Industriousness, persistence, self-reliance and self-confidence are some of the qualities that are helpful in creative output. Children should, therefore, be helped to imbibe these qualities. Moreover, they should be encouraged to stand up against criticism of their creative expression. They should be made to feel that whatever they create is unique and expresses what they desire to express.

(vii) **Using the creative resources of the community:** Children should be made to visit the centre of art, scientific, and industrial creative work. This may stimulate and inspire them for creative work. Creative artists,

scientists and creative persons from different fields may also be occasionally invited to the school to interact with children in an effort to enhance the scope of knowledge of children and kindle the spark of creativity in them.

(viii) **Avoidance of blocks to creative thinking:** Factors like conservation, faulty methods of teaching, unsympathetic treatment, fixed and rigid habits of work, anxiety and frustration, excessively high standards of achievement for low levels of work, over-emphasis on school marks, and authoritarian attitude of teachers and parents, are known to be detrimental to the growth of creativity among children. As far as possible, parents and teachers should, therefore, try to avoid such factors in upbringing and educating the children.

(ix) **Proper organization of the curriculum:** Learning experiences in the form of curricula should be so designed as to foster creativity among children. For this purpose, the school curriculum should be organized primarily on the basis of concepts rather than facts. It should also cater to the individual needs of each student rather than to the generalized needs of all students.

It should also follow the general philosophy that truth is something to be sought for rather than something to be revealed. It should be quite flexible and make provision for studying and working without the threat of evaluation. In a nutshell, the curriculum should reflect what is expected from the creative children in terms of fluency, flexibility, originality, divergent thinking, inventiveness and elaboration.

(x) **Reform in the evaluation system:** The Indian education system is entirely examination oriented. Appropriate reform must therefore be made in its evaluation system if creativity is to be nurtured. The emphasis on memorization by rote, fixed and rigid single responses, and convergent thinking, which kills creativity of children should be abandoned and a proper evaluation system adopted for encouraging complete and blanked experiences in developing their creative behaviour.

(xi) **Use of special techniques for fostering creativity:** Researchers in the field of creativity have suggested special techniques and methods for fostering creativity among children. A few of these are as follows:

(a) **Brainstorming:** It is a strategy or technique which allows a group to explore ideas without judgment or censure. In practice, children may be asked to sit in a group for solving a problem and attacking it without any inhibition from many angles.

To start with, students may be provided with a focus. These can be any, like, particular problems like 'student unrest', or growing unemployment in India, or how to check truancy in schools. Students are then asked to suggest ideas as rapidly as possible and the following norms are observed:

- All ideas are encouraged and appreciated, therefore, no criticism is allowed during the brainstorming session.

- Students are encouraged to come out with as many ideas as possible, even unusual and unorthodox ones.

- Students are not restricted to new ideas only and are also encouraged to enlarge upon ideas put forward by fellow students.

- No evaluation or comment of any sort is to be made until the session is over. At the end of the session, all the ideas received (preferably written on the blackboard) should be discussed in a free, frank and open environment, and the most viable ideas accepted for solution of the problem in hand.

(b) **Use of teaching models:** Some of the teaching models developed by educationists may prove quite beneficial in developing creativity among children. For instance, Bruner's Concept Attainment Model helps in developing creativity in children for the attainment of various concepts.

Such inquiry training model is helpful in developing creativity among children in addition to imparting training in the acquisition of scientific inquiry skills.

(c) **Use of gaming technique:** Gaming techniques, in a playful spirit, help the children in the development of creative traits. These techniques provide valuable learning experiences in a relaxed, spontaneous and evaluative situation. To facilitate both verbal and non-verbal transaction of ideas, children may be asked to name all the round things they can think of, tell different ways to use a knife, or explain the ways in which a cat and a dog are alike.

In non-verbal transactions, children may be asked to build a cube, construct or complete a picture, draw and build patterns, interpret patterns of drawings and sketches, and build something out of the raw material given to them.

(xii) **Teaching by example:** Children are imitative by nature. Teachers and parents who themselves follow the beaten track and do not show any originality or never experience the excitement of creating or doing something new fail to simulate creativity among the children in their charge. They must, therefore, themselves develop the habit of creative thinking.

Such children should learn to believe in change, novelty and originality, and themselves experience the creative process. Their behaviour and style of teaching must reflect their love for creativity. Then and only then they can inspire children to be creative.

CHECK YOUR PROGRESS

10. Who developed Torrance Tests of Creative Thinking (TTCT) and what do they cover?

11. How can co-curricular activities help in creative expression in children?

2.6 PROBLEM–SOLVING AND CREATIVITY

Henry Kaiser once stated: 'Problems are only opportunities in work clothes.' For everyone, there are needs and motives that need to be satisfied. For this purpose, definite goals or aims are set. In an attempt for their realization, one experiences obstacles and interferences in one's attempt to achieve them. This creates problems, and serious as well as deliberate efforts have to be made to overcome these impediments.

The productive work involved in the evaluation of the situation and the strategy worked out to reach one's set goals is collectively termed as problem-solving. This is an essential exercise for individual advancement and advancement of society. The meaning and nature of problem-solving is further clarified by the following definitions:

- **Woodworth and Marquis (1948):** Problem-solving behaviour occurs in novel or difficult situations in which a solution is not obtainable by the habitual methods of applying concepts and principles derived from past experience in very similar situations.

- **Skinner (1968):** Problem-solving is a process of overcoming difficulties that appear to interfere with the attainment of a goal. It is a procedure of making adjustment in spite of interferences.

An analysis of the above definitions highlights the following observations about the meaning and nature of problem-solving behaviour:

- In the satisfaction of one's needs and realization of set goals, problem-solving behaviour arises only when the goal is purposeful and essential for the individual. There is serious interference in the realization of this goal and this interference of obstacle cannot be overcome by simple habitual acts or mechanical trial and error methods.

- One has to utilize one's thinking and reasoning powers and engage in serious mental work by systematically following some well-organized steps for the removal of the difficulties and obstacles.

- Problem-solving behaviour involves deliberate, conscious and serious efforts on the part of the problem-solver.

- Problem-solving behaviour helps in the removal of or adjustment with interferences and ultimately helps an individual to reach his goal and satisfy his motives.

- Problem-solving behaviour helps an individual in the growth and development of his personality, making his life happier by appropriate adjustment. It also contributes significantly to the progress and development of society.

- Problem-solving is the highest level of learning in the hierarchy proposed by Robert Gagne, which depends on the mastery of next lower types of learning. It involves the application of principles and facts to explain and solve new phenomena or predict consequences from known conditions.

Problem-solving is a key skill and can make a huge difference in their career. At work, problems are at the center of daily activities. It is either solving a problem for a client (internal or external), supporting those who are solving problems, or discovering new problems to solve. The task of problem-solving requires prediction, analysis of facts and principals to develop cause-effect relationship in the physical phenomena of the environment.

Generally, our daily life activities are followed in routine and we do not face any problem to perform our routine duties. However, it is not always so, sometimes we are not confronted with a problem situation and we have to think as well as identify an appropriate solution to reach the goal.

A problem situation is any obstacle that may be physical, social and economical or in any other form, which may hinder the progress of the individual or person to reach the goal. There are a number of different obstacles that can interfere with our ability to solve a problem quickly and efficiently. For example, problem-solving can be impaired by biases of personal beliefs, a misunderstanding of information relevant to solving problems and overconfidence.

When dealing with a problem, people often make assumptions about the constraints that prevent certain solutions and create obstacles in the progress of a problem; sometimes a mental set also creates an obstacle in problem-solving like the tendency to approach a new problem with the same approach that worked previously for different problems. People have to only use solutions that have worked in the past rather than looking for alternative ideas. It can often work as a heuristic, making it a useful problem-solving tool.

However, it can also lead to inflexibility, making it more difficult to find effective solutions. While part of learning is developing effective strategies for dealing with problems, the automatic or rote application of a strategy to a problem can lead a person down the wrong path and impede problem-solving.

Much of effective problem-solving lies in knowing which approach to use to solve the problem. Functional fixedness is the tendency to view physical objects in terms of their traditional uses. By doing so, we greatly limit the possibilities for creative uses of objects in nontraditional ways. It prevents people from seeing all of the different options that might be available to find a solution. It helps to view a problem only in their customary manner. For example, a hammer can not only be used for driving or removing nails, but also serves as an effective paperweight, nutcracker or a pendulum weight.

The problems you face can be large or small, simple or complex, and easy or difficult to solve. Regardless of the nature of the problems, a fundamental part of every manager's role is finding ways to solve them. Thus, being a confident problem solver is important for success. Much of that confidence comes from having a good process to use when approaching a problem.

With a good process, you can solve problems quickly and effectively, contrary to which your solutions may be ineffective, or you will get stuck and do nothing, with sometimes painful consequences. Problem-solving is basically a mental process that people go through to discover, analyse and solve problems. This involves all of the steps in the problem process, including the discovery of the problem, the decision to tackle the issue, understanding the problem, researching the available options and taking actions to achieve your goals.

Before problem-solving can occur, it is important to first understand the exact nature of the problem itself. If your understanding of the issue is faulty, your attempts to resolve the problem will also be incorrect or flawed.

Approaches to Problem-solving

Traditionally, two different approaches have been mentioned by psychologists, adhering to two families of learning theories. These are:

(i) Cognitive field theory

(ii) Stimulus-response theory

Cognitive field theory emphasized the importance of the perception of total situation and relationship among its components and restructuring the cognitive field. Kohler conducted his classical experiments on Sultan to study the process of problem-solving in animals. He, from his study on problem-solving, proposed that the solution of a problem is arrived at after some initial efforts by an individual. Many studies have been conducted on children and adults to confirm that a solution of a problem is reached through insight into a situation.

The second point of view has been advanced by stimulus-response theorists, who emphasize the importance of trial-and-error. They hold that a problem is solved through a gradual process of elimination of error and putting together correct responses. There has been considerable controversy as regards the superiority of one approach over the other as an interpretation of problem-solving.

Some psychologists are of the opinion that the cognitive field theorists approach is most effective for solving problems that require higher mental processes. The stimulus-response approach is effective for solving simple problems. To do away with the controversy of cognitive and stimulus-response approach, Harlow proposed a third explanation. His approach is more realistic and rational in nature.

Harlow conducted a series of experiments on monkeys and human subjects of low mental abilities. He presented his human subject with simple problems of discrimination and observed that, in the beginning, his subjects showed trial-and-error behaviour to solve a series of problems but noticed that when similar problems were presented to the subjects in future, they made correct discrimination in the first

try. The later stage appears to be insightful learning, i.e., the stage when the problem gets suddenly solved.

According to Harlow, the underlying assumption is that in the previous trial-and-error learning, the subjects discover 'how to learn'. They acquired what he called a learning set. They acquired a method of learning that transferred positively to other problem situations of similar type. According to Harlow:

Generalizing broadly to human behaviour, we hold that original learning within an area is difficult and frustrating, but after mastery of the basic facts, learning with the same area becomes simple and effortless.

2.6.1 Developing Effective Problem-solving Behaviour

Psychologists have tried to study the behaviour involved in the process of problem-solving in animals as well as in human beings. They have suggested different steps involved in the process of problem-solving according to their respective findings and viewpoints. In 1984, John Bransford and Barry Stein advocated five steps that are associated with the task of problem-solving. They referred to these steps as 'IDEAL' thinking and arranged them in the following order:

I = Identifying the problem

D = Defining and representing the problem

E = Exploring possible strategies

A = Acting on the strategies

L = Looking back and evaluating the effects of one's activities

On the other hand, in 1979, Bourne, Dominowski and Loftus enumerated three steps or stages in problem-solving—preparation, production and evaluation—by proclaiming that 'we prepare, produce and evaluate in the task of problem-solving'.

Problem-solving is an individual phenomenon and involves the exercise of cognitive abilities of a high order and continuous and persistent struggling on the conscious as well as unconscious levels. Often, there is a considerable movement back and forth as one moves from one step to another during problem-solving. In general, the following steps may be followed in the task of problem-solving:

1. **Problem-awareness:** The first step in the problem-solving behaviour of an individual is concerned with her/his awareness of the difficulty or problem that needs to be solved. She/he must face some obstacle or interference in the path of realization of her/his goals, needs or motives and consequently, she/he must be conscious of the difficulty or problem.

2. **Problem-understanding:** The difficulty or problem encountered by the individual should next be properly identified and analysed so that its exact nature becomes clear. This should be followed by relating the problem to specific goals and objectives. Thus, all the difficulties and

obstacles in the path of the goal or solution must be properly named and identified and what is to be achieved through the problem-solving effort should be clearly known in very specific terms.

3. **Collection of the relevant information:** In this step, the individual is required to collect all the relevant information about the problem by all possible means. He may consult experienced persons, read the available literature, recall his own experiences, think of the numerous possible solutions and put in all possible efforts to collect comprehensive data and knowledge concerning the problem.

4. **Formulation of hypothesis or hunch for possible solutions:** After understanding the nature of the problem and collecting all relevant information, one may start some cognitive activities to think out the various solutions to the problem.

5. **Selection of the correct solution:** In this important step, all the possible solutions, thought out in the previous step, are closely analysed and evaluated. In 1946, Gates, along with a few other scholars, suggested the following activities in the evaluation of the assumed hypotheses or solutions:

    (i) Identify the conclusion that completely satisfies all the demands of the problem

    (ii) Find out whether the solution is consistent with other well-established or accepted facts and principles

    (iii) Make a deliberate search for negative aspects, which might cast any doubt upon the conclusion

6. **Verification of the concluded solution or hypothesis:** The solution arrived at or conclusion drawn must be further verified by applying it in the solution of various similar problems and only if and when the derived solution helps in the solution of these problems should one consider the solution to be acceptable. Such a verified solution may then become a useful product of one's problem-solving behaviour and be utilized in solving other future problems.

The above suggestions will help the individual select the proper solution of the problem out of the numerous solutions that may be available. In the final analysis, however, she/he has to use her/his own discretion by utilizing higher cognitive abilities to properly identify the appropriate hypothesis or solution by rejecting all other hypotheses.

It is not necessary to pass through all the phases in every problem. Table 2.1 shows the steps which have been given by different research workers on problem-solving.

S. No.	Rossman		Dewey		Merrifield		Klausmeier
1.	Need or felt difficulty	1.	Sensing difficulty Locating and defining	1.	Preparation	1.	Attending and cognizing difficulty
2.	Information gathered	2.	Suggesting hypothesis	2.	Analysis	2.	Stating the general requirements
3.	Solution tested	3.	Testing hypothesis	3.	Production	3.	Recalling existing knowledge
4.	New ideas formulated, tested and accepted			4.	Verification	4.	Applying substantive knowledge
				5.	Re-application	5.	Inferring possible solutions
						6.	Evaluating the quality of the accepted solution.
						7.	Transfer of new acquired knowledge

Table 2.1 *Steps for Problem-solving*

2.6.2 Problem-solving and Role of the Teacher

An important question which every classroom teacher faces is that of helping the students in problem-solving. No universal law can be formulated for solving each and every type of problem. Problem-solving is an individual process that can be tackled by various strategies. A classroom teacher can develop a scientific approach to solve problems, which the students are expected to face in social life.

Tentative suggestions are provided for teachers that can prove useful in developing the right attitude to approach a problem. These are:

1. **Moderate motivation:** It has been pointed out by experimental studies that extreme motivation or excessive emotional involvement in a problem hinders productive thinking. It is necessary for the teacher to create moderate motivation in students. If the teacher finds that students show high motivation, she/he should drop the problem and return to it when she/he finds the students in a calmer state. On the other hand, motivation should be sufficient to sustain the interest of the class. A teacher can create motivation by utilizing various techniques.

2. **Encourage divergent thinking:** The teacher should not emphasize confirmatory behaviour in students. She/he should encourage divergent thinking in students. Students should be encouraged to tackle problems in a variety of ways. The teacher should allow flexibility and encourage original approach to problems. Reasoning should be developed through guided discussions in the class.

3. **Problem should be presented as a whole:** The teacher should present problems in the class as a whole so that students may have a perception of the entirety of the situation for its solution.

4. **Level of difficulty:** The teacher should see that the problems are not too difficult for the class. The maturation level and level of developmental task to create motivation in the students should be kept in mind. The problem should be neither too difficult nor too easy for the class. The problem should create a moderate level of anxiety in the students.

5. **Active manipulation:** The teacher should present a problem in a planed way. She/he should try towards an active involvement of the class in the process of solving a problem. Use of diagrams, figures and manipulation of concrete material should be made to conceptualize the abstract problems. The teacher can shift the functional properties of process and then evaluate the environment in these terms.

6. **Practice:** The teacher should provide a variety of problems for practice in order to develop mental skills in students aiding them to solve similar types of problems in future.

7. **Incomplete solution:** It has been proved that incomplete tasks are retained more than complete. The implication of this is that the teacher should never provide complete solutions to problems. Some unanswered question should be left for the students for solution. The teacher can develop the spirit of formulating tentative conclusions of the problem. She/he should make an effort to develop a scientific attitude in students.

2.6.3 Thinking and Problem-solving

Thinking is significant for problem-solving. A problem stimulates a thinker. A thinker thinks about the solution when faced with a problem. Words have great significance in the thinking process. The names and concepts of things have a great role in thinking. In analysing the importance of words in thinking, some scholars conclude that thinking is always verbal, though children can sometimes resort to mental patterns and physical postures. However, symbolic thinking is often verbal.

Thinking, no doubt, solves a problem, but all kinds of problems do not arouse thinking. If a problem is not experienced, it is possible that thinking might not begin at all and the problem would remain in the same form. For example, experiencing hardship and being acquainted with the extensiveness of a difficulty helps to find the symbolic means of conquering a problem.

When a means to problem solving is found, it is tested. All kinds of problems do not lead to thinking and all kinds of thinking is not the solution to problems. When thinking inclines towards problem-solving, it adopts the scientific approach. From the scientific and logical viewpoint, problem-solving has the following stages:

- **Experience of difficulty:** When a need is felt or a hurdle is faced, the person concerned is perplexed, troubled and restless. He/she wants to achieve, wants to adopt a thought or ideal, or wants to possess something. However, if he/she has no means to get what he/she wants, or is not able to recognize the thing, ideal or tool, when a person is unable to clarify an incident, he/she experiences difficulty. When he/she sees that his need is

not being fulfilled by the available means and his/her present knowledge in not enough to reduce his/her restlessness, then he/she reaches the threshold of thinking.

This problem can arise any time in our daily life, such as expenses being more than income, car accident, sickness, and rising prices. Such problems do not solve by present knowledge or means, giving rise to complexities.

- **Explanation and definition of problem:** When a difficulty arises, it is very unclear in its initial form. A difficulty gives rise to tension, anxiety, perplexity and restlessness, but keeps itself under wraps. A difficulty resides behind veils and cannot be seen without unveiling. Common people experience its presence, but commit error in recognizing it or do not attempt to recognize it at all.

  Recognizing a problem means to mark its extent or limit and define it. If a person wants to solve a problem, he/she has to understand and clarify it. If a difficulty does not resolve, the means employed to solve it can prove misleading. A person cannot conquer a difficulty in the absence of its definition.

- **Suggestions for problem-solving:** Facts, information and other related aspects present suggestions for problem solving. An attempt is made to guess from the observation of the facts and go beyond the present facts. The thinker guesses with the help of facts, imagines, or in scientific language, forms a concept. Conceptualization is a task of great courage and is formulated with carefulness.

  The thinker decides the presented suggestions for problem-solving, determines the objective of each suggestion and then adopts one of the suggestions as a conclusion. If a suggestion does not seem appropriate, the thinker rejects it and evaluates another.

  Thus, testing various suggestions, the thinker accepts one such suggestion, which presents the correct solution to the problem, or the person sits down dejected and the flow of thinking interrupts. An able thinker can present several suggestions and can recognize a good suggestion by testing it. He/she can recognize a good suggestion from a bad one.

- **Solution of the problem:** When a suggestion is accepted, it is used for problem-solving. Experiments are conducted in some problems while in others the solution is found without any experiment. The use of experiments constitutes the fifth stage of thinking; if the problem is not experimented, the solution is may be found out by inner vision, the solution representing the fifth stage.

- **Testing the solution:** Once the solution to a problem is identified, it can be applied to solving the problem and validating if it is indeed appropriate. When discussions on problem-solving were carried out, many suggestions were considered and the best solution was accepted as a temporary solution. This temporary solution is used for experimentation.

In gestalt psychology, it is at this stage that a person is able to find a solution by the similarity of a situation. John Dewey has described these stages of discussion on thinking in his book *How We Think* as:

 (i) Experience of difficulty

 (ii) Definition of difficulty

 (iii) Suggestion or concepts for problem-solving

 (iv) Consideration of suggestions

 (v) Testing the concepts by activity

These five steps of problem-solving recommend both methods of inclusion and exclusion. Inclusion is used to prepare the base of the imagination, but exclusion considers the suggestions facilitated by which the thinker reaches logical conclusions from imagination and once again, takes refuge of inclusion to prove other cognitive solutions.

The development of discussion thinking cannot happen suddenly. It is related with learning. Children learn by thinking and develop their ability to think by learning. An inexperienced child learns by trial-and-error. He/she uses more of his intellect when grown and takes the help of prior experiences. The ability to logical thinking develops gradually. Students can and must be trained for logical thinking in problem-solving.

CHECK YOUR PROGRESS

12. What is meant by problem-solving?

13. What is a problem situation?

14. What kind of problems is the stimulus-response approach most useful for?

2.7 SUMMARY

- The definition of originality is easily translated in behavioural language and is studied in connection with the solution of problems.

- Creative behaviour is that which is visible to those productions that are considered creative by the associated judges.

- Creativity can be described as the capacity or ability of an individual to create, discover or produce a new, novel idea or objects, including the rearrangement or reshaping of what is already known to him, which proves to be a unique personal experience.

- According to M. J. Levin, 'creativity is the ability to discover new solutions to problems or to produce new ideas, inventions or works of art. It is a special form of thinking, a way of viewing the world and interacting with it in a manner different from that of the general population'.

- Since a person can behave creatively in many ways, it is not strange that

there are many definitions of creativity, but there is no universally accepted definition of creativity.

- A. T. Kearney identified that firms engaged in comprehensive and creative performance measurement realized improvements in overall productivity in the range of fourteen to twenty-two per cent.

- As there is enough scope for improvement in productivity and profitability, creative managers and researchers are always striving for collection, analysis, and interpretation of qualitative information to measure and compare in order to give the right direction.

- The focus of outcome measure is on the overall process results in terms of customer satisfaction and time management process, whereas diagnostic measures deal with specific objectives within the process.

- While developing an integrated performance measurement system, a consortium of firms, universities, and consultants proposed a common framework.

- Creativity is another term influenced by our own viewpoint of the world and is open to personal interpretation.

- Creativity has proven to be comparatively harder to test and hence, there are fewer scientific testing instruments to check creativity.

- Around the 1950s, scientists began trying to find a link between creativity and intelligence, but all the published correlations between the two concepts were low enough to justify treating intelligence and creativity as distinct cognitive attributes.

- Thinking is the systematic transformation of mental representation of knowledge to characterize actual or possible states of the world, often in service of goals.

- Thinking can take place without images and verbal symbols but not imagination.

- The instruments of thinking—images, imagination, signs and indications—are internal. Thinking continues to be an internal activity unless and until it takes the form of verbal thinking.

- Behaviour is expressed through its conative, cognitive and affective components, and creative behaviour is no exception.

- The characteristics and personality traits of a person may provide reliable indications for the identification of creative potential which may be further verified by comparing the performance with standardized creativity tests.

- Creativity needs stimulation and nourishment. Most creative talent, unless it is given proper training, education and opportunities for expression, is wasted. It becomes essential, therefore, for teachers as well as parents to realize the need of creating an environment conductive to full growth and development of the creative abilities of children.

- A healthy atmosphere, favourable for creative thinking and expression is essential for the stimulation and nourishment of creativity among children.

- Children should be made to visit the centre of art, scientific, and industrial creative work. This may stimulate and inspire them for creative work.

- Problem-solving is a key skill and can make a huge difference in their career.

- The task of problem-solving requires prediction, analysis of facts and principals to develop cause-effect relationship in the physical phenomena of the environment.

- A problem situation is any obstacle that may be physical, social and economical or in any other form, which may hinder the progress of the individual or person to reach the goal.

- Much of effective problem-solving lies in knowing which approach to use to solve the problem.

- Before problem-solving can occur, it is important to first understand the exact nature of the problem itself. If your understanding of the issue is faulty, your attempts to resolve the problem will also be incorrect or flawed.

- In 1984, John Bransford and Barry Stein advocated five steps that are associated with the task of problem-solving.

- Problem-solving is an individual phenomenon and involves the exercise of cognitive abilities of a high order and continuous and persistent struggling on the conscious as well as unconscious levels.

- Recognizing a problem means to mark its extent or limit and define it. If a person wants to solve a problem, he/she has to understand and clarify it.

- Testing various suggestions, the thinker accepts one such suggestion, which presents the correct solution to the problem, or the person sits down dejected and the flow of thinking interrupts.

- Children learn by thinking and develop their ability to think by learning. An inexperienced child learns by trial-and-error.

- The ability to logical thinking develops gradually.

2.8 KEY TERMS

- **Consortium:** It refers to an association, typically of several business companies.

- **Aesthetically:** It refers to a way that provides pleasure through beauty.

- **Ebullience:** It refers to the quality of being cheerful and full of energy; exuberance.

- **Cognitive:** It refers to something related to the mental action of acquiring knowledge and understanding through thought, experience, and the senses.

- **Percepts:** It means an object of perception; something that is perceived.

- **Conative:** It is one of three parts of the mind, along with the affective and cognitive.

- **Ideational:** It refers to something consisting of or referring to ideas or thoughts of objects not immediately present to the senses.

- **Diffidence:** It means modesty or shyness resulting from a lack of self-confidence.

- **Heuristic:** It means to enable a person to discover or learn something for themselves.

- **Gestalt psychology:** It is a movement in psychology founded in Germany in 1912, seeking to explain perceptions in terms of gestalts rather than by analyzing their constituents.

2.9 ANSWERS TO 'CHECK YOUR PROGRESS'

1. According to M. J. Levin, 'Creativity is the ability to discover new solutions to problems or to produce new ideas, inventions or works of art. It is a special form of thinking, a way of viewing the world and interacting with it in a manner different from that of the general population.'

2. Convergent thinking refers to intellectual ability whereas divergent thinking refers to the method adopted by individuals to attain their goals and objectives.

3. The integrated framework incorporates four types of matrices, namely, customer satisfaction/quality, time, costs and assets, which monitors both outcomes and diagnostics for effective performance management.

4. According to Wallas, the four stages of creativity are as follows:

    (a) Preparation

    (b) Incubation

    (c) Inspiration or illumination

    (d) Verification or revision

5. According to Wallas, a deliberate or voluntary turning away from the problem is the beginning of the second stage of the creative process, i.e., the incubation stage.

6. Perceptual thinking is often defined as 'a mental activity present with the sense organs and the thing affecting it'.

7. Three types of thinking processes are:

    (i) Perceptual thinking

    (ii) Imaginative thinking

    (iii) Conceptual thinking

8. Thinking involves the solution of problems by trial-and-error method.

9. For a total assessment of creative behaviour, we have to apply a multi-dimensional approach involving the use of the available creative tests and the multiple non-testing devices like observation, interview, rating scale, personality,

inventory, situational test, interest inventories, attitude scales, aptitude tests, value schedules and projective techniques.

10. Creativity tests Torrance Tests of Creative Thinking (TTCT) were developed by the American psychologist E. Paul Torrance and cover both verbal and non-verbal activities performed by the subjects.

11. Co-curricular activities in schools can be used for providing opportunities for creative expression in children.

12. The productive work involved in the evaluation of the situation and the strategy worked out to reach one's set goals is collectively termed as problem-solving.

13. A problem situation is any obstacle that may be physical, social and economical or in any other form, which may hinder the progress of the individual or person to reach the goal.

14. The stimulus-response approach is effective for solving simple problems.

2.10 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the various characteristics of creativity?

2. How can one distinguish between a creative and a non-creative person? Name some of the common personality traits of a creative person.

3. How do Torrance Tests of Creative Thinking evaluate verbal performance?

4. Give a brief review of Baqer Mehdi's verbal and non-verbal tests of creativity.

5. What is the role of the teacher in the process of problem-solving?

Long-Answer Questions

1. Why do firms emphasize on and invest in measuring their creative performance? Discuss with reference to the three dimensions of creative performance measurement put forward by A. T. Kearney.

2. What are the differences between thinking and imagination? Evaluate thinking as a mental and cognitive process.

3. What is meant by tools of thinking? Explain the five tools of thinking.

4. Name and explain the various elements which obstruct the thinking process.

5. Explain Harlow's approach to problem-solving. How does he use the trial-and-error method to arrive at a 'learning set'?

2.11 FURTHER READING

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NOTES

UNIT 3 CREATIVE LEARNING METHODOLOGY

Structure

3.0 INTRODUCTION

Creativity is a skill which enables one to imagine and explore ideas which are unusual and unique. Creativity allows one to find solutions to problems which are not expected. Creativity is considered to be in born and natural and many theorists are of the opinion that creativity cannot be taught in any manner. However, there are several ways in which creativity can be fostered and developed in a person. Creativity, however, can be fostered only when right conditions and environment are provided to the learners.

There is no one specific method in which creativity can be developed in a person. There are various techniques that can be applied in various situations to help people develop their creative skills. When a person develops creative skills, he or she tends to develop ideas and solutions which are unique and unusual. A creative learner often explores several ideas and possibilities before finding the best solution to the given problem.

In the educational set-up, creativity can be developed in students by incorporating creative learning in the curriculum which is taught to the students. Students can creatively learn in all domains of curriculum if they are encouraged and provided with the right kind of resources for the same. This unit deals with creative learning methodology and the development of creativity in students.

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Describe the process of creative learning and the concept of learning to learn
- Assess the four pillars of creative learning and the development of creativity through games
- Analyse the importance of creativity in education and the methods to encourage creative learning in students
- Explain the development of creativity in students and the factors responsible for it
- Discuss the role of a teacher in developing creativity in students

3.2 UNDERSTANDING CREATIVE LEARNING

The National Advisory Committee on Creative and Cultural Education defines creativity as, 'Imaginative activity fashioned so as to produce outcomes that are both original and of value.' The definition highlights four major features of creativity which includes the following:

- **Using imagination:** When it comes to creativity, imaginative activity is not limited to just fantasizing or imagining, though it may include both of these. Imaginative activity is also not just creating mental pictures or representations of things that do not exist or have not been experienced. With respect to creativity, imaginative activity is the process of generating something that is original and includes providing an alternative which is not conventional, is unique and different. Imaginative activity thus involves the processes of thinking and/or behaving. Imaginative activity is a form of serious mental play which is directed towards a creative purpose. Imaginative activity is a thought process which is generative in nature. A creative person expands all the possibilities of a given situation, looks at the situation afresh from a new perspective and provides alternatives which are unusual, unique and different from the routine or expected ones. A creative person is able to come out with new ideas by reinterpreting the existing ideas in unexpected ways or applying the existing ideas in areas to which these may be least associated.

- **Pursuing purposes:** Creativity has with it associated action and purpose. Creativity is often referred to as applied imagination wherein a creative person is actively engaged in producing something in a deliberate manner. The idea behind creativity is to solve a central problem in an unexpected way. Creativity is a highly dynamic process wherein the actual outcomes can be quite different from the ones that have been anticipated. When it comes to solving a problem in a creative manner, it is also possible that the objective changes because of the new ideas and possibilities that emerge during the course of solution of the problem.

- **Originality:** Creativity and originality go hand in hand. The categories of originality may be different but originality is the premise of creativity. Individual originality suggests that a person's work may be original in relation to the previous work. Relative originality suggests that the work of a person may be original in relation to someone else's work. Historic originality suggests that the work of the person may be original and unique. The degree of originality may also vary in creativity.

- **Judging value:** Creativity involves generative as well as evaluative mode of thought. Originality is essential for all creative work but is never enough. Original ideas may be irrelevant if there is no purpose associated with these ideas. Thus, the outcome of an imaginative thought can be creative only if it is of value to the problem in hand. Value here refers to outcome related to the purpose. The criteria of value may vary according to the purpose in hand. The value related to an activity can be—effective, useful, valid, satisfactory or tenable.

3.2.1 Learning to Learn and Teaching for Creativity

The process of creativity involves taking an idea and playing with it to fathom the various possibilities. In a creative process thus there can be many dead-ends and ideas that do not work. A creative process may need to undergo several modifications, changes and a lot of imaginative activity may be involved before the best outcome is arrived at. The application of creative ideas may involve a lot of critical thinking. Critical evaluation is essential to find out what is working and what is not working. Critical evaluation is essential at all stages of creativity.

Creative processes draw from knowledge and practical skills and thus it is not always possible to teach creativity. There are various techniques that can be used to foster creative thinking. It is not possible to teach children creativity. Creative teaching can be defined in two ways—teaching creatively and teaching for creativity. Teaching creatively simply means that teachers make use of imaginative approaches to make learning interesting, effective and exciting. It is believed that teachers can be highly creative while developing materials to arouse the interest of the children and make learning more interesting. This way teachers can motivate children to learn in a better manner.

Teaching for creativity involves teaching so that the children can develop their own creative thinking and behaviour. Teaching for creativity involves teaching creatively. Teaching for creativity is a tough and demanding process and it is essential that the tutor's creative abilities be developed enough so that the creative abilities of the children can be developed in the right manner. Teaching for creativity cannot be made a routine process. The three main tasks associated with teaching for creativity involves the following:

- **Encouraging:** Creative people have a strong self-belief which helps them perform in the most creative manner. There are several people who consider themselves to be creative but do not have the confidence to embark on their creative journey. Thus, encouraging these people and

giving them confidence to try is perhaps the first and foremost activity involved in teaching for creativity. Encouraging people is very important for stimulating creative achievement.

- **Identifying:** Research suggests that all people have different creative capacities. Teaching for creativity therefore involves enabling the people to identify their own creative strengths. This can then help people develop their creativity in the most effective manner.

- **Fostering:** Creativity is not limited to one specific gift or talent but is a multitude of several abilities and skills. To foster creativity, it is essential to develop common capacities and sensitivities. Knowledge about the creative process can further help people foster creativity. Creative abilities are best enhanced and fostered by being creative.

Teaching for creativity thus has the following aims:

- Allowing broad and narrow focused experimental and creative activity and explaining the purpose of the activity

- Encouraging appropriate attitude towards creativity and imaginative activity

- Encouraging self-expression

- Encouraging and stimulating learners to develop critical evaluation skills

- Emphasis on the use of originality, imagination and curiosity

- Encouraging personal attributes that facilitate creativity

- Encouraging self-confidence, independence of mind and capacity to think for oneself

Teaching for creativity also develops a self-directed learner. In other words, teaching for creativity encourages self-directed learning. Teaching for creativity involves goal-setting and planning, self-monitoring, self-assessment and self-management and therefore in practice, teaching for creativity enhances self-learning, and also enables a person to develop the best practices for accomplishing a task.

Creativity in itself is considered to be a mode of learning. Creativity has the following distinct features:

- Creativity involves thoughtful playfulness. It is based on learning through experiments. Creativity involves playing with and developing possibilities and critically evaluating these and testing them to find the best one.

- Creativity is a flexible process. Creativity is an unusual activity which involves an active attempt for unlearning to learn afresh.

- Creativity involves finding, introducing, constructing and re-constructing something new. Creativity actively expands the possibilities related to a situation and therefore is innovative.

Therefore, learning and creativity are closely associated with each other. Creativity according to many scholars is a sub-type of learning. Several approaches have been adopted in the study of learning and creativity and the relationship between the two.

The constructive approach to learning suggests that there are several important aspects of learning. First, learning is contextual and second learning requires knowledge to learn. Therefore, it is not possible to learn or acquire new knowledge if there is no existing structure of knowledge. The third important aspect of learning is that it is self-regulated in the sense that every person learns at his or her own pace depending on the previous knowledge and skills. Learning is both an individual and social activity in which interactions with the environment and other people are conducive to learning.

Constructionist methods also link learning with creativity. Constructionism is an educational method that is based on the constructivist theory of learning. Constructivism states that knowledge is constructed in the mind of an individual. Constructionism extends upon this and states that learning can take place in an effective manner when something which is tangible in the real world is constructed within the mind of a person. Constructionism basically makes learning more meaningful.

Several models of creativity have been developed over the years and efforts have been made to use these models to understand in a more effective manner the relationship between learning and creativity. One of the earliest models of creativity was based on the creative process. This model was conceptualized by Henri *Poincaré* who stated that the creative process begins with a conscious thought and is followed by an unconscious work resulting in what is known as inspiration. Graham Wallas used Henri *Poincaré*'s model of the creative process to develop a four stage model of creativity. This model of creativity states that creativity is progressive in nature and evolves over the stages of preparation, incubation, illumination and verification.

Learning and creativity share many similarities. Learning is social in nature because to learn people interact with each other and in turn are influenced and also influence others. While learning, the learner also gets influenced by the environment in which learning takes place. Also while learning, a person develops or constructs an understanding of the domain on his or her own. In other words, while learning, one actively participates to comprehend the domain and gain an understanding. Creativity, similar to learning, is also a social process. A creative idea emerges from the interaction between the creator and his or her environment and also several other factors. Interactions with other people or objects and the environment thus form the basis of both learning as well as creativity.

There are two other aspects that are shared by learning and creativity. These include time and previous experience. Learning is not an instantaneous process and learning takes time. While learning, a learner requires time to reflect upon the ideas and therefore may come out with new prospects and possibilities. Creativity also requires time because a creative person needs to think on ideas time and again till the best outcome is reached at. Creativity as we know involves framing several perspectives for a situation which also means that creative ideas are inspired by previous ideas and experiences. Similarly, learning also takes place when a learner can relate new ideas and concepts to previous experiences and situations.

On the basis of the several theories of creativity, a model for creative learning has also been developed by researchers. The creative learning process has been described by Myers and Torrance as, 'becoming sensitive to or aware of problems, deficiencies, gaps in knowledge, missing elements, disharmonies and so on; bringing together available information; defining difficulty or identifying the missing element; searching for solutions, making hypotheses, and modifying and retesting them; perfecting them; and finally communicating the results.'

A model for creative learning with three stages was developed by Don Treffinger. The three levels of creative learning included divergent functions, complex thinking and feeling processes and involvement in real challenges. The divergent functions include a variety of cognitive and affective factors. The divergent functions underline the importance of openness and possibilities in creativity.

Level I which is the divergent functions provides a foundation for creative learning. In Level II, the cognitive and affective factors from Level I are extended. In Level II, higher level of skills is employed to learn in a creative manner. In Level III, the creative person is involved in real problems and challenges.

Level I:

Cognitive factors include:

- Fluency
- Flexibility
- Originality
- Elaboration
- Cognition and memory

Affective factors include:

- Curiosity
- Willingness to respond
- Openness to experience
- Problem sensitivity
- Self-confidence
- Tolerance for ambiguity

Level II:

Cognitive factors include:

- Application
- Analysis
- Synthesis
- Evaluation
- Methodological and research skills
- Transformations
- Metaphor and analogy

Affective factors include:

- Awareness development

- Open to complex feelings and conflicts

- Relaxation and growth

- Values development

Level III:

Cognitive factors include:

- Independent enquiry

- Self-direction

- Resource management

- Product development

Affective factors include:

- Internalization of values

- Self-actualization

Creative learning can be most effective when the learner is familiar with and skilled enough to draw conclusions from several perspectives. This model of creative learning provides a basic and the most general framework for creative learning. It has however been found out that most learners and facilitators focus on the lowest level of creative learning model and stress mainly on the cognitive factors whereas for learning creatively, it is essential to make use of all levels of the model of creative learning.

There are three integral concepts of creative learning. These include preparation, generation and evaluation. Every act of creativity requires the preparation of ideas. Thus for creative learning to take place, the individual needs to first develop a desire of curiosity to create and thereby learn. Once the desire of creative learning has been established, information is gathered and assimilated from external environment by sharing information with others at a social level and then reflecting upon the same at a personal level.

The generation process associated with creative learning encompasses the social and personal design. In this process, ideas are generated which may involve interactions with others in the environment. Explicit and tactic thinking is employed during this process for creative learning. There are several environmental factors that affect and trigger creative ideas. For the generation of creative ideas in the learning process, time is required. The process of evaluation in creative learning involves evaluating the initial creative ideas as well as the final and the best options. The process of evaluation in creative learning usually takes place at a personal level. Creative learning also involves personal and social components. At the personal level, explicit and implicit thinking is involved. At the explicit level, an individual consciously prepares for the task, generates creative ideas and reviews them so that learning can be facilitated. At the tactic level, the environmental factors and conscious thoughts influence creative learning. Thus, the creative learning process

begins with social and individual preparation and ends with personal and social evaluation.

3.2.2 Learning with Joy and Developing Creativity through Games

Learning can always be a joyful experience for a child. Learning through play and games helps children procure pleasure in learning. Games provide an opportunity to the young children to perform an activity in a joyous atmosphere which is very essential for the development of creativity in young children. When children play games, they have to continuously face new situations to which they need to find solutions. This is therefore one of the best ways of developing creativity in young children.

Games serve the following purposes for the development of creativity in young children:

- They enable the children to experiment, explore and discover.
- Games teach children how to cooperate and play together.
- Games teach children how to make use of their loco-motor system.
- They allow the children to use their imagination and memory in a creative manner.
- They enable the children to develop self-confidence and be self-reliant.
- Games teach children to live with successes and failures in the right spirit.
- Games also teach children to manage their emotions in an effective manner.

Children never get tired of games and this is the main reason why creative flows can be attained by the use of games.

3.2.3 Four Pillars of Creative Learning

The four pillars of learning are discussed in this section.

Learning to know

This type of learning is radically different from 'acquiring itemized codified information or factual knowledge', as often stressed in conventional curriculum and in 'rote learning'. Rather it implies 'the mastering of the instruments of knowledge themselves'.

Acquiring knowledge is a never-ending process and can be enriched by all forms of experience. 'Learning to know' includes the development of the faculties of memory, imagination, reasoning, problem-solving, and the ability to think in a coherent and critical way. It is 'a process of discovery', which takes time and involves going more deeply into the information/knowledge delivered through subject teaching.

'Learning to know' presupposes learning to learn, 'calling upon the power of concentration, memory and thought', so as to benefit from ongoing educational opportunities continuously arising (formally and non-formally) throughout life.

Therefore 'learning to know' can be regarded as both a means and an end in learning itself and in life. As a means, it serves to enable individual learners to understand the very least enough about the nature, about humankind and its history, about his/her environment, and about society at large. As an end, it enables the learner to experience the pleasure of knowing, discovering and understanding as a process.

Learning to do

This pillar of learning implies in the first place for application of what learners have learned or known into practices; it is closely linked to vocational-technical education and work skills training. However, it goes beyond narrowly defined skills development for 'doing' specific things or practical tasks in traditional or industrial economies. The emerging knowledge-based economy is making human work increasingly immaterial. 'Learning to do' calls for new types of skills, more behavioural than intellectual. The material and the technology are becoming secondary to human qualities and interpersonal relationship.

Learning to do thus implies a shift from skill to competence, or a mix of higher-order skills specific to each individual. The ascendancy of knowledge and information as factors of production systems is making the idea of occupational skills obsolete and is bringing personal competency to the fore. Thus 'learning to do' means, among other things, ability to communicate effectively with others; aptitude toward team work; social skills in building meaningful interpersonal relations; adaptability to change in the world of work and in social life; competency in transforming knowledge into innovations and job-creation; and a readiness to take risks and resolve or manage conflicts.

Learning to live together

In the context of increasing globalization, the Delors Commission places a special emphasis on this pillar of learning. It implies an education taking two complementary paths: on one level, discovery of others and on another, experience of shared purposes throughout life. Specifically it implies the development of such qualities as: knowledge and understanding of self and others; appreciation of the diversity of the human race and an awareness of the similarities between, and the interdependence of, all humans; empathy and cooperative social behaviour in caring and sharing; respect of other people and their cultures and value systems; capability of encountering others and resolving conflicts through dialogue; and competency in working towards common objectives.

Learning to be

This type of learning was first conceptualized in the Report to UNESCO in 1972, *Learning To Be* (Edgar Faure *et al*), out of the fear that 'the world would be dehumanized as a result of technical change'. It was based on the principle that 'the aim of development is the complete fulfillment of man, in all the richness of his personality, the complexity of his forms of expression and his various commitments— as individual, member of a family and of a community, citizen and producer, inventor of techniques and creative dreamer'. 'Learning to be' may therefore be interpreted in one way as learning to be human, through acquisition of knowledge, skills and

values conducive to personality development in its intellectual, moral, cultural and physical dimensions. This implies a curriculum aiming at cultivating qualities of imagination and creativity; acquiring universally shared human values; developing aspects of a person's potential: memory, reasoning, aesthetic sense, physical capacity and communication/social skills; developing critical thinking and exercising independent judgment; and developing personal commitment and responsibility.

It is important to note that the four pillars of learning relate to all phases and areas of education. They support and interpenetrate one another and should therefore be applied as basic principles, cross-cutting themes and generic competences for integration in and across subject areas or learning domains.

CHECK YOUR PROGRESS

1. How can creativity be developed in students in the educational set-up?
2. Why is creativity a highly dynamic process?
3. What are the two ways in which creativity can be defined?
4. How can the fourth pillar of learning 'Learning to be' be interpreted?

3.3 EXPLORING CREATIVITY THROUGH EDUCATION

Education across the world faces several challenges. The education system needs to be flexible and adaptable enough so that the various challenges can be faced in an effective manner. Researchers however stress on the need of more creativity in education so that the challenges can be met. Besides, it is also important that the creative abilities as well as motivation and self-esteem of learners be developed in a manner so that effective learning can be facilitated. Creativity is in fact the buzz world of the 21st century but its underlying importance in education is not emphasized in the right manner. It is required that at all levels of education, creativity is fostered.

An education system wherein creativity is considered integral must give learners the freedom to recognize their potentials and capabilities. Education must give freedom to learn for which it is essential to create an atmosphere where thinking, questioning and imagining is encouraged. As creative learners, students must work in a collaborative manner and ask questions and even act creatively about ideas and issues across various disciplines. Creative learners try to imagine and explore alternatives and think in a different manner. Creative learners need unlimited time to play, explore, become bored, overcome boredom, discover their own interests, and pursue those interests. Creative learning enables the learners to develop analytical and critical reasoning skills. As has been stated in creative learning, a learner has the freedom to learn. This also implies the fact that the teacher also has the freedom to teach. This however does not mean that the teacher or the facilitator is a passive participant in creative learning. Research suggests that creative teachers are willing to change and welcome and adapt to new ideas and experiences and are not afraid to go off the main track and the conventional methods of teaching.

In the traditional method of teaching, the teacher is the source, the educational material is the information or message and the student is the receiver. The traditional method of teaching is the 'chalk and talk' method of teaching and has been used since decades in all institutions of teaching. In the traditional method of teaching, the teacher controls the entire instruction process and emphasizes on factual knowledge. The teacher delivers the lecture and the learner listens to the same but the learners are passive and play little part in the learning process.

Traditional method of teaching is a one-way flow of information where the teacher talks continuously for hours without getting to know about the response or the feedback of the learners. Teaching and learning do not focus on practical aspects of learning. In traditional form of teaching, learning takes place not by understanding but by memorizing the concept. Thus, traditional education has several shortcomings which need to be addressed and have been addressed by the introduction of several innovative methods of teaching and learning.

Education today places a lot of emphasis on creative learning and thinking. Creative learning in education emphasizes on the fact that each student must know and take an active part in deciding on the skills that need to be developed. Creative learning gives the learners the freedom to express their opinions even if these are wrong. Creative learning in education is essential to develop flexibility in learning for students to recognize their potential and abilities.

In education today, creative learning is also essential to obtain freedom in teaching and to improve the learning environment for the students. With creative learning, education can be more oriented towards the individual needs of the learners. Creative learning is also essential to increase creative abilities and original thinking of the learners.

Creative practices in education should help the learners build their knowledge of things which are especially important to them and therefore strengthen their sense of individuality. The creative learning education model must be based on fostering individuality, flexibility and personality of a learner. Thus creative learning in education must focus on:

- Creating learning and teaching environment that is sensitive to the individual needs of the learners
- Facilitating original and creative thinking
- Enabling intelligent decision making
- Fostering learning experiences
- Acquisition of knowledge for resolving problems

3.3.1 Designing for Creative Learning

Designing for creative learning presents major challenges. This is mainly because of the fact that creativity is considered to be the most complex of the cognitive tasks that learners can be asked to achieve and therefore designing for creative learning presents difficulties. In addition, it is argued that creativity cannot be taught. Many researchers are of the opinion that teaching about the kinds of creativity is possible

rather than teaching creativity. There are various models that can be used for designing for creative learning.

The pedagogical model for designing for creativity is the one that is most applicable in various disciplines of science education, engineering, business, information technology and architecture. According to this model, there are specific conditions that need to be present in the learning environment for learning in a creative manner. These conditions are:

- Keeping an open mind
- Tolerating ambiguity and teaching learners to tolerate the discomfort of searching for answers
- Allowing time for ideas to take shape
- Leading by example
- Accepting failure
- Encouraging risk
- Searching for multiple answers
- Promoting internal motivation
- Ensuring control and ownership of learning

The pedagogical methods of designing for creative learning aim at developing creativity as a habit. Researchers of these methods of designing for creative learning argue that creative people are creative not because of their personal traits but because of their attitude in the sense that they respond to problems in fresh and new ways.

Stage and component models for designing for creative learning are the ones that are process based and relate to problem solving. One such model was introduced by Michael Gelb which included five stages to creative learning—preparation, generation, incubation, evaluation and implementation. An eight stage model was designed by Paul Plsek for creative learning. This included the stages of observation, analysis, generation, harvesting, enhancement, evaluation, implementation and settling in with the creative attitude.

In general, process based models that work on problem solving require the creative learners to take the following steps:

- Empathize with the problem and the people
- Defining the problem
- Generating many ideas and choosing one idea
- Making a model
- Testing the model in an iterative manner till the best solution is achieved

One criticism of the various models used for designing for creative learning is the fact that all of these are based on the assumption that creative people search for novel ideas. This may however not always be true and novelty, though imperative to creativity, may not always be the end result of creative learning process.

Creative learning has been fostered using several tools. Of these, multimedia was perhaps the first tool which was put to use by a large number of educational institutions so that problem based learning could be introduced for producing creative learners. Multimedia technology has been used as an innovative and learning strategy for creative learners so that learners can actively participate in what is being taught rather than being passive listeners as was the case with traditional teaching methods.

Multimedia technology enables the learners to think critically, creatively and analytically to solve problems. Multimedia technology allows creative learning as it enables the learners to make use of their multiple sensory modalities. This not only makes the learners pay more attention to instructions but also retain more information and learn better.

There are several multimedia tools and technologies that enable the creation of interactive and creative lessons for the learners. Technologies like Photoshop and Premier can be used to create interactive graphics and videos. Several authoring tools are also made use of for integrating all media used in a multimedia lesson for the creative learner. One main advantage of using multimedia tools for creative lessons is that the learners are generally required to work in groups and therefore learn to work collaboratively and in cooperation with others. Learning with multimedia technologies is interactive learning and enables the learner to learn in a creative manner thinking critically on how to solve a problem.

Another tool used for creative learning is the mind map. The mind map provides the facilitators and teachers to explain concepts using innovative ways. The mind map was introduced in the late 60s by Tony Buzan. The mind map was basically introduced as a tool to enable learners to take notes of key words and images in a quick manner. Mind maps are very easy to create and review. These engage the brain of the learners more as compared to other tools and enable creative learners to assimilate and connect facts in a better manner.

Mind mapping enables the creative learner to make full use of the visual and sensory tools and retain the information for a longer time. The notion behind mind maps is to enable the creative learners to build their own creativity, think and cross link the ideas that exist in their minds.

For creative learning, the teachers and facilitators are also using the **Z to A** approach. In this approach, the teacher tries to explain the application part of a specific concept first. In other words, the teacher or the facilitator does not focus on the theoretical part of the concept but on how the concept is applied. This approach helps the learners to get a better understanding of the concept and also develops the curiosity to learn the concept which eventually triggers the creativity of the learners.

Role playing and scenario analysis based teaching is another innovative method used to foster creativity. In this method of creative learning, the facilitator or the teacher makes sure that the learners are actively involved and participate in learning a particular concept. This method of creative learning not only focuses on the practical aspect of a concept but also on the theoretical one. This enables the creative learners to retain the learned concept for a longer time and assimilate related information for better learning.

As has already been stated that creativity cannot be taught and therefore a specific method for creative learning and teaching cannot be listed. However, to ensure that creative learning is fostered in educational institutions, the following five areas need to be worked upon:

- **Curricula:** In most countries, the facilitators and parents are of the view that the curricula taught in educational institutions lacks the idea of creativity and the curriculum does not encourage creativity. Therefore, it is essential to make sure that creativity be made an integral part of the curriculum which is taught at various level of education.

- **Pedagogies and assessment:** Today, in spite of the fact that creativity is encouraged by teachers and facilitators in every possible manner, the conventional methods of learning still prevails because of several factors. These include tight schedules, overloaded curriculum and school culture that does not support new ideas of creativity. Assessment is considered as the major barrier in terms of creative learning. The assessment process has not changed even though teaching and learning methods have changed and therefore it is not possible to bring about a change in the learning objectives.

- **Teacher training:** To ensure that creative learning is facilitated in the best possible manner, teachers need to be trained first in terms of the concept of creative learning and its consequences. Those teachers trained in creativity would have a better idea of what creativity can do for learners and the fact as to why creativity is the very premise of learning in this modern day and age.

- **Digital media and ICT:** Technology plays an important role in enabling creative learning. Technology is not only essential for fostering creative learning but also for innovative teaching.

- **Educational culture:** It is essential to bring about a change in the educational culture to ensure that it facilitates creative learning and teaching. A shift is needed to be brought about in the educational culture so that innovative pedagogic practices can be implemented for creative learning.

Curricula for creative learning

The curricula and learning objectives must provide a definition of creativity which takes into account the broad aspect of creativity across all curricula and also across all disciplines. The curriculum designed for creative learning must provide flexibility, time and space for creativity and innovative learning. It is also essential that the curriculum designed for creative learning be reviewed and updated at regular time intervals so that it can be changed as per the changing creative needs of the learners. It is also important that guidance documents be provided to the teachers as well as the facilitators stating how to foster creativity in the learners. The teachers and facilitators must be able to develop teaching practices that have creative outcomes.

The curriculum for creative learning must be so designed that teachers and facilitators find it possible to foster creativity in all students.

Pedagogies and assessment for creative learning

As has already been stated that change in learning objectives cannot be implemented till the method of assessment is changed. Therefore, it is essential to develop formative assessment methods. Formative assessment must be used as tools by learners and teachers to understand what learning processes need to be improved, which skills need to be developed and also the cognitive areas that need to be worked upon for facilitating creative learning. In addition, innovative and creative approaches need to be introduced in assessments as well so that quality of learning and teaching can be improved upon. It is also essential to do away with the deep-rooted traditional practices of assessment in order to foster creative learning.

Teacher training for creative learning

Teacher training programmes must be implemented at all levels of education to enable teachers to include creative learning techniques in their teaching methods. Teachers and facilitators must be provided with hands-on experience on how to include creative learning as an integral part of their teaching methodology. It is essential for teachers to develop cross-curricular competencies as well as embed digital tools in all forms of learning to foster creativity. Modular training approaches with emphasis on technological development must be adopted for teachers and facilitators to ensure that they can help students to express their creativity with the use of right tools.

Digital media and ICT for creative learning

It is essential to know the status and level of technology that is used by teachers and facilitators for creative learning. To ensure the development of educational strategies that foster creativity, it is essential to know how effectively teachers make use of technology for creative teaching and learning. It is essential that teachers get the required technology and technical support to ensure that creativity of the learners is enhanced. Teachers must be able to integrate technology in the right manner into their teaching methods so that creative and innovative learning and teaching can be facilitated at all levels.

Educational culture for creative learning

Education culture needs to be changed across the globe. The important stakeholders of education need to bring a change in their approach and be more open to new ideas, innovations and technologies in education. This is essential to foster creative learning at all levels of education. The new approaches to education must be realistic and must combine the useful elements of the traditional approaches and new ones like embedding the ability to solve problems, and divergent thinking. Education culture that nurtures creativity and innovation must be encouraged. Though creativity is present in the education culture, there are instances when it is not properly highlighted and therefore it is essential to bring about a change in the education culture to promote creativity in the right manner.

Creative learning therefore includes the following:

- **Creative curriculum:** A creative curriculum is a carefully planned and thematic approach to teaching and learning. Creative curriculum is specifically designed to support the natural curiosity of the learners and to stimulate their creativity. This type of curriculum is student-centred and focuses more on developing skills of the learners rather than on the content which is included in the curriculum.

- **Cross curricular teaching:** Cross curricular teaching refers to linking the content at various levels of curriculum across disciplines to facilitate creativity and innovation in learning.

- **Creative teaching:** Creative teaching is an essential part of creative learning. It includes the teachers making use of imaginative approaches to learning to make learning more interesting, effective and exciting.

- **Teaching for creativity:** Teaching for creativity involves teaching creatively wherein teaching forms and methods are used which develop creative thinking and behaviour of the learners.

- **Promoting creative learning:** Teachers and facilitators promote creative learning by encouraging learners to question and challenge, make connections and see relationships, speculate, keep options open when enquiring and reflect critically on their ideas, actions and the results.

In creative learning, the learners exhibit the following:

- They are practically engaged in the learning process either individually or in groups.
- The learners work harder than the teachers and facilitators.
- The learners are motivated and interested in what they are doing and learning.
- The learners are able to explain and enthuse about what they are doing.
- The learners are indulged in collaborative learning.
- The learners experiment with new ideas, materials and processes.
- The learners also reflect on what they are learning and on their progress.
- The learners are listened to and are also valued.

In creative learning the staff exhibits the following:

- The staff acts as facilitators who empower and enable the creative learners.
- The staff explores and learns along with the creative learners.
- The staff asks more open-ended questions.
- The staff does not have a rigid lesson plan but just an idea of what the lesson has in store for the learners.
- The staff actively listens to the learners.

The outcomes of creative learning for learners are as follows:

- Creative learning can help learners solve problems. Learners find their way around the problems and develop the abilities to ask questions and solve the problems and also stay motivated to solve problems which they eventually find easy to work on.

- Creative learning enables learners to improve their social skills. Creative learners not only develop skills of working in a team and in a cooperative manner but also develop better communication skills.

- Creative learning enables learners to take risks and experiment. Creative learning makes learning exciting and interesting for learners and they therefore experiment on a specific problem and take risks to find the best possible outcome.

- Creative learning enables learners to learn in an independent manner. The learners create, manipulate and control the choices that they can make while learning. In creative learning, the learners do not have to depend on anyone to make the decisions and choices related to learning.

- Creative learning also facilitates co-construction of learning. It enables the learners, practitioners and teachers to work together to foster creativity in the learners.

- Creative learning enables the learners to reflect upon what they have learnt in a critical manner. This also enables the learners to find out whether they learnt in the most effective manner or not.

3.3.2 Outcomes of Creative Learning for Staff and Teachers

With the concept of creative learning fast replacing the traditional teaching methods, the role of the staff and the teachers has now changed to that of a facilitator who is responsible of facilitating students in learning and not making them learn. The facilitator provides the required space to the students to explore and find innovative solutions and answers. The facilitators use open-ended questions to foster creativity in the students so that they can learn more. Creativity and learning has also brought about significant changes in how learning is planned and organized. Teachers as facilitators are now required to outline creative learning strategies and also focus on what the students learn rather than what the teachers are making the students learn.

Creative learning enables the teachers and facilitators to take risks in terms of curriculum innovation. This is essential so that the students can learn in a creative and innovative manner. Creative learning has also enabled the teachers to develop what is known as a 'Creative Reflective Cycle' which supports a creative and reflective approach to creativity and learning. Creative learning has also brought about motivation and enthusiasm in teachers to develop better learning skills in the students. Research has suggested that with creative learning, teachers share the same excitement and thrill as the students in learning a new concept.

There are several ways in which creativity can be achieved in learning. For this, it is essential that the learners as well as the teachers or facilitators possess few skills. These include:

- The learners as well as the facilitators need to think creatively to achieve creativity in learning.
- The learners as well as teachers need to have the skills to find innovative solutions to the existing as well as future problems.
- The learners as well as teachers need to have skills to evaluate the current status and also find better solutions as and when needed.

Teachers can use the following methods and techniques to encourage creative learning and thinking in the students or learners.

- **Pestalozzi Method:** It is a method in which learners are encouraged to find the answers. Unlike other methods of encouraging students to give direct answers to questions, this method aims at encouraging students to find answers on their own. This method helps the students and learners to observe, reason, judge and imagine. This eventually helps the learners to develop creativity.

- **Montessori Method:** The education system is so designed and modelled that it depends on teacher driven lessons and no space is left for the learners to self-develop their skills and also innovate on methods of learning. The Montessori Method gives the students space in terms of developing self-learning capabilities. In this method, the learners or the students learn while the teachers observe the progress of the learning activity of the students.

- **Harkness Style of Teaching:** This is a method of teaching wherein the learners are required to sit in round tables rather than on desks and benches. This method of teaching converts the class into an open conference wherein interactions can take place in an effective manner. The students do not follow linear teacher driven classes in this method of teaching but sit around a round table so that they can share opinions and take responsibility for the same. This also enables the students to imbibe new and better ideas from their peers.

- **Project Based Learning:** Project based learning is another method that enables teachers to achieve creativity. The existing teaching methods focus on individual projects and lessons. However, it is important to that students focus on one project at a time so that the entire knowledge can be put together in a focused manner. This enables the students to answer questions and assessments for the project in an easy manner.

- **Focus on Concepts:** It is important for teachers to enable students to focus on concepts for fostering creative learning. When students focus on a specific concept, they explore ideas to find a solution and also evaluate the solution to find the best possible outcome. This way, students develop creativity and innovation in learning. On the other hand, if factual knowledge is provided to students or learners, they learn but it does not do anything to encourage creativity and imagination.

- **Consider Every Idea as Patent:** When students learn in a creative manner, they are bound to come out with solutions or products which are

new and unique. Therefore, like every new innovation is considered to be patent, these new ideas and products created by students must also be considered patent by the teacher or the facilitator. The creation of new ideas and products by creative learners is based on their sense of emerging knowledge.

- **Design Thinking Methods:** Design thinking tools and methods must be used as much as possible when students are made to learn. Design thinking methods are usually based on discussions and brainstorming wherein the creativity of the learners in unleashed in the most effective manner. There are many design thinking methods that can be used by teachers to help students learn in a creative manner. These include the following:

  o **Disney Model:** Disney's Creative Strategy is a tool for fostering creative thinking and has been inspired by Walt Disney who discovered creative ideas and turned them into reality. Disney's strategy was modelled by Robert Dilts who defined the technique as a means for converting dreams into reality. The technique involves a group of people who use a specific flow of thinking to create parallel thinking and to generate and evaluate ideas. The group also critically assesses the ideas and finds a solution to the problem. This method bridges the gap between imagination and reality. This creative thinking strategy unlocks the capabilities of the mind to dream and form unique solutions to solving problems faced. However, the problem with these solutions lies in the fact that they might not be applicable to reality. The Disney's Model of creative learning and thinking consists of three stages each of which represents a way of thinking. The stages must be applied in a specific sequence of the dreamer, the realist and the critic.

  The dreamer represents the first stage of the model of creative thinking. The dreamer stage is based on the premise that any creative idea begins with a dream full of passion and enthusiasm. This strategy allows the members of the group to share their dreams without any restrictions or criticism. This in turn helps to create a pool of creative ideas out of which some may be viable while others may not be practical. It is the viable creative ideas that form the basis of the other two stages of this method. In the realist stage, the members of the group think in a more logical manner. They try to develop action plan for the viable ideas and put them into practice. The plans in this stage are constructive and are aimed at turning the idea into an actual plan. The group basically works on finding as to how the specific plan can be turned into reality and also critically evaluating the plan. The critic stage of the model is based on critically evaluating the idea in order to shortlist its weaknesses and strengths. The team tries to find out if the idea will work or not and whether there is something wrong with the idea.

  o **Lego Serious Play:** The Lego Serious Play Tool is used to contribute to design thinking. Design thinking is an essential process that enables

creativity and innovation. The Lego Serious Play enables the people working on an idea to clearly understand the idea and reach creative solutions for the same. Design thinking encompasses both logical thinking as well as creative imagination to design innovative and unique products and ideas. The Lego Serious Play is a tool that involves the use of Lego bricks in the design thinking process so that creative ideas can be generated.

The tool is used by a group of members who communicate their ideas through a process of story-telling. Each of the members of the group creates its own character to address the problem at hand. This enables each member of the group to share ideas.

Before the Lego bricks can be used, the group members must be made familiar on how to use the bricks to unleash their creativity. This method of creative thinking basically involves a trained facilitator. The steps involved in the method include:

1. *Question:* In this step, the facilitator introduces the basic problem and asks challenging questions to the group members. This step starts the discussion related to the problem.

2. *Metaphor:* In this step, the group members build models that describe the challenge question or questions that have been asked by the facilitator.

3. *Sharing:* In this stage, all members share their ideas and view related to the problem using the models.

4. *Questions:* In this step, the group shares the experiences to create a solution to the problem.

o **De Bono Six Thinking Hats:** The process of critical thinking and learning is a very complex one and can also be very confusing. One of the successful methods of fostering creativity is the six thinking hats technique introduced by De Bono. The six thinking hats is based on the fact that human thinking is unstructured and reinforced in different ways and can therefore drive the thinking of individuals in different ways. The six thinking hats is a technique that allows the thinking process to follow a specific direction as and when necessary to get the desired results. The six thinking hats is a technique that can be used to look at a problem and find solutions using different types of thinking. The six thinking hats include:

1. *White hat:* The white hat represents the facts and information which is available to a person about a problem. There is no development in the thinking process using the white hat.

2. *Yellow hat:* Using the yellow hat, a person takes an optimistic approach to thinking about the problem. This helps to shortlist the advantages or benefits of the problem at hand.

3. *Black hat:* With the black hat, a person thinks about a problem cautiously and defensively. The black hat enables one to find out

the disadvantages of the problem. The black hat also enables one to think as to why a problem cannot be solved using logical approaches.

4. ***Red hat:*** The red hat is the emotions hat. It enables one to think on the basis of feelings that one has towards the problem and the gut reaction to the problem. The aim of using the red hat is to understand the emotional reaction of a person to a problem but not the reason for the specific feeling.

5. ***Green hat:*** The green hat enables one to think creatively about a problem. This hat allows one to find creative solutions to a problem. The person may make use of several creativity tools to find the desired solution to the problem.

6. ***Blue hat:*** The blue hat is more of a control hat to make sure that the entire creative thinking process is carried out in a planned and controlled manner. The blue hat can be used to guide the thinking process in better directions.

o **Problem Solving using Hurson's Product Model:** Creative processes have certain barriers and problems that are faced during the production of the idea or the product. Therefore there should be methods that can be used to discover these problems and find a way to get over these. Problem Solving using Hurson's Product Model was introduced by Tim Hurson.

This model consists of six stages:

1. ***What's going on:*** The first stage is to identify and understand the problem. In this stage, one identifies the problem and also the information related to the problem. The impact of the problem is also identified and the aim of solving the problem is also found out. Thus at the end of the stage, a complete understanding of the problem is achieved.

2. ***What is success:*** This is the stage in which those involved in creative problem solving define success and how to define a successful solution to the given problem. When defining the successful target for the problem, there are four elements that need to be focused upon—the expected outcome of the problem, what should be included and what should not be included in the problem, the values that need to be included in the solution and also how to evaluate the successful solution of the problem.

3. ***What is the question:*** When trying to creatively solve a problem, there are several questions that may need to be answered. The problem solvers need to find out which specific questions need to be answered and are more important for the problem. In this stage, the aim is not to find the answers to the problem but to define the most important questions.

4. *Answers:* Once the questions have been identified and defined, the next step is to find the answers. The answers are provided to reach a solution to the problem. In other words, while addressing specific questions, the aim is to find a solution to the entire problem in general.

5. *Forge the solution:* Once all the answers have been obtained, each of these is evaluated to find the best solution to the given problem. This stage helps in the identification of the best solution.

6. *Align resources:* This stage involves identifying the resources that can be used to implement the solution to the problem.

Hurson's Production Thinking Model is one of the problem solving tools that can be applied in creative and innovative projects because it fuels creative thinking during the discussions and is best applicable in organizations.

o **Reverse Brainstorming:** For finding a creative solution for a problem, the process itself needs to be creative. The process of brainstorming which is used in several organizations and institutions for problem solving lacks the creativity that can be used to get the desired results. The process of reverse brainstorming can be used to create better ideas and solutions to a problem. The process of reverse brainstorming works in a reverse manner and instead of focusing on how to solve a problem, it focuses on what causes the problem and how can an unexpected solution to the problem be found. In this method, one tries to understand the problem and create ideas that can be used to solve the problem. The process enables one to make use of unique thinking methods to find the desired solution. The following are the steps involved in reverse brainstorming:

1. Identify the problem that needs to be solved

2. Reverse the expected process in the sense try to find out how the problem can be solved in an unexpected manner

3. Collect all ideas without any criticism

4. After finding out the ideas that can make the problems worse, flip these ideas to find the best solutions to the problem at hand

5. Evaluate the results so that the best solution can be found out

o **Scamper Technique:** Scamper technique is one of the most successful techniques of creative thinking and creative learning. This technique is based on the fact that every new idea is basically a modification of old and existing ideas. This technique was first introduced by Bob Eberle. SCAMPER is an acronym for seven techniques:

S- Substitute

C- Combine

A- Adapt

M- Modify

P- Put to another use

E- Eliminate

R- Reverse

- The substitute technique focuses on how the existing idea or product can be replaced by another. The aim of the substitute technique is to provide alternative solutions and answers to a specific problem.

- The combine technique analyses the possibility of merging two ideas into one for a more effective and efficient result. This technique allows combining two or more innovative ideas and finding the best solution to the given problem.

- The adapt technique is used to adjust the idea or product so that it can produce a better and desired result. Adjustment can be either minor or significant changes so that the existing idea can be enhanced and made flexible to find better solutions.

- The modify technique refers to changing the idea or the product in such a manner that more innovative and creative capabilities are unleashed when to get the desired result.

- Put to another use is the technique that specified how an existing idea or product can be used in other situations in a more creative manner.

- Eliminate technique is the one that focuses on improving the idea or the process by eliminating certain parts of the idea or the process. All unnecessary ideas are eliminated in this manner and what is left is the best possible solution for a given problem.

- The reverse technique focuses on rearranging the process and ideas in a manner that can help to provide better and more innovative ideas and products.

- **Problem to Solution and Solution to Problem Models:** These models can be used to enhance the creativity of the students in a very efficient and effective manner. The Problem to Solution Model drives the students to find solutions to a problem. In other words, a student takes a problem from everyday life and then finds the best solution to the problem by taking into account several ideas. The Solution to Problem Model aims at helping a learner to find a solution for a problem which does not exist yet. The two models are used so that students can use their creativity in the best possible manner.

- **Reflecting upon Previous Lessons and Skills:** While the education system does not allow so, efforts must be made to enable learners as well as facilitators or teachers to reflect upon lessons that have already been learnt and the skills that have been so developed. This builds a continuation in the education process and also helps the learners to think critically and evaluate problems to find innovative and unique solutions to the problems.

- **Acknowledging Innovation and Creativity in Rubrics:** The education system must make provisions so that every new and creative idea in rewarded and acknowledged in the assessment. It is essential that a rubric section be included in assessment so that creative ideas can be assessed independently from the grading criteria.

Application of Reverse Brainstorming

A study was taken up to study the application of reverse brainstorming in a problem situation. The problem was that the people who visited the website did not stay on it for a long time and did not interact with the website content as required. To find a solution to the problem in a creative manner, reverse brainstorming was applied to the problem.

In the first step, the problem at hand was identified. The problem was defined for the group of participants so that they could understand the problem in the right perspective. In the second stage, team flipped the problem. In other words, the team worked on finding out as to how to drive the users away from the website and how to reduce the interaction level of the users with the web content.

In the third step, the members of the group looked at finding new and unusual ideas using which the users of the website could be driven away rather than visiting the website and interacting with it. Some of the ideas that were presented by the members of the group included:

- Building a complex navigation system so that the users could not reach the desired content
- Choosing a disturbing colour scheme and difficult to read fonts for the content of the website
- Hosting the website on a slow server
- Using very large files that take a lot of time to load

The fourth step included reversing all the ideas that were framed to drive the users away. This step gives the possible solutions to the problem. Therefore, the solutions to the problem include:

- Building an easy to use navigation system and a clear structure for the website so that users could reach the content easily
- Choosing comfortable colour scheme and easy to read fonts for the content
- Hosting the website on a fast server
- Using optimum size of files for the content of the website so that the users can easily access the content and interact with it as and when required

In the fifth step, the methods which are not feasible or viable as the solution to the problem are eliminated and therefore the best solution to the problem is arrived at.

3.3.3 Fostering Creativity in Learning

To foster creativity in learning, it is essential that the learners as well as the teachers and facilitators have a clear commitment and belief in the benefits of creative learning. Within an educational institution, creativity can be fostered by providing a curriculum that promoted cross-curricular links and also provides opportunities for independent enquiry and learning. Educational institutions must make provisions for a flexible time table so that creative learning can be encouraged in every possible manner. For effective implementation of creative learning curriculum, it is also essential that professional development of the teachers and facilitators takes place from time to time. A change in the education culture and making it more risk taking is also essential for fostering creative learning.

The various ways in which creativity can be fostered in classrooms include the following:

- Creativity must be embraced as a part of learning. The classroom environment must be such that it allows and recognizes creativity. The class must be so set up that it enables the learners to find out different ways to solve a problem and thereby find the best possible solution.

- In classrooms, the most effective strategies for creative learning must be adopted. Creative arts and media oriented approaches are known to work the best for fostering creativity in classrooms. In addition, strategies that make use of emotional and cognitive functions must also be used effectively to enhance creativity in the classrooms.

- Creativity needs to be considered as a skill and not an idea that can be taught in the classroom. Creativity is usually divided into Big C and Little C. While Big C is more concerned in finding creative solutions for bigger problems of the society, Little C is more concerned with finding solutions to problems that take place in everyday life. Both of these are considered as smaller skill sets of creativity and thus can be included in the classroom to foster creativity in the best possible manner.

- Programmes must be created to develop creative skills in students. Such programmes must allow the students to work together in groups to find solutions to problems not from within their domain but from other domains as well. This not only facilitates creative thinking but also enables the students to develop the skills of cooperation and coordination. Thus, creative learning in classrooms is not limited to the development of just learning skills.

- Using a creativity model in the classroom can also help in fostering creativity in an effective manner. The oldest and the most widely accepted creativity model is the Osborne-Parnes Model. The various steps of the model involve divergent thinking patterns to develop ideas and then convergent thinking so that the number of ideas to be explored can be reduced and the best possible solution can be obtained.

The Osborne-Parnes Model has six steps. The first step is called mess finding wherein the goal or the objective is identified. The second step is fact finding wherein knowledge and data related to the problem is gathered. The third step is problem finding wherein the problem to which a solution has to found is identified. The problem is stated in clear terms as well. The next step is idea finding wherein the students are required to generate ideas to find the solution to the problem. Solution finding is the next step in which the ideas are explored and evaluated to find the best one. The last step is acceptance finding in which ideas are implemented to find the best solution to the problem at hand.

By using a creativity model like the above one in the class, the students can develop several new and innovative ideas to solve a specific problem. This way, the students learn in a creative manner.

- Classroom assignments must be designed so that they make use of both convergent thinking as well as divergent thinking. Standardized tests must be used in the classrooms to make use of the convergent thinking skills in the sense that the students must be able to analyse the questions and provide one correct answer. Divergent thinking on the other hand enables the student to look at the problem from different approaches. Divergent thinking involves the use of association and multiplicity of thought and therefore assignments must be designed so that the students can best make use of their divergent thought process and provide creative, new and unique solutions to the problem at hand.

- The classroom atmosphere must be such that it supports creativity. Creative thinking and learning needs to be shared and validated by others around for which it is essential to create a congenial environment in the classrooms.

- It is essential to let students ask questions which may even require the teachers to think upon and trigger their creativity. The teachers must make sure that they do answer such questions and discuss them in classroom to validate the creativity of the students. This way, the students would be more interested to learn.

- In classrooms, creativity must be seen in the positive light. If the teachers are enabling students to learn in a creative manner, it is essential that the teachers also embrace creativity in a positive manner and encourage new and innovative solutions to problems. The students must be encouraged to come up with varied ways of finding a solution to a specific problem.

- The teachers can make use of the Incubation Model developed by E. Paul Torrance for fostering creativity in the classrooms. This model has three stages. The first stage called heightening anticipation is the one in which the teacher creates a desire in the students to learn and know. This is done by the teacher by establishing a connection between the classroom and the real life outside. The second stage is called deepen expectations. This is the stage in which the teacher makes use of the curriculum in new ways. The teacher in the classroom creates opportunities and allows the students to brainstorm so that new and novel ideas can be thought of and

developed. The third stage called the keep it going stage is the one in which the teachers find out ways in which creative thinking can be extended beyond the classrooms. The teachers come up with ways in which creative learning is not restricted to only the classrooms.

- To foster creativity in the students, they must be given the freedom to express. The classroom environment must be such that the students can share and talk about their new and novel ideas. This way the students not only get a chance to have their idea evaluated but also build the required confidence about finding unique and creative ideas.

- To foster creativity in students in classrooms, it is also important that creative approaches to lessons be developed by teachers. The curriculum must be so designed that it allows for flexibility to introduce creative approaches.

- When fostering creativity in classroom, the teacher must also allow space for mistakes. This is essential for the students to come up with original and innovative ideas. If the teacher leaves no room for mistakes, creativity of the students is inhibited in several ways.

- The teachers must give time to students to ask questions. The lessons must be so designed that they leave the students wondering and wanting to ask questions and explore ideas. This is one of the best ways in which creativity can be encouraged and fostered in students.

- Teachers must allow the students to take ownership of their learning when it comes to creative learning. The teacher must make sure to design lessons and projects wherein students need to put in their creative best. This not only helps to enhance creative skills but also enables the students to learn better.

- Encouraging the curiosity of the students is another way of fostering creativity. The teacher must know what drives the thinking abilities of the students and draw examples from the world of the students. This way, the students are not only encouraged to learn 'out of the box' but also develop new ideas.

- In the classroom, the teacher must make an effort to integrate arts, music and culture into the lessons. Research suggests that art, music and culture are the best vehicles for triggering creative learning.

- The teacher must make use of a collaborative thinking model to solve a specific problem. Collaborative thinking not only enables the students to find solutions to problems but also explore a wide range of ideas before finding the best possible solution of a problem.

- Multi-disciplinary lessons must be designed to foster creative learning in classrooms. For instance, the concepts of geometry can be reinforced using arts. The multi-disciplinary approach not only makes the concept clearer but also enables the students to think over various ideas and learn using the best one.

- In the classroom, it is also important that the teacher taps into the multiple intelligences to foster creativity. The teacher in the classroom needs to know for a fact that all students learn in different ways and the same method of learning does not work for all students in the same effective manner. Therefore, the creative lessons must be so designed that the teacher is able to meet the learning needs of all types of students.

- Creative skills must be taught explicitly to the students in classrooms. The creative skills must cover the five major areas of imagination, self-motivation, resilience, collaboration and also give responsibility to the students. These skills are important for students to imbibe creativity and also include it as a part of their everyday learning.

Creativity Training Programmes

With the growing importance of creativity, several educational institutions have started using creativity training programmes. The creativity training programmes include both narrowly focused skill bases creativity programmes and also broader knowledge based educational programmes. Creativity training programmes must be well-designed so that they can be most effective. These programmes focus on developing cognitive skills. These programmes are employed at all levels of education and even at a professional level. Creativity training should be based on a sound and valid conception of cognitive activities underlying creative efforts. Creativity training programmes should in essence be lengthy and challenging and must include elements like discrete cognitive skills and associated heuristics. Creativity training programmes must always make use of real world examples. The training programmes must also include enough material along with exercises which are appropriate to the domain so that those attending the training can practice these exercises and develop the required creative skills.

Creativity training programmes must be well-structured and domain specific. They must enable people to apply relevant strategies and heuristics to complex and realistic concepts. This enables in developing creative abilities that are essential to frame creative outcomes and solutions.

3.3.4 Assessment in Creativity

It is argued by researchers that if creativity is considered to be a learning activity, then assessment is an essential aspect of creativity as well. Assessment for creativity must also be creative and must be both formative as well as summative. However, assessment for creativity is problematic. This is because creativity is personal, emotional and contextual and varies from one person to another and also from one problem or challenge to another. Creativity may also be considered non-academic by many and therefore is difficult to assess.

Measuring creativity is also difficult mainly because of the problems associated with the phenomenon. There is also no defined criteria for measuring creativity. According to Norman Jackson, 'a more synoptic approach to the assessment of creativity over a length of time considering a number of assessments (e.g., over a student's whole degree programme) would be more appropriate than the atomistic

approach generally employed'. The assessment of creativity is perhaps the toughest at the disciplinary level. A formal assessment at this level cannot be used to assess creativity in any manner.

Another problem with the assessment of creativity is that there are no set standards that can measure creativity. It is argued that creativity levels of expert and novice people are different and therefore a consistent rating or measuring criterion cannot be developed and used. William and Askland suggest that, 'Problems of assessing creativity may lie in a poor understanding of the pedagogical dimensions of creativity, along with a lack of appropriate strategies to understand where different levels of creativity occur and how they should be assessed, and a lack of tools and models to support assessment.'

One way of assessing creativity can be to assess the achieved learning outcomes rather than assessing intended learning outcomes. This is a means of assessing what a creative learner has achieved from his or her own learning goals. The best assessment strategies are the ones that evaluate the whole creative process so that the concepts of personal reflection, self- assessment, management of learning and decision-making are all evaluated in the best possible manner. This type of assessment ensures improved and active involvement of the creative learners. Pedagogical design is also important for the development of assessments for creativity so that these assessments are developed in line with the needs of the educators as well as the creative learners.

CHECK YOUR PROGRESS

5. What freedom should education provide?

6. What are the five stages to creative learning as introduced by Michael Gelb in his model on designing for creativity?

7. When and who developed the mind map tool for creative learning?

8. What is the Lego Serious Play Tool?

9. Why is the measurement of creativity a difficult process?

3.4 DEVELOPMENT OF CREATIVITY

It is important that creativity in young children be developed at an early age. For this, the curriculum must be designed in such a manner that creativity is one of the achievable aims of the curriculum. The curriculum for young children must be designed in such a manner that it enables them to think critically and creatively. This enables the children to solve problems in an effective manner. The curriculum must be designed to give an opportunity to the children to be innovative, enterprising and capable of leadership. Education therefore plays an important role in the development of creativity in young children.

Developing creativity in young children involves the development of the following elements:

- Imagination wherein the young children are able to imagine a specific concept in a creative or different manner

- Originality wherein the children are able to come up with ideas and products that are new and unusual

- Productivity wherein the children are able to generate several different ideas through divergent thinking

- Problem solving wherein the children are able to apply their knowledge and imagination to the given problem

- The ability to produce outcomes of value and worth

Many times, creativity is considered to be synonymous to intelligence especially in case of young children. However, creativity and intelligence are different concepts. This simply means that those children who score well in intelligence tests may not be highly creative.

The concept of multiple intelligences holds true for all children but this is different from creativity which refers to a more generic set of abilities that can be applied to a range of domains. Talent and creativity are also not the same as thought of by many people. Talent means that a person has high level of aptitude and skill in a specific area but this does not imply high degree of creativity and originality in that area.

When it comes to creativity in young children, it must be kept in mind that every child has a creative potential and is capable of creative expression. The creative ability of each child can be related to his or her personal stage of development. When it comes to young children, the emphasis must be on the creative process and not the creative outcome of the process. This is because young children may not have developed all the necessary abilities and skills to achieve creative outcomes. Loris Malaguzzi says, 'Creativity becomes more visible when adults try to be more attentive to the cognitive processes of children than to the results they achieve in various fields of doing and understanding.'

Association for Promotion of Creative Learning

The Association for Promotion of Creative Learning (APCL) adopts a creative learning and teaching methodology on the basic premise that each child is unique and learns in a unique manner. At APCL, it is believed that students learn using the concept of multiple intelligences. The multiple intelligences through which children learn include the following:

- Verbal
- Logical
- Spatial
- Rhythmic
- Kinesthetic
- Interpersonal
- Intrapersonal

These intelligences are developed in different children in different measures and by different means. In schools, where a specific curriculum is followed, the children are able to learn by verbal and logical intelligence and therefore only those children are said to be successful in school who show logical and verbal skills while the other students do not get the required and desired success. APCL has developed techniques to integrate all intelligence in its teaching methods so that children with all learning styles get the opportunity to develop a potential in their own learning styles.

APCL also believes in the fact that each child has a unique learning environment. The learning environment plays an important role in helping the children develop the required creative skills. It is also essential to have an atmosphere of joy and happiness for the development of the creative potential of the children. APCL has created most of its learning activities in the form of games so that the children can develop the creative potential in an effective manner.

APCL believes that creative learning methodology requires development of team spirit and cooperation. Group cooperation is essential for the development of creativity among young children. At APCL, it is also believed that curiosity is the basis for creative learning and curiosity comes naturally to children.

At APCL, seven core competencies are recognized for creative learning of young children. These include:

- Power of observation
- Concentration
- Memory
- Thinking
- Imagination
- Emotional control
- Power of expression

These competencies are basic to any process of learning and the efficient use of these competencies can make learning more creative. APCL also believes that creative teaching is effective only if it can lead to what is known as self-learning. Young children therefore must be able to master the art of learning if they want to be creative. For this purpose, APCL believes that:

- Every occasion is a learning occasion
- Every person, animate and inanimate object in the world is a learning object, learning facilitator and learner

Mental image-making is another area in which APCL works. Mental image-making enables young children to develop the power of concentration, memory and imagination. It also enables the children to have better emotional control. APCL also helps in fostering creativity by enabling children to learn the art of questioning. APCL has found that learning the art of questioning may provide a forum to such curiosity development plan. APCL believes that it is not only important to know the

art of answering, it is rather more important to master the art of questioning. Questioning guides the path of thinking—both convergent and divergent and thus gives direction to curiosity.

APCL has also developed activity based learning methods for young children for the development of their creativity. Creative learning is enabled through different kinds of activities involving books, pictures, projects, exhibitions, debate, role play, games, stories, discussions, debates, computers and excursions.

3.4.1 Environmental and Psychological Factors

There are several researchers who have worked to see how creativity develops in young children. There are several theories of child development that view young children as highly creative with a natural tendency to fantasize, imagine, explore and experiment with the environment. However, it is not essential that high levels of creativity are maintained from childhood to adulthood. For example, Karen Meador presents evidence from the US that creativity as measured by divergent thinking tests declines when children enter kindergarten, at around the age of five or six.

Runco also studies how creativity develops in young children. He concluded that a child who is regarded as highly creative in early life may or may not show creativity consistently in later stages. Thus, creativity undergoes uneven development from the fact that certain traits and talents develop at different rates and stages and are influenced by several factors.

Thus, in young children, the development of creativity takes place at different rates throughout the various stages of life and is influenced by several factors including environmental, societal and parental. Also, all children of the same age group do not develop similar creative interests and the extent of creativity in different children is also different.

Many researchers on creativity agree to the fact that it is possible to some extent to encourage and also inhibit creativity in young children. According to Meador, children are apparently more creative before they enter kindergarten after which their creativity may either be constrained or it may decline because of several factors.

There are several ways in which creativity can be fostered in young children. The best way to foster creativity in young children is to make sure that this is done in their educational settings. There are several components of creativity in young children which need to be identified in order to foster creativity in them in an effective manner. Creativity in young children is closely related to the personality as well as the emotional aspect of the children. The model developed by Russ explains the relationship between creativity and psychological processes. According to this model, the following are the three elements which are involved in understanding the relationship between creativity and psychological process:

- Personality traits like self-confidence, curiosity and motivation
- Emotional processes like fantasy and anxiety
- Cognitive abilities like divergent thinking, sensitivity, knowledge and judgement

The model simply implies that for a child to express his or her creativity, it is essential for him or her to have a combination of attributes. While some children may have the required abilities and skills to be creative, others may need help to develop the requisite skills to show creativity. For instance, a child may be interested in creative process but lacks the self-confidence to do so and therefore needs to be encouraged to be confident enough to show that he or she has something of value to offer to the society.

Educational settings can influence creativity of young children in three respects—creative environment, creative programmes and creative teachers and their way of teaching.

Creative environment

What is fundamental to creative environment is encouraging children's play. Play is in fact one of the strongest methods of fostering creativity in young children. Imaginative play, role play and free choice of activities include the key components of creative environment for early childhood development of creativity. Play like creativity requires imagination, insight, problem solving, divergent thinking and ability to experience emotions and make choices. However, not all play involves and requires creativity. According to Prentice, active involvement is required on the part of young children to develop creativity. Young children when actively involved in their own learning tend to improve their imagination and develop creative abilities essential for creative learning and thinking.

The stimulation offered by the physical environment also helps in the development of creativity in young children. The physical environment may include the size and layout of the classroom, the outdoor space, the quality of the materials and the equipment used and access to the environment. It is also required that for children to develop creativity in educational settings, they be given enough time to work on their projects. Time is an essential element when it comes to fostering creativity in young children.

Creative programmes

Research suggests that it is possible to enhance the creative skills of young children through specific teaching programmes. In this aspect, art based programmes work the best. However, the main criticism to the use of creative programmes in the enhancement of creativity is the fact that not all art based programmes are successful in fostering creativity in the required manner.

Creative teachers

In educational settings, creative teachers and their methods of teaching are key elements in fostering creativity in young children. Teachers can do the following to encourage creativity in young children:

- Asking open-ended questions
- Encouraging experimentation
- Modelling creative thinking and behaviour

- Tolerating ambiguity
- Praising children who come up with unexpected and unique answers

For developing creativity in young children, it is also essential for the children and the teachers to interact. It is essential that teachers show interest in the creative potential of the young children so that their creative abilities can be developed in the required manner.

Research also suggests that teachers and adults can also stifle the opportunities of creativity of the children. They can limit creativity by discouraging fantasy and also by having low expectations about what the young children can achieve. The following are the main factors that may be responsible for teachers or adults inhibiting the creativity of the young children:

- Pressure to focus on literacy and numeracy
- Lack of training
- Tension between meeting the needs of the class and encouraging the creativity and needs of the children

It is believed that creativity in young children is limited to arts subjects only which is not true. Creativity is associated with creative subjects like art and music. But this does not mean that creativity is limited to these subjects alone. Creativity is a means of problem-solving and so is applicable in different areas. The way in which creativity is expressed by children is different for different curriculum areas.

Young children are often encouraged to treat the process of creativity as a fun activity and not take it seriously. Creativity however requires concentration, persistence and determination to succeed and is in fact a tedious task and therefore needs to be taken seriously. While creativity is considered by many as an in-born trait and limited to a few people, the truth is that all children possess creative abilities which are affected by several factors. Young children need the right kind of support so that they can develop creative skills and abilities and those who do not get the required support and opportunity may not be able to show their creativity in any form.

With regards to creativity in young children, there are several people who believe that free play and unstructured art activities are enough for the development of creativity. Children do benefit from arts and free play but for the development of creativity in the most effective manner, children need stimulation so that their creative potential can be used in an optimum manner. Also it is not essential for young children to be knowledgeable and skilful to be creative though these are the fundamental requirements for creativity. A balance needs to be maintained between knowledge and creative skills for effective creative learning.

The key consideration in developing creativity in young children is the fact that each child has a unique style of learning. Young children learn through multiple intelligences and therefore have a unique style of learning. This style of learning plays an important role as to how creativity can be developed in young children.

Psychological Approaches

Several theories of creativity have been developed to describe the nature of creativity and its relationship with learning. In 1972, John Curtis Gowan classified the various theories of creativity into five categories including:

- Cognitive, rational and semantic approaches
- Personality and environmental approaches
- Mental health and psychological approaches
- Psychoanalytic and neo-psychoanalytic approaches
- Psychedelic approaches

The cognitive, rational and semantic approaches to creativity view creativity as rational and is set in a cognitive domain with emphasis on verbal concepts and associations. The associative theory is an example of this group of theories. According to the associative theory, creativity is about making associations. The theory states that creativity seeks to join disparate things and ideas to create something new and original. Another theory is that of convergent and divergent thinking which states that creativity involves convergent as well as divergent thinking to make judgements about creative ideas. Divergent thinking involves a broad search for novel ideas whereas convergent thinking is more focused.

Personality and environmental approaches are concerned with the personality characteristics of the creative person. These theories focus more on the nature of the person rather than on the products and processes of creativity. The mental health and psychological theories of creativity stress on the need of self-realization, personal growth and fulfilment. These theories focus on both the creative person as well as the process of creativity.

The psychoanalytic view of creativity has been influenced to a great extent by the work of Freud. According to Freud, there was very little difference between creativity and neurosis except the fact that a creative person can make use of unconscious materials and achieves gratification. Thus according to Freud, a creative person needs a temporary break from the reality to bring out creativity. Over the years, the locus of creativity has shifted from unconscious to preconscious.

The word psychedelic means mind-manifesting. Psychedelic approaches to creativity therefore focus more on expanding the awareness of the mind so that a person can become more creative in a wider environment.

3.4.2 Role of a Teacher in Developing Creativity in Students

School is, in fact, the proper place where an organized effort should be made to develop the basic foundations for creativity in children. Deliberate attempts need to be made to develop an environment of creativity among them. Some methods useful in promoting creativity are:

I. **Identification of the creative child:** Both test and non-test techniques can be used to identify the creative child. Guilford and Merrifield developed test

techniques that measured fluency, flexibility, originality, redefinition and sensitivity to problems.

Getzels and Jackson, on the other hand, used five different measures of creativity in their research.

- **Word-association tests**: Students are required to give as many definitions and number of different categories into which they could be placed.
- **Uses of things tests:** A student is asked to give as many uses as he can for a common object.
- **Hidden shapes tests:** A student is required to find more complex form of figures and shapes on cards, presented to him in a simple form.
- **Three different endings:** A student is required to suggest three different endings to incomplete short fables.
- **Make-up problems:** A student is required to make-up or form as many mathematical problems he can on the basis of information given in a complex paragraph.

Besides these, the Minnesota tests of creative thinking comprising non-verbal tasks like picture construction, creative design, circles and squares, etc. and Torrence's check-list comprising 84 characteristics for identifying the creative children, are also very helpful.

II. **Factors in the school that hinder creativity:** The present curriculum and methods of teaching are rigid and tradition bound. The current educational system largely encourages acquisition of knowledge and lays emphasis on rote memory. It rarely calls upon children to think and use their creativity. Most of the school activities and curriculum are usually teacher-centred.

III. **Strategies for developing creativity:** It is often said that creativity needs to be identified, energized and guided almost from birth. Research findings suggest that the development of creativity cannot be left to chance. Creativity is likely to flourish in an environment which values independent and free thinking.

IV. **Types of programmes for the education of creative children:** Following are the programmes for educating and guiding creative children.

- Identification of the creative children in the school
- Formulation of general and specific goals for guiding creative talent
- Providing appropriate learning environment
- Stimulating creativity among those children who do not apparently show it

V. **Providing creative learning environment and experiences in the classroom:** The teachers should follow the given guidelines to promote creativity in children:

- Inspire the students to learn to disagree constructively
- Inspire the students to emulate creative persons

- Provide for exciting experiences to the students
- Provide a safe, permissive and warm environment
- Develop student's ideas through constructive criticism and through referral to competent authorities

- Provide necessary guidance and counselling for developing motivation and overcoming emotional fears
- Allow the students ask unusual questions
- Appreciate imaginative and unusual ideas of the students
- Assure students that their ideas have values
- Evoke originality in thinking
- Provide opportunities to students for self-initiated learning
- Provide materials which develop imagination of the students
- Ask challenging and thoughtful questions
- Rewards rather than punishment helps to increase creativity in students or children
- Shower love on them and let them know it
- Provide activities like drama, dance, music, etc.
- Encourage debates, discussions, quiz, etc.
- Show wit and humour in the class
- Encourage them to do intensive and extensive reading
- Arrange lectures of creative personalities
- Encourage students for self-evaluation
- Follow gaming technique
- Follow brain storming strategies

Brain Storming as a Strategy for Developing Creativity

Brainstorming is a technique which emphasizes the importance of divergent thinking. It involves generating ideas in response to some problem in a group. It allows children to attack and solve a problem without any inhibition or restriction. Literally speaking, it is 'storming' a problem by a number of possible ideas and solutions.

To start with, students may be provided with a focus, i.e., a particular problem like 'Students' Self-government in the School', 'Checking Late Coming', 'Improvement in the Examination System', 'Organizing the Annual Function', etc. Thereafter, students are asked to suggest ideas. In this context, following guidelines need to be kept in view:

- Students are encouraged to suggest as many ideas as possible; however, unusual these might be.
- Students are allowed to express their ideas freely.

- Students' ideas should not be criticized.
- Students may be encouraged to build new ideas on the basis of ideas already suggested by the fellow students.

- Main points of all the ideas should be written on the blackboard.
- In the end, attempts should be made to find out a meaningful solution.

CHECK YOUR PROGRESS

10. How should the curriculum be designed for school students?
11. How can educational settings influence creativity?
12. What methodology does the Association for Promotion of Creative Learning (APCL) adopt?
13. What is brainstorming?

3.5 SUMMARY

- Creativity is a skill which enables one to imagine and explore ideas which are unusual and unique. Creativity allows one to find solutions to problems which are not expected.

- There is no one specific method in which creativity can be developed in a person. There are various techniques that can be applied in various situations to help people develop their creative skills.

- In the educational set-up, creativity can be developed in students by incorporating creative learning in the curriculum which is taught to the students.

- The National Advisory Committee on Creative and Cultural Education defines creativity as, 'Imaginative activity fashioned so as to produce outcomes that are both original and of value.'

- The idea behind creativity is to solve a central problem in an unexpected way. Creativity is a highly dynamic process wherein the actual outcomes can be quite different from the ones that have been anticipated.

- The process of creativity involves taking an idea and playing with it to fathom the various possibilities.

- Constructionist methods also link learning with creativity. Constructionism is an educational method that is based in the constructivist theory of learning. Constructivism states that knowledge is constructed in the mind of an individual.

- Learning and creativity share many similarities. Learning is social in nature because to learn people interact with each other and in turn are influenced and also influence others.

- Creative learning can be most effective when the learner is familiar with and skilled enough to draw conclusions from several perspectives.

- Learning can always be a joyful experience for a child. Learning through play and games helps children procure pleasure in learning.

- 'Learning to know' includes the development of the faculties of memory, imagination, reasoning, problem-solving, and the ability to think in a coherent and critical way.

- An education system wherein creativity is considered integral must give learners the freedom to recognize their potentials and capabilities.

- Traditional method of teaching is a one-way flow of information where the teacher talks continuously for hours without getting to know about the response or the feedback of the learners.

- Multimedia technology has been used as an innovative and learning strategy for creative learners so that learners can actively participate in what is being taught rather than being passive listeners as was the case with traditional teaching methods.

- Cross curricular teaching refers to linking the content at various levels of curriculum across disciplines to facilitate creativity and innovation in learning.

- Creative learning also facilitates co-construction of learning. It enables the learners, practitioners and teachers to work together to foster creativity in the learners.

- The Montessori Method gives the students space in terms of developing self-learning capabilities. In this method, the learners or the students learn while the teachers observe the progress of the learning activity of the students.

- The Lego Serious Play Tool is used to contribute to design thinking. Design thinking is an essential process that enables creativity and innovation.

- Using a creativity model in the classroom can also help in fostering creativity in an effective manner. The oldest and the most widely accepted creativity model is the Osborne-Parnes Model.

- To foster creativity in students in classrooms, it is also important that creative approaches to lessons be developed by teachers.

- With the growing importance of creativity, several educational institutions have started using creativity training programmes. The creativity training programmes include both narrowly focused skill bases creativity programmes and also broader knowledge based educational programmes.

- Measuring creativity is also difficult mainly because of the problems associated with the phenomenon. There is also no defined criteria for measuring creativity.

- It is important that creativity in young children be developed at an early age. For this, the curriculum must be designed in such a manner that creativity is one of the achievable aims of the curriculum.

- The concept of multiple intelligences holds true for all children but this is different from creativity which refers to a more generic set of abilities that can be applied to a range of domains.

- The Association for Promotion of Creative Learning (APCL) adopts a creative learning and teaching methodology on the basic premise that each child is unique and learns in a unique manner.

- There are several theories of child development that view young children as highly creative with a natural tendency to fantasize, imagine, explore and experiment with the environment.

- Educational settings can influence creativity of young children in three respects—creative environment, creative programmes and creative teachers and their way of teaching.

- The psychoanalytic view of creativity has been influenced to a great extent by the work of Freud. According to Freud, there was very little difference between creativity and neurosis except the fact that a creative person can make use of unconscious materials and achieves gratification.

- Brainstorming is a technique which emphasizes the importance of divergent thinking. It involves generating ideas in response to some problem in a group.

3.6 KEY TERMS

- **Creative curriculum:** It is a carefully planned and thematic approach to teaching and learning.

- **Cross curricular teaching:** It refers to linking the content at various levels of curriculum across disciplines to facilitate creativity and innovation in learning.

- **Brainstorming:** It is a technique which emphasizes the importance of divergent thinking.

- **Heuristic:** It refers to enabling a person to discover or learn something for themselves.

3.7 ANSWERS TO 'CHECK YOUR PROGRESS'

1. In the educational set-up, creativity can be developed in students by incorporating creative learning in the curriculum which is taught to the students.

2. Creativity is a highly dynamic process since the actual outcomes can be quite different from the ones that have been anticipated.

3. Creative teaching can be defined in two ways—teaching creatively and teaching for creativity.

4. 'Learning to be' may therefore be interpreted in one way as learning to be human, through acquisition of knowledge, skills and values conducive to personality development in its intellectual, moral, cultural and physical dimensions.

5. Education must give freedom to learn for which it is essential to create an atmosphere where thinking, questioning and imagining is encouraged.

6. The model on designing for creativity as introduced by Michael Gelb included five stages to creative learning—preparation, generation, incubation, evaluation and implementation.

7. The mind map was introduced in the late 60s by Tony Buzan.

8. The Lego Serious Play Tool is used to contribute to design thinking. Design thinking is an essential process that enables creativity and innovation.

9. Measuring creativity is difficult mainly because of the problems associated with the phenomenon. There is also no defined criteria for measuring creativity.

10. The curriculum must be designed to give an opportunity to the children to be innovative, enterprising and capable of leadership.

11. Educational settings can influence creativity of young children in three respects—creative environment, creative programmes and creative teachers and their way of teaching.

12. The Association for Promotion of Creative Learning (APCL) adopts a creative learning and teaching methodology on the basic premise that each child is unique and learns in a unique manner.

13. Brainstorming is a technique which emphasizes the importance of divergent thinking. It involves generating ideas in response to some problem in a group.

3.8 QUESTIONS AND EXERCISES

Short-Answer Questions

1. How are creativity and originality related to each other?
2. What is a creative process?
3. How are previous experiences and time associated with creativity?
4. Write a short note on creative learners.
5. What is the need of creative learning in education?
6. What characteristics are exhibited by learners in creative learning?
7. What is the six thinking hats technique in creative learning?
8. What does development of creativity in young children involve?
9. Why is it difficult to assess creativity?
10. Differentiate between teaching creatively and teaching for creativity.
11. List the aims of teaching for creativity.

Long-Answer Questions

1. Explain the main features of creativity.
2. What is teaching for creativity? Explain.

3. Describe the various approaches to study the relationship between learning and creativity.

4. Write about the various theories of creativity.

5. Critically evaluate the creative learning model.

6. Assess the three integral concepts of creative learning.

7. Analyse the various models used for designing for creative learning.

8. Explain in detail the various tools used for fostering creativity.

9. What are the five areas in education wherein creative learning needs to be inculcated and included as an integral part?

10. Explain in detail the various outcomes of creative learning.

11. Explain in detail Disney's Model of Creativity.

12. Explain the SCAMPER technique of creative thinking and learning.

13. How can teachers foster creativity in classrooms?

14. Explain in detail the process of developing creativity in young children.

3.9 FURTHER READING

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UNIT 4   PROBLEMS OF CREATIVE CHILDREN

Structure

4.0 INTRODUCTION

Creativity is the ability of an individual to develop new ideas. However, it is known for a fact that creativity is natural and cannot be taught. When an individual thinks in a creative manner, several problems and hurdles are encountered and the creative process is therefore considered iterative in nature, wherein the individual is involved in the process till the best solution is obtained and arrived at. The main problem in creativity is the fact that it cannot be assessed.

Children are believed to be highly creative and make the most optimum use of the unusual things and ideas to come with something unique. There are several problems associated with creativity in young children, some of which can bring about personality and behavioural changes in the children. This unit discusses how creativity operates in children, the various problems creative children face, the barriers to creativity that exist in the system and how they can be encountered and effectively dealt with.

4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain how creativity operates in children
- Discuss how creativity is fostered in children
- Evaluate how creativity operates within the brain
- Explain how Artificial Intelligence (AI) operates
- Explain the concept of metacognition
- Assess the various paradigm shifts in the field of creativity
- Analyse the various barriers to creativity and creative attitudes

4.2 CREATIVE CHILDREN

The dictionary meaning of creativity mentions it as the ability to create; but the word creativity have been defined in many ways by various psychologists.

According to American art teacher and author Betty Edwards: 'Creativity is the ability to see problems in new ways, to see things from a new perspective, and the knack of looking for answers in unexpected places.'

According to the leading psychologist J. P. Guilford, the following traits should be considered to label people as creative:

- Sensitivity to problems
- Fluency of thinking
- Flexibility of thinking
- Originality
- Redefinition
- Elaboration
- Tolerance of ambiguity
- Commitment
- Risk taking

Creativity as an aspect of personality is a special perceptiveness on the part of certain individuals. These people live far more in the real world of nature than in the verbalized world of concepts, abstractions, beliefs and stereotypes that most people confuse with the real world.

Such people can see the raw, the fresh, the concrete as well as the generic, the abstract, the categorized, and the classified. These people are self-actualized and characterized as bold, courageous and spontaneous. Creativity becomes an attitude shown throughout the daily life of the individual.

Other qualities used to describe the creative personality include self-confidence, independence and openness to experience. They have a sense of

humour and playful child-like attitude, a preference for complexity, an acceptance of disorder and a tolerance of ambiguity.

4.2.1 Problems in Maintaining Creativity

As has already been discussed, creative children are not appreciated and often also not accepted by those around. The fundamental problem for creative children in maintaining their creativity is to deal with challenges, issues and discomfort that arise from being different. Creative children have divergent thinking abilities that enable them to think in an unusual manner and make them different, often placing them in the the minority. Since they think differently, they are often regarded as different or weird from others who do not have the tendency to think in an unusual manner.

Creative children, because of their divergent thinking abilities, often do not follow the norms and rules of the society and are therefore often isolated. In their isolation, their creativity is the best outlet of their emotions. Creative children also find it hard to maintain their creativity around friends who are not as creative. Since creative children exhibit better talent than the friends around them, they are often alienated by friends because of the inferiority complex of the friends.

Creative children also attempt difficult and different tasks wherein their creativity is applied the most. They often learn on their own and need to maintain creativity in this case as well. One major issue faced by creative children is that they need to maintain the image of a well-rounded personality. Because of their creative abilities, creative children are often considered superior and good at everything, which is an image they need to maintain. If they fail to do so, they may be demoralized and their creativity may be curtailed.

Another problem in maintaining creativity is that creative children are often not provided support from their parents, teachers and peers. This psychological estrangement may sometimes demotivate a child to give up his or her creative abilities so as to be accepted by the society. In creative children, creativity needs to be nurtured at a young age and in such a manner that it is maintained throughout life. It is believed that all children are creative and, if they are provided the right environment, they would be able to maintain their creativity in the most effective manner.

For enabling children to maintain creativity, it is important that an environment that supports and promotes creativity is provided to children. A supportive environment will allow children to try new things, take chances and think differently, without the fear of being ridiculed and the fear of failure.

Problems Faced by Creative Children in Classroom

In a traditional classroom setting, there are several problems faced by creative children that make it difficult for these children to maintain creativity. One main factor that affects the creativity of creative children in classroom is the fact that intelligent children are more liked and appreciated by teachers. It has already been stated that it is not essential for intelligent children to be creative and creative children to be intelligent.

Therefore, in a classroom, children who are more intelligent especially in terms of logical intelligence are more liked and appreciated by teachers whereas creative children who are not intelligent are not paid enough attention to. As a result, such children become estranged from the teachers as well as their peers and sometimes also give up their creative abilities to be accepted as a part of the classroom.

Another problem that is faced by creative children in classrooms is the fact that there are no assignments or assessments that can test their level of creativity. Since creative knowledge cannot be tested using formative and summative assessment, the creativity of creative children is never highlighted in the right manner. Thus, creative children fail to exhibit their creativity in the right sense.

Creative children also threaten ideas of their teachers, which is why there are instances when teachers try to repress creativity of such children. Creative children think in an unusual manner and may come out with different solutions to a specific problem or question which also means that they may question the teacher's solutions and answers. Research states that many teachers do not like being questioned by such children and therefore do not encourage creativity of these children.

Creative children face another problem in the sense that there are no rewards for creativity. A comprehensive assessment system and reward system for creativity is not present and is not included in the traditional education setting. This discourages the creative child to pursue inherent creativity and children often give up their creative abilities owing to the lack of recognition and appreciation.

In the traditional education setting, there is little scope for individualized learning. In other words, creative children required individual attention of the teacher as these children learn at their own pace and in a manner which is different from others. The lack of an individualized style of learning often inhibits the creative abilities of these children as these are not explored and utilized to their full potential. In addition, in a classroom setting, the method of teaching is such that no room and space is left for curiosity, which is basic to creativity and lack of curiosity does not allow creativity to flourish in the children.

Creative children are viewed as different from others and are not treated like other children. In fact, in many instances, creative children are isolated from others in the classroom. There are many creative children who lack the social and verbal skills to exhibit their creativity. In case of such children, creative abilities are not enhanced at all and are, in fact, inhibited and remain dormant.

For creative children, another problem is that they find things either too easy or too difficult in class. When creative children find things in class to be difficult, they also find it difficult to cope up with others children in the class. On the other hand, if they find things easier than other children, they are not liked by the rest of the class. Creative children, therefore, often find it very hard sometimes to maintain their creativity and strike a balance between how they interpret things in the classroom setting.

4.2.2 Problems when Creativity is Repressed

Creativity is repressed in young children because of several reasons. One of these reasons is the fact that the originator of the new idea is in the minority category. In other words, when a creative child comes out with a new idea, she/he may be the only one who supports the idea. Thus, if a child goes ahead with a creative idea, he/she is considered to be divergent and different and faces several social hurdles.

A creative child is often seen as developing from one side only. Such a child wants to learn on his own and attempt difficult tasks. The main aim of the creative child is to try and achieve uniqueness. In this aspect, a creative child may often face estrangement from parents, teachers as well as peers. Isolation of the creative child eventually leads to the development of depression in the child. In order to be accepted as a part of the society, the creative child may repress her/his creative abilities. Creative abilities of the child may even be repressed by parents and teachers who consider the child to be different and may want the child to do better in terms of logical intelligence.

Creativity can be repressed in various ways and by several factors. The environment plays an important role in encouraging or inhibiting creativity. When the environment is not conducive to creative ideas and thinking, creativity is suppressed in an individual. The thinking of an individual also plays a major role in repressing or encouraging the creativity of a person. When a person thinks in a logical manner and considers his or her first solution as the best solution, it is natural that creativity is repressed. Being creative involves thinking of novel ideas and exploring several possible options. But when a person thinks only on one track, her/his creative abilities are inhibited.

The creative abilities of a person are also repressed when the person is not able to get the freedom to express ideas. The lack of challenging tasks is also another reason for suppression of creativity. For creative people, it is imperative that they be assigned challenging tasks that require them to think out of the box. Lack of encouragement and resources also repress creativity of children. When children do not get the required encouragement from teachers, parents and peers to work on their creative abilities, they tend to let go off their creative abilities.

It is essential that creative children be provided with sufficient resources and activities using which their creativity can be encouraged. When these resources are not available, children are not able to put to use their creative abilities and this represses the creativity of the children.

Repression of creativity has several adverse effects on children. Children not only stop thinking in a creative manner but also exhibit a drastic change in their behaviour. Children whose creative abilities are repressed also develop learning disabilities. This is because creative children learn in their own unique style and when their style of learning is affected, they stop learning which gives rise to several types of learning disabilities.

In addition, children who have repressed creativity also develop a low self-esteem and a low idea of self-concept. They not only lose confidence but also start developing depression which is not a good sign for the physical as well as the mental health of children.

The following are considered to be 'creativity killers' when it comes to children:

- **Evaluation:** Evaluation makes children worry about how they will be judged by others. This leads to repression of creativity of the children. Creative children should be primarily concerned with how satisfied they are with their own accomplishments and achievements rather than being bothered about how they will be evaluated or graded by their teachers or peers.

  When children are free from this distraction of evaluation, they can freely express their creativity.

- **Rewards:** Rewards are often overused and deprive a child of pleasure of creative activity. This suppresses the creative activity of children.

- **Competition:** Competition is another creativity killer. Competition puts children in a win-lose situation where only one child can come out on the top. This puts the child into a dilemma of how to make use of her/his creative abilities.

  Children must therefore be encouraged to work at their own pace so that they can make use of their creative abilities in the most effective and efficient manner. When a child is free from the competitive spirit, he or she can learn in a better manner by making use of the creative talents.

- **Over-control:** When parents and teachers of children control all their activities, the creative abilities of children often get repressed. When children are told to do things in a certain way, they are not able to bring out any originality or uniqueness in their work which suppresses the creative talents of the children. This way, children are not able to explore the various ideas and thoughts and be creative.

- **Pressure:** When parents, teachers and peers have unreasonable expectations from children, it represses their creativity. The pressure of learning intellectual subjects rather than pursuing the subjects of their interests often makes children give up their creative abilities.

It is important for young children to find ways of coping with problems that repress their creativity. One of the best ways to deal with the problem is to take criticism in a positive manner so that creative abilities could be enhanced.

The creative abilities of children must be encouraged in the best ways possible by providing them the required support, encouragement and environment. When children are encouraged to pursue their creativity, they enjoy better mental and physical health and activity.

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CHECK YOUR PROGRESS

1. What is creativity?
2. What is the fundamental problem for creative children in maintaining their
   creativity?
3. What is considered to be the main aim of a creative child?
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4.3 FOSTERING CREATIVITY

It is essential to foster creativity in children from an early age so that the child can learn to explore ideas and also use her/his brain in a constructive manner. Creativity is essential for the emotional development of the children. Social development and physical development are also closely associated with creativity and creative children are not only more social and outgoing but they also enjoy good health.

In children, creativity is also essential to support language, literacy and cognitive development. Creativity is thus basic for the learning process of children and needs to be fostered in different ways. However, many people believe the fact that creativity is natural and in-born and so cannot be developed, taught or fostered.

The truth is that creativity cannot be taught but can be fostered by providing the child with the right environment and resources. This is because creativity is more of a skill rather than a talent and so can be developed and fostered but only when the conditions are conducive for the same.

Following are some ways in which creativity can be fostered in children:

- Creativity in children can be fostered by providing them with the necessary resources. Of all the resources, the most important is time. Children need time to explore and play with unstructured ideas and imagination. This is essential for the effective development of the creative skills of the people.

  Another resource required by children is space. This is the child's own space where they can work in the most creative manner. In addition, it is important to provide children the required material and supplies using which they can play with their imagination and let the creative ideas flow.

- Providing a creative atmosphere to children also enables fostering creativity in them. Fostering creativity in children works at all times and in all environments. In other words, creativity development in children must not be limited to classrooms or schools. Even at home, children must be encouraged to indulge in creative activities.

  Children must be encouraged to try without the fear of failure. If children are afraid of failure, they will not be able to think in a creative manner and this will curtail the creativity of the children.

- Children must be given the freedom to explore ideas and do what they want to do. They must be given enough flexibility so that they can

creatively think about different concepts. This way children can accomplish several tasks in a creative manner. On the other hand, if children are not allowed the freedom or creativity to perform a task, they may not be able to find out different ways of accomplishing the task.

- For fostering creativity in children, they must be encouraged to read for pleasure. The children must also be allowed to participate in arts so that they can let out and enhance latent creativity. Television time for children must be limited so that they can utilize the time for other creative activities.

- Divergent thinking must be encouraged in children so that they can express their ideas and thoughts in a more effective manner. Children must be allowed to disagree with a specific solution and encouraged to find alternative solutions to a given problem. When children can find more than one solution to a given problem, they can think in the most creative manner possible.

- To foster creativity in children, it must be ensured that they are not rewarded for their creativity. This is because incentives can interfere in the process of fostering creativity as they bring down the quality of responses of children and do not allow them to think in a flexible manner.

- To foster creativity in children, emphasis must be placed on the creative process and not the creative product. In other words, the emphasis must be on how children participate in the creative activities and not on how they perform at creative activities. If the emphasis is on the creative product, children may respond in a specific manner and may not explore other ideas of finding the solution to the problem at hand.

It is also essential that creativity be fostered in children in their educational environment. Teachers play an important role in fostering creativity in children but for this, it is essential for teachers to allow children to actively participate. It is also essential that the teachers accept the fact that the children can come up with better ideas and must accept these ideas. Teachers should also turn some control over to the children from time to time.

For fostering creativity in children, teachers can do the following:

- Emphasize on the process of creativity rather than the product of the creative process

- Provide an environment in the classroom that enables the children to explore and play in an effective manner; in other words, the classroom and school environment must be such that it does not put restraint on the creative thinking of children

- Adapt to the ideas of children rather than trying to work with structured ideas that have already been framed, for if children are made to work with structured ideas, they are not able to explore ideas and possibilities and therefore are not able to think or learn in a creative manner

- Accept the unusual ideas of children instead of rejecting them and labeling them as different and understand that the unusual ideas of the children are because of their divergent thinking abilities that make them creative

- Use creative problem solving techniques in all domains of the curriculum and ensuring that children must be able to work in a creative manner in all spheres of education and are able to creatively solve everyday problems

- Allow time for children to explore ideas and possibilities so that they can find the mist creative idea or solution

For fostering creativity in children, it is essential that the children are given:

- Authentic and challenging tasks that have a real purpose

- Responsibility to think creatively

- Accountability in terms of what they do

Fostering Creativity in Classrooms

To foster creativity in classrooms, teachers must encourage their students to think laterally and find associations between things that are otherwise not connected in any manner. Teachers must encourage the students to apply their learning and knowledge to new contexts and children must be encouraged to experiment to find alternative solutions to the specific problem at hand.

Teachers can promote and foster creativity in the classroom by using the following approaches:

- Teachers can ensure that their lesson plans contain and are based on different styles of learning and teaching methods and also incorporate creative learning in the most optimal manner.

- Teachers must provide children enough opportunities to experience hands-on experiments and also solve problems collaboratively as well as individually.

- Teachers must create opportunities in the classroom to encourage the children to actively participate in what is going on in the class. Children must also be allowed to question the course of action or the action plan which is being implemented in the class.

- Teachers must make use of creative thinking techniques in the classroom. Some of these techniques include brainstorming, and activities like thinking hats.

- Teachers must also share with the students the outcomes or intentions of learning. This way, children are given the freedom to choose whether or not they are going to work on a specific project and how they will go about it.

- Teachers must also encourage children to improvise, experiment and think outside the box.

- Teachers must encourage students to ask questions and make connections between things which may not be associated at all. This provides children with the opportunity to explore several ideas before deciding upon the best one.

- Teachers can foster creativity in classroom by encouraging students to ask open ended questions, like 'what if…?', and 'how might you…?'.

- Teachers, along with the children, need to actively participate in the creative learning activities.

- Teachers can also model creative thinking and behaviours in the classroom to foster creativity in the children.

- Teachers must also encourage students to develop criteria on the basis of which students can evaluate and judge their own creative work. This enables children to reflect upon the work done by them. These evaluation criteria must enable children to check for the originality of their work.

- Teachers in the classroom must also facilitate an open discussion of the problems faced by students and find ways in which these problems can be solved.

- Students in the classroom must also be encouraged to share their ideas and progress with others. This also helps children to reflect upon their creative work.

- Teachers must train children to use their failures and setbacks as means of learning opportunities. Teachers must help children overcome their fears which is essential for children to learn in a creative manner.

- Teachers must make sure that the assessment methods used in the classroom are deigned in a manner which ensures that the creativity is rewarded in the required manner.

- Teachers must make use of positive language and praise as often as possible in the classroom to foster creativity and encourage children to think and learn in the most creative manner.

Fostering Creativity through Arts

Art is an area where children tend to be most creative and show their creativity in a natural and easy manner. Following are some ways in which creativity in classroom can be fostered through arts:

- Children must be allowed to indulge in spontaneous art explorations. Directed and planned art projects are also important for fostering creativity but the majority of projects must be spontaneous.

- An art centre in the classroom must be set up with easy-to-use and accessible materials so that children can explore the various art ideas on their own.

- Rather than the outcome of the art project, the enjoyment and value of the creative process must be emphasized upon. The result of the art project is not

important but what is important is the fact that the children explore various ideas and experiments before finally deciding on what to do and create.

- Children must be encouraged to try new ways of doing things. When children are working on an arts-and-crafts projects, they must be encouraged to use materials in different innovative ways to design what the problem states.

- Creativity must be expanded into other areas of curriculum. In other words, arts can be incorporated in other domains of curriculum so that learning in other subjects can also become creative.

- It is most important for the teacher to appreciate any and all efforts by the students. The best way of doing this is to display the artwork of the children.

- Children must be allowed to make mistakes, experiment and repeatedly explore so that creativity is fostered in the most effective manner.

How can learners foster and develop a creative attitude?

Learners can develop a creative attitude by developing a creative state of mind. Following are some means using which learners can develop and foster creative attitudes:

- Learners must overcome the perception of 'I am not creative'. Research states that all people are creative, though in different ways and degrees.

- Learners need to expect the unexpected. They need to realize that the problem at hand can have unusual solutions as well, apart from the normal solutions that are already available.

- Learners need to enjoy playing and exploring ideas. When learners enjoy what they are working on, they tend to develop better creative ideas and solutions.

- Learners need to tolerate ambiguity. In other words, learners must have an open mind and accept the fact that they do not know of some things.

- To foster a creative attitude, it is important for the learners to be curious. Curiosity is the premise of creativity and so, learners who are curious are the ones who best develop creative attitudes.

- Learners should be able to face and overcome their fears. This is essential for the learners to develop creative attitudes.

- To develop a creative attitude, learners need to be proactive. This enables them actively participate in whatever they do and therefore explore several ways and means of solving the given problem at hand in a creative manner.

CHECK YOUR PROGRESS

4. How can creativity be fostered in a child?

5. How does an art centre in the classroom help enhance creativity in children?

4.4 BRAIN AND THE CREATIVE ACT

Creativity is the ability to connect knowledge and experiences in the sub-conscious mind. It is creativity that enables a person to come out with new ideas and thoughts, and therefore, it is said to be closely associated with the brain.

Creativity is a lot of different processes in the brain. These include the ability to improvise, the ability to think divergently and also get flashes of insights. Creativity requires the brain to think out of the box. What goes on in the brain during the creative process is not clearly known. Though while thinking or learning creatively, it is both the left and the right parts of the brain that function together, as these hemispheres of the brain are interlinked.

Flashes of insights are the ideas and thoughts that come to the mind in a spontaneous manner, especially when the brain is in a relaxed state. When a person gets these flashes of insights, it is not considered a logical or methodical solution to the problem but a spontaneous and creative one.

Flashes of insight simply refer to getting ideas that are obvious but have not been thought of before. The right hemisphere of the brain is said to be associated with creativity and the left hemisphere is known to be the logical and analytical part of the brain.

The left side of the brain is associated with rational, objective and reality based thoughts. The functions of the left side of the brain are associated with the following:

- Analytical thought
- Maths and science
- Language
- Logic

The right part of the brain is fantasy based and is associated with risk-taking. The functions of the right part of the brain are associated with:

- Creativity
- Art and music
- Intuition
- Thought

On both sides of the brain, there is a brain lobe known as the superior temporal gyrus which is the creative spot of the brain. This is the spot where flashes of insights take place inside the brain.

The left hemisphere of the brain has brain cells that have short dendroids. The function of these dendroids is to pull information from the surrounding areas. The brain cells in the right hemisphere, however, assimilate information and knowledge from distant places. These cells have a wider scope and so compile unrelated facts and information in the brain. This is where unusual connections are established and creative ideas take place.

When a person experiences a flash of insight, the superior temporal gyrus of the left part of the brain does not react but the one present on the right side does. The outcome is a bunch of ideas that are novel and unique, based on a wide range of information.

Ideas and creative thinking is also associated with front lobes of the brain. When a person experiences flashes of insights, the frontal lobes of the brain go into some kind of a temporary sleep mode which then enables ideas to flow into the mind. This state of mind enables ideas to flow from the unconscious to conscious mind which leads to the development of unusual ideas.

Creativity is also said to be associated with analytical intelligence. There is, in fact, a positive relation between creativity and intelligence wherein intelligence is said to be the basis for creativity. However, it is argued that intelligence does not lead to a creative mind. The premise of the relationship between intelligence and creativity is the fact that intelligent people are able to store more information in their brain and therefore, their brain is able to come out with novel ideas often.

Following three areas of the brain are used for creative thinking:

- **Attention control network:** This part of the brain is used mostly when a person needs to focus on a specific or particular task and becomes active when a person needs to concentrate on a complex task or wants to indulge in activities like reading or listening.

- **Imagination network:** This is that part of the brain which is used for imagining things. It helps a person form mental images of future scenarios and even remember past events. This part of the brain enables a person to form mental images when a creative person is involved in creative activities.

- **Attention flexibility network:** This part of the brain monitors what goes on in the brain and helps to switch between the imagination and attention control networks.

A recent study by Rex Jung was aimed at understanding what happens in the brain when a person is indulged in a creative activity. When a person gets creative, it involves reduction in the activity of the 'attention control network'. Reducing activity in this part of the brain allows for the development of new ideas. This increases the activity of imagination and of the 'attention flexibility network'.

When a person becomes creative, the brain is said to exhibit the following signs:

- The brain is indulged in the process of creating new ideas. The production of new ideas is based on the premise that the new ideas are a combination of already existing ideas and these existing ideas are combined in new ways to create new ideas.

- The brain prepares to get new ideas. This is done by creating new connections between the ideas that the brain knows. This also implies the fact that to create new ideas, the brain needs time as well as space.

- The brain processes the information it has in the sense that it works on old as well as new ideas and creates and identifies relationships between these processes.

There are several ways in which the brain can be stimulated to get more ideas. One way is for a person to criticize her/his ideas which enables the person to find new and better ideas after a complete reflection of the generated idea. Another is to expose the brain to challenging tasks to bring out creativity.

It is important that the brain comes up with several bad as well as good ideas in the process of creativity. This way, the brain can critically evaluate all the available ideas and then choose the best one. It is also imperative to develop ideas that may fail. In other words, to get more ideas, it is important that a person accept the fact that not all ideas can work in the same creative manner and that some may need to be rejected.

CHECK YOUR PROGRESS

6. Where is the creative spot of the brain located?

7. How are the frontal lobes of the brain associated with flashes of insights that a person receives?

8. Name the three areas of the brain used for creative thinking.

4.5 ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) can be defined as the intelligence exhibited by machines or software and the branch of computer science that develops machines and software with human-like intelligence. Technically, artificial intelligence or AI is a precise branch of computer science which studies the development of software and hardware that simulates human intelligence.

Major AI researchers and textbooks define the field of AI as 'the study and design of intelligent agents', where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who first coined the term artificial intelligence (or AI) in 1956 at the Massachusetts Institute of Technology, called it 'the science and engineering of making intelligent machines'.

AI recognizes its surroundings and initiates actions that can maximize its chance of success. It includes the ability to make decisions, the ability to show expertise in some specific domain, the ability to learn and understand, the ability to reason and plan during problem solving, and, the ability to use senses, such as hearing, speech and vision. Tools and insights from various fields, including linguistics, psychology, computer science, cognitive science, neuroscience, probability, optimization and logic, are used.

Artificial intelligence includes the following key areas:

- **Neural networks:** These are the systems that simulate intelligence and attempt to replicate the types of physical connections that occur in the brain. In computer science and related fields, artificial neural networks are considered as computational models that are inspired by animals' central nervous systems, especially the brain, and are capable of machine learning and pattern recognition.

  Generally, they are referred to as systems of interconnected 'neurons' that can compute values from inputs by feeding information through the network. Today, the field of neural networks is gaining success in a number of disciplines, such as voice recognition and natural-language processing.

- **Robotics:** It refers to programming computers that can see, hear and react to other sensory stimuli.

- **Expert systems:** These are specially programmed computers and are used to make decisions in real-life situations. For example, some expert systems help doctors diagnose diseases based on symptoms.

- **Natural languages:** These are specially programmed computers that understand natural human languages.

- **Game playing:** These are specially programmed computers and are used to play games such as chess and checkers.

In addition, there are some other programming languages that are identified as AI languages because they are used almost exclusively for AI applications. The two most common are LISP and Prolog.

AI is nowadays considered as the key technology for various novel and innovative applications, such as banking systems that can detect attempt made by any stranger for credit card fraud, telephone systems that recognize speech, and software systems that can automatically detect problems and suggest appropriate assistance. These technologies would not have existed today without the continued centralized/federal support of fundamental AI research over the past three decades.

Thus, the concept of AI as a true scientific pursuit is very innovative. It remained a plot for popular science fiction stories over centuries. Most researchers associate the beginning of AI with Alan Turing. Following are details of some AI programmes:

Turing test, as defined by Alan Turing in his 1950 paper 'Computing Machinery and Intelligence' was used to measure machine intelligence.

Intelligent behaviour by Norbert Wiener observed a link between human intelligence and machines and theorized intelligent behaviour in 1950.

Logic theorist, a program devised by Allen Newell and Herbert Simon in 1955 claimed that machines also contain minds similar to humans. It proved thirty-eight out of the first fifty-two theorems in *Principia Mathematica*.

The term AI originated at Dartmouth Summer Research Conference on Artificial Intelligence in 1956 which was organized by John McCarthym, the father of AI.

In 1957, General Problem Solver (GPS) was tested. GPS was an extension of Wiener's feedback principle and was capable of solving to a great extent commonsense problem.

In 1958, LISP was invented by McCarthy and was soon adopted as an ideal language for programming among most AI developers.

Seven years later, in 1963, AI began to pick up momentum. The field was still undefined and the ideas formed at the conference were re-examined. In 1963, DoD's (Department of Defense's) Advanced Research projects started at MIT. The computer scientists from around the world were invited to research on machine-aided cognition (artificial intelligence), and in 1968, at MIT Micro-World programme, SHRDLU controlled a robot arm. In the mid-1970s, expert systems for medical diagnosis (MYCIN), chemical data analysis (Dendral) and mineral exploration (Prospector) were developed and during the 1970s, Computer Vision (CV) technology emerged (referring to machines that can 'see'). David Marr was the first to model the functions of the visual system. In 1972, Prolog was invented by Alain Colmerauer. Characteristically, logic programming language uses both the logic types, declarative and procedural representation language.

Definitions

AI is the study of how to make computers do things which humans do better. This is ephemeral as it refers to the current state of computer science and excludes major problem areas that cannot be solved well, either by computers or by people.

AI is also known as the branch of computer science that is concerned with the automation of intellectual performance. AI is based upon the principles of computer science, namely data structures used in knowledge representation, the algorithms needed to apply that knowledge and the languages and programming techniques used in their implementation.

It is a field of study that encompasses computational techniques for performing tasks that seem to require intelligence when performed by humans. It seeks to explain and follow intellectual performance in terms of computational processes.

Artificial intelligence is about generating representations and procedures that automatically or autonomously solve problems that were previously solved by humans.

There are various definitions of AI. Most of these definitions take a very technical direction and avoid philosophical problems connected with the idea that AI's purpose remains to construct an artificial human. These definitions are categorized into the following four categories:

1. Systems that think like humans (focus is on reasoning and human framework)
2. Systems that think rationally (focus is on reasoning and a general concept of intelligence)

3. Systems that act like humans (focus is on behaviour and human framework)

4. Systems that act rationally (focus is on behaviour and a general concept of intelligence)

AI vocabulary

The following terms are most commonly used in AI vocabulary:

- **Intelligence:** It relates to tasks involving higher mental processes, such as creativity, solving problems, pattern recognition, classification, learning, induction, deduction, building analogies, optimization, language processing, knowledge and many more. Intelligence is the computational part of the ability to achieve goals.

- **Intelligent behaviour:** It is depicted by perceiving one's environment, acting in complex environments, learning and understanding from experience, reasoning to solve problems and discover hidden knowledge, applying knowledge successfully in new situations, thinking abstractly, using analogies, and communicating with others.

- **Science-based goals of AI:** It pertains to developing concepts, mechanisms and understanding biological intelligent behaviour. The emphasis is on understanding intelligent behaviour.

- **Engineering-based goals of AI:** It relates to developing concepts, theory and practice of building intelligent machines. The emphasis is on system building.

- **AI techniques:** It depicts how we represent, manipulate and reason with knowledge in order to solve problems. Knowledge is a collection of facts. To manipulate these facts by a program, a suitable representation is required. A good representation facilitates problem solving.

- **Learning:** It means that programs learn from what facts or behaviour can represent. Learning denotes changes in the systems that are adaptive in other words, it enables the system to do the same task(s) more efficiently next time.

- **Applications of AI:** It refers to problem–solving, search and control strategies, speech recognition, natural language understanding, computer vision, and expert systems.

4.5.1 Agents in AI

Anything that can be observed as perceiving its environment through sensors and acting upon that environment through effectors is considered as an agent. For example, a human is an agent having eyes ears and other sense organs for sensing, and hands, legs, mouth and other body parts for effectors. Likewise, a robotic agent substitutes cameras and infrared range finders for the sensors and various motors for the effectors.

In AI, an Intelligent Agent (IA) is described as an independent entity which perceives through sensors and acts upon an environment using actuators (i.e., as an

agent) and directs its activity towards achieving goals (i.e., as a rational). Intelligent agents may also acquire or use knowledge to accomplish/achieve their desired goals. They may be exceptionally simple or extremely complex.

Technically, an Intelligent Agent or IA is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through its effectors to maximize progress towards its goals.

Structure of an Intelligent Agent (IA)

Mathematically, simple agent can be defined as an agent function which maps every possible percepts sequence to a possible action the agent can perform or to a coefficient, feedback element, function or constant that affects eventual actions.

Agent function is an abstract concept as it could incorporate various principles of decision-making, such as calculation of utility of individual options, deduction over logic rules, or fuzzy logic. The programme agent, instead, maps every possible percept to an action.

Problem–Solving Agent

A problem–solving agent is an agent who decides the series of actions with several options of unknown value by examining the various possible sequences of actions that may lead to states of known value and then select the best sequence.

Finding such sequence of actions is referred to as search. A problem is taken as an input for any search algorithm and as an output, it returns a solution in the form of action sequence. The actions returned by search algorithm can be carried out in the execution phase once a solution is found.

The following is the simple problem–solving agent function:

- **Perception:** It is defined as 'the formation, from a sensory signal, of an internal representation suitable for intelligent processing'. Computer perception is an example of artificial intelligence. It focuses on the following:

    (i) **Machine vision:** It is easy to interface a television camera to a computer and get an image into memory; the problem understands what the image represents. Vision takes lot of computation; in humans, roughly ten per cent of all calories consumed are burned in vision computation.

    (ii) **Speech understanding:** Speech understanding is also very popular now. Some systems can be trained for the individual user and they require pauses between words. Understanding continuous speech with a larger vocabulary is harder.

    (iii) **Touch (tactile or haptic) sensation:** It is important for robot assembly tasks.

4.5.2 AI Technique

During the last three decade, AI research has concluded that intelligence requires knowledge. To compensate for the overwhelming quality, knowledge possesses the following less desirable properties:

- It is huge.

- It is difficult to characterize correctly.

- It is constantly varying.

- It differs from data by being organized in a way that corresponds to its application.

- It is complicated.

An AI technique is a method that represented knowledge such that:

- The knowledge captures generalizations that share properties and these are grouped together rather than being allowed separate representation.

- The knowledge is understood by people who have provided it—even though for programs where bulk of the data comes automatically from readings.

- The knowledge can be easily modified to correct errors and reflect changes in real conditions.

- The knowledge can be widely used even if it is incomplete or inaccurate.

- The knowledge can be used to overcome its own sheer bulk by narrowing the range of possibilities that must be usually considered.

In order to characterize an AI technique, let us consider initially OXO or tic-tac-toe and use a series of different approaches to play the game.

The programmes increase in complexity, their use of generalizations, the clarity of their knowledge and the extensibility of their approach. In this way, they move towards being representations of AI techniques.

The Tic-Tac-Toe game consists of a nine element vector called 'Board'; it represents the numbers 1-9 in three rows.

- **The first approach:** An element contains the value 0 for blank, 1 for X and 2 for O. A 'Movable' vector consists of 19,683 elements (39) and is needed where each element is a nine element vector. The contents of the vector are especially chosen to help the algorithm. The algorithm makes moves by pursuing the following steps:

  1. View the vector as a ternary number. Convert it to a decimal number.

  2. Use the decimal number as an index in 'Movable' and access the vector.

  3. Set 'Board' to this vector indicating how the board looks after the move. This approach is capable in time but it has several disadvantages. It takes more space and requires stunning effort to calculate the decimal numbers. This method is specific to this game and cannot be completed.

- **The second approach:** The structure of the data is as before but we use 2 for a blank, 3 for an X, and 5 for an O. A variable called 'Turn' indicates 1 for the first move and 9 for the last. The algorithm consists of three actions:

  (i) MAKE2 which returns 5 if the centre square is blank; otherwise, it returns any blank non-corner square, i.e., 2, 4, 6 or 8.

(ii) POSSWIN (p) returns 0 if player p cannot win on the next move and otherwise returns the number of the square that gives a winning move. It checks each line using products $3 \times 3 \times 2 = 18$ gives a win for X, $5 \times 5 \times 2 = 50$ gives a win for O, and the winning move is the holder of the blank.

(iii) GO (n) makes a move to square n setting Board[n] to 3 or 5.

This algorithm is more involved and takes longer but it is more efficient in storage which compensates for its longer time. It depends on the programmer's skill.

- **The final approach:** The structure of the data consists of 'Board' which contains a nine element vector, a list of board positions that could result from the next move and a number representing an estimation of how the board position leads to an ultimate win for the player to move.

This algorithm looks ahead to make a decision on the next move by deciding which the most promising move or the most suitable move at any stage would be and selects the same.

Consider all possible moves and replies that the program can make. Continue this process for as long as time permits until a winner emerges, and then choose the move that leads to the computer program winning, if possible in the shortest time.

This is most difficult to program by a good limit but the technique can be extended to in any game. This method makes relatively fewer loads on the programmer in terms of the game technique but the overall game strategy must be known to the adviser.

4.5.3 Multiple Intelligence

The theory of multiple intelligence was developed by Howard Gardner, professor of Education at Harvard University. It suggests that the traditional nation of intelligence based on IQ testing is very limited.

Howard Gardner was the first to see the limits of the old way of thinking about intelligence. In his book *Frames of Mind*, published in 1983, he proposed that there was not one, monolithic kind of intelligence that was crucial for success, but rather, a wide spectrum of intelligences with seven key varieties. His list includes two standard academic kinds, i.e., 'verbal' and 'mathematical logical alacrity'. It also includes 'spatial capacity' often seen in an outstanding artist or architect; the 'kinesthetic genius' displayed in physical fluidity; the 'musical or rhythmical'; the 'personal intelligences'; 'interpersonal skills' and 'intrapsychic capacity'.

Gardner acknowledges that seven is an arbitrary figure. For the variety of intelligences, there is no magic number to the multiplicity of human talents. At one point of time, Gardner had given twenty different varieties of intelligence. Interpersonal intelligence broke down into four distinct abilities, i.e., leadership, the ability to nurture relationships and keep friends, the ability to resolve conflicts and the skill of social analysis.

Gardner's thinking about the multiplicity of intelligence continued to evolve. In 1993, he gave the summary of personal intelligences as follows:

Interpersonal intelligence is the ability to understand other people: what motivates them, how they work, how to work cooperatively with them. Successful politicians, social workers, teachers, clinicians, religious leaders and sales people are individuals who have high interpersonal intelligence. Intrapersonal intelligence is a correlative ability, turned inward. It is the capacity to form an accurate, veridical model of oneself and to be able to use this model to operate effectively in life.

According to Gardner, the core of interpersonal intelligence includes the 'capacity to recognize and respond appropriately to moods, temperaments, motivations and desires of other people'. In intrapersonal intelligence, he included 'access to one's own feelings and the ability to discriminate among them and draw upon them to guide behaviour'.

The theory of multiple intelligence has evolved to focus on metacognition—that is, awareness of one's own mental processes—rather than on the full range of emotional abilities. Gardner pointed out that many people with IQ of 160 work for people with IQ of 100, if the former have poor interpersonal intelligence and the latter have a high one. The multifaceted view of intelligence offers a richer picture of child's ability and potential for success than standard IQ.

CHECK YOUR PROGRESS

9. Name the two most common AI languages.
10. What is meant by intelligence in AI vocabulary?
11. What is meant by an agent in AI?

4.6 METACOGNITION

Metacognition defined simply is 'thinking about thinking'. Metacognition is the awareness of one's own knowledge and enables one to understand and be aware of what one knows and what one does not know. Metacognition is the ability of a person to understand, manipulate and control the cognitive processes. The term metacognition was first used by Flavell. According to Flavell:

> Metacognition consists of both metacognitive knowledge and metacognitive experiences or regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes, knowledge that can be used to control cognitive processes.

Cognitive abilities are the basic mental abilities used to think, study and learn. Cognitive abilities enable a person to achieve a specific target that can be measured. Metacognitive abilities, on the other hand, are the ones that ensure that the learning goal has been achieved. Metacognition is the ability to make use of prior knowledge to plan strategy to approach a learning task, frame an action plan to solve the problem and take the necessary steps to solve the problem. Metacognition also involves evaluating the results and modifying the action plan as and when required.

Flavell offers the following example of metacognition:

> I am engaging in metacognition if I notice that I am having more trouble learning A than B; if it strikes me that I should double check C before accepting it as fact.

Metacognitive knowledge by Flavell is further divided into three categories—knowledge of personal variables, task variables and strategy variables. The knowledge of personal variables refers to knowledge about how human beings process information and learn and also the knowledge of one's own learning process.

Knowledge of task variables is the knowledge about the nature of the task as well as the processing demands that a task will put on a person. Knowledge of strategy variables involves knowledge of cognitive as well as metacognitive processes and abilities and the knowledge as to when and where these strategies can be applied.

Metacognitive skills need to be developed in children so that their learning can be improved. Understanding requires a learner to possess cognitive skills as well as metacognitive skills. Learners create knowledge with the help of cognitive processes. Learners guides regulate and evaluate learning through the metacognitive skills that they possess. It is through metacognitive skills and strategies that creative and real learning is said to take place.

The development of metacognitive skills is essential for the learners to become independent. It is through metacognitive skills that a learner is able to think through a problem or approach a learning task, select appropriate strategies, and make decisions about a course of action to resolve the problem or successfully perform the task. Metacognition enables a learner to reflect critically upon his work and also point out the inaccuracies which eventually helps the learner to improve upon the work done or the solution achieved.

Metacognition is often linked to intelligence. The relationship between metacognition and intelligence is stated in the triarchic theory of intelligence propounded by Sternberg. Sternberg calls metacognitive abilities as meta-components. According to Sternberg, meta-components are processes that control cognitive elements and also receive feedback from the cognitive elements. Sternberg states:

> Meta-components are responsible for figuring out how to do a particular task or set of tasks, and then making sure that the task or set of tasks are done correctly.

Metacognitive abilities therefore involve the processes of planning, evaluating and monitoring problem solving activities. Sternberg maintains that the ability to appropriately allocate cognitive resources, such as deciding how and when a given task should be accomplished, is central to intelligence.

Research suggests that most individuals indulge in metacognitive abilities when they are provided with an intense cognitive task but the level of metacognition between individuals may vary. Those people who are more metacognitive do better at their cognitive tasks. Individuals can better regulate both cognitive as well as metacognitive abilities through a cognitive strategy instruction program.

The cognitive strategy instruction program is an instructional approach which emphasizes on the development of thinking and creative skills to enhance learning. According to Scheid: The objective of CSI is to enable all students to become more strategic, self-reliant, flexible, and productive in their learning endeavours.

The cognitive strategy instruction program is based on the assumption that cognitive strategies possessed and known to those known to be bright students can be taught to most students.

According to Fogarty, metacognition is a process that has three phases that enable an individual to become better thinkers. These phases are:

- **Plan:** It is essential to develop a plan before approaching a specific problem. During this phase, the learners find answers to questions related to what has to be learned, what knowledge can be used to find solutions to the problem at hand and the time required to find the solution.

- **Monitor:** This phase enables the learners to better understand the problem and also break it down into smaller portions to know how they will reach at the final solution. Monitoring enables the learners to find out whether they are moving on the right track in finding the solution to the problem or a change of plan is required.

- **Evaluate:** In this phase, the learners evaluate their thinking after the task has been completed. Evaluation involves the learners assessing on how well they did at the problem, whether the expected and desired results were achieved and whether they need to bring about a change in their thinking to find a better solution to the stated problem.

Wilson gave another process based definition of metacognition according to which metacognition consists of the following three phases:

Metacognitive Awareness is the awareness of the individual regarding where they are in the learning process, their knowledge about content knowledge, personal learning strategies, and what has been done and needs to be done. Metacognitive Evaluation refers to judgements made regarding one's thinking capacities and limitations as these are employed in a particular situation or as self-attributes. For example, individuals could be making a judgement on the effectiveness of their thinking and/or strategy choice. Metacognitive Regulation occurs when individuals modify their thinking.

Improving Metacognition in the Classroom

Most teachers know for a fact that if students reflect upon how they learn, they learn in a better manner and become better learners. As the metacognitive abilities of students increase, so do their learning and thinking abilities. Metacognition plays an important role in all learning and life experiences of students. Beyond academic learning, when students gain awareness of their own mental states, they begin to answer important questions:

- How do I live a happy life?
- How do I become a respected human being?
- How do I feel good about myself?

The following strategies can be used to improve metacognition abilities of students in the classroom:

- The students must be taught how their brains are wired for growth. When students learn about how they learn and grow, they tend to learn in a better manner. Teaching students the science of metacognition can therefore enable students to learn how to develop their brains and improve their learning abilities.

- Students must be given time and allowed to practice what they do not know well. The act of being confused and identifying one's lack of understanding is an important part of developing self-awareness. This not only triggers the metacognitive abilities but also creates an environment where not knowing and then learning about a particular concept becomes an integral part of the classroom culture.

- Students must be provided opportunities to reflect upon their coursework. This enables them to reflect upon their own cognitive growth which further enables the students to think about their thinking and the learning process in which they indulge.

- Students must be encouraged to keep their learning journals wherein they can monitor their own thinking skills. Teachers can assign students weekly questions that can help the students to reflect upon how they learned rather than what they learned. Questions might include: 'What was easiest for me to learn this week and why', 'what was most challenging for me to learn and why', 'what study strategies worked well as I prepared for my exam', 'what strategies for exam preparation didn't work well', and, 'what will I do differently next time'.

- Teachers must use a wrapper to increase the monitoring skills of the students. A wrapper is a short intervention associated with an activity and involves the use of metacognitive skills. For example, before a lecture, a teacher can give few tips to students about active listening and, at the end of the lecture, can ask the students to write down three key ideas from the lecture. Afterwards, the teacher can share his or her three key ideas of the lecture and the students can reflect upon whether their ideas are close to that of the teacher or not. This type of an activity enhances metacognitive as well as learning skills.

- When assessing, teachers must make use of essay type questions rather than multiple choice questions. This is because research states that children use low level of thinking skills when answering multiple choice questions while higher level thinking skills are used for answering essay type questions and therefore assessment should be based more on essay type questions which can trigger the metacognitive activity to a great extent.

- Reflexive thinking must be encouraged by teachers. Reflexive thinking is the metacognitive process of becoming aware of the biases which hamper creative learning. Teachers can create a classroom culture wherein

reflexivity is an integral part. For instance, the teacher can indulge the students in dialogues related to human and societal biases.

When students indulge in such conversations or write about such things, they think about their own thinking and therefore are also able to challenge their own thinking. This way, the students learn better and are able to develop better cognitive abilities.

CHECK YOUR PROGRESS

12. What is meant by metacognition?
13. What are the three phases of metacognition according to Fogarty?

4.7 PARADIGM SHIFTS

A paradigm is a belief or a structure within which a person thinks or acts. It has already been stated that when it comes to creativity, most children think out of the box and in unusual ways. When a child starts thinking within the same paradigm, it affects the creative outcomes because using the same paradigm again and again produces a tunnel vision. It is therefore essential that a shift in the paradigm be brought about so that a child can be more creative and see things differently so that he or she can think creatively about a specific concept.

The study of creativity can be viewed from three paradigmatic stages—the genius stage, the creative person stage, and the social stage. These are explained below:

- **The He-paradigm or the genius stage:** This paradigm of creativity takes into account the lone genius or the fact that creativity is associated with a few people only and that creativity cannot be found in all. This paradigm states that creative people have two main features—exclusivity and disconnection.

  According to this paradigm, creativity is exclusive because only a few people are chosen for it. This paradigm of creativity also lays emphasis on the fact that creativity is in some ways divine. As per this paradigm of creativity, creativity is restricted to the highest level of creation and refers to only those creations that are completely novel. This paradigm of creativity also emphasizes on the fact that the creator is detached from the community and only then is able to generate the various creative ideas.

- **The I-paradigm or the creative person stage:** This paradigm shift resulted when researchers started focusing on the creative process rather than on the creative person or genius as in the he-paradigm.

  According to this paradigm of creativity, it is believed that everyone is capable of being creative and that creativity is not limited to only a limited few. This paradigm also emphasized the fact that intelligence is not a sufficient condition for creativity and thus it is not essential that intelligent people are creative.

This paradigm stated that creativity was not associated with the personality of the person but with the unconscious mind of the person. According to the creative person paradigm, the traits of the creative person included tolerance for ambiguity, independence of judgement, strong desire to create, preference for complexity, deep motivation, originality, verbal fluency, intuitive nature and good imagination.

- **The We-paradigm or social stage of creativity:** When defining and studying creativity, the role of social factors is mostly ignored. However, the We-paradigm shift to creativity states that creativity is influenced by social factors.

On the basis of this paradigm of creativity, creativity is considered to be a result of human interaction and collaboration. This paradigm of creativity also lays emphasis on group creativity. Creativity, according to this paradigm, is defined as a result of transactions between the person and the environment and when an individual interacts with others. In essence, social factors play an important role in creativity and the creative performance of an individual.

Apart from the above three paradigms associated with creativity, there is also cultural creativity, which states that creative acts are socio-cultural in nature and origin. This paradigm of creativity focuses on how the existing cultural and symbolic elements are used by creative people for the formation of new and creative products and ideas. According to this paradigm of creativity, creativity is looked upon as a generative process wherein previous knowledge is essential for the creation of new ideas and products.

Researchers who support this paradigm of creativity state that, 'human creativity uses what is already existing and available and changes it in unpredictable ways'. The cultural paradigm of creativity, in fact, consolidates the We-paradigm of creativity wherein creativity is associated with social factors.

Creative people, as has already been stated, think out of the box. Also, it is important for creative people to keep shifting their paradigm so that they can turn out to be more creative and learn in a better manner. Following are some ways of shifting paradigm when it comes to creativity:

- **Eliminate the box:** Creative people think out of the box, but, to shift the paradigm, the best method is not to just think outside the box but also eliminate it completely. This elimination of the box enables the thoughts to flow freely and easily. Thus, when this box is eliminated, a creative person gets thoughts which change from absurd to concrete, from ordinary to bizarre. In other words, a creative person gets several ideas across a wide domain and spectrum.

- **Act non-evaluatively:** It has been stated that creative thinkers and learners need to reflect often on their thoughts and solutions. However, a paradigm shift to be non-evaluative can be of help and can enable creative people to perform better.

Evaluation uses old information which means that it is the old ideas that the creative mind is working on again and again. To overcome old ideas,

it is best to be non-evaluative so that new ideas can be triggered. To get better ideas, a creative person must think in a non-evaluative manner and even list ideas and suggestions and listen to others in a non-evaluative manner. A creative person must apply brainstorming so that new ideas can flow easily.

- **Work on the essence of the problem:** To solve a problem, a creative thinker and learner needs to have a clear understanding of the problem. However, having an in-depth understanding of the problem also means that a creative person already has several specific thoughts and ideas in the mind related to the specific problem. This is what spoils and hinders new thinking and ideas.

  Therefore, it is essential for the creative person to shift paradigm so that he or she can be more creative. For this, a creative person can begin with the essence of the problem and understand the main activity involved in the problem. For example, the essence of a can opener is to open things. But, instead of working on how to improve the working of the can opener, the creative person can work on for instance ways to open things.

  This paradigm shift would help the creative people to come out with a solution as to how to improve the can opener but in a new manner and using more novel and creative ideas.

- **Reversal and de-reversal:** The common way of solving a problem is to move upside down; break the problem into smaller parts and then finding an appropriate solution. The reversal-de-reversal is a paradigm shift in which the problem in turned upside down and is then solved. This gives the creative person a new way to look at the problem. This way, the person may even get a new direction to solve the problem.

  The reversal-de-reversal process works in the following manner:

  1. The key verb of the problem is reversed. For instance, instead of increase, decrease is used or instead of fail, succeed is used.

  2. The creative person is then required to list solutions to the reversed problem in a non-evaluative manner.

  3. Now, each reversal is de-reversed by writing a how in front of each solution.

  4. The solution statements are then combined so that these make sense and a new solution statement to the given problem is obtained.

- **Guided fresh eye:** This is another method of paradigm shift wherein the creative person is required to think about the problem and look at it as someone else or something else. This enables the creative person to restate the problem and find new creative solutions for the problem.

- **Verb substitution:** Sometimes, changing a word systematically in the problem statement transforms the perspectives in which the statement and the problem is viewed and therefore, a paradigm shift occurs which enables the problem to be solved in a new manner and in a new

perspective. This substitution of word provides the creative thinker with new ways to approach the problem and the person is thus able to provide novel and unique solutions to the problem.

- **W-questions:** Another way of shifting the paradigm is to ask questions that force the creative person to look at the problem in a new and different manner. These questions are not limited to the how of the problem but also take into consideration the 'why', 'what', 'who' and 'which' of the problem.

These are the W-questions of the problem to which the creative person needs to find answers by thinking in a different and a more creative manner. This, therefore, enables the creative person to find new answers to the given problem and results in better solutions to the given problem.

CHECK YOUR PROGRESS

14. What is a paradigm?
15. What are the three paradigmatic stages of creativity?
16. What is a reversal-de-reversal paradigm shift?

4.8 BARRIERS TO CREATIVITY AND CREATIVE ATTITUDES

Creativity has a few problems associated with it because of its basic nature. Creative people are considered to be different and because of their divergent thinking are often estranged and isolated. Creative people have parents, peers, as well as teachers who do not consider them as a part of the society. This also results in several creative people to give up their creative abilities because they want to be accepted as a part of the society.

Creative skills and abilities of some people are often repressed because of several factors. When it comes to creativity, there are several barriers to creativity and also the creative attitudes of people. These barriers inhibit the creativity of those who possess the creative abilities.

Those who possess creative abilities think differently, have better intuitive abilities, and also have a personality and attitude that tells them apart from the others. The barriers to creativity have an impact on the attitude of the creative people as well. The barriers negatively affect the attitudes of the creative people who, when they are unable to exhibit and express their creativity in a specific manner, tend to develop personality as well as behavioural problems. Such people often develop a low self-esteem and give up their creative skills.

Barriers to creativity are 'creativity killers' that hinder the very process of creativity and do not enable ideas to flow freely in the minds of the creative people. The barriers to creativity can be classified into the following types:

- **Historical barriers:** Historical barriers state that historical thought has an influence on the creativity of a person. Because of the dominance of historical and social thought, several creative people feel that they have little or no control over their thinking abilities. This, therefore, proves to be a hindrance in the creative thought process of an individual.

- **Biological barriers:** There are many scholars who are of the view that creativity is a hereditary trait and those who do not inherit creativity cannot generate creative and novel ideas. Therefore, those who have creative abilities which are not inherent fail to exhibit them and in many cases these creative abilities are not recognized and repressed.

- **Physiological barriers:** Physiological barriers are the ones that hinder the creative abilities of a person by virtue of some kind of mental or physical disability. These disabilities do not allow a person to develop creative skills in an effective manner and therefore they fail to express their creative ideas.

- **Sociological barriers:** The social environment plays an important role in fostering and enhancing the creative abilities of a person. However, the society is composed of a large number of members who live together following the set norms of the society. Within this social construct, all individuals are required to behave in a specific manner and show skills that are acceptable to the society. This is a major barrier for creative people. Creative people usually think in a different manner which does not match the thinking style of others in the society.

  Creative people often do not follow the norms of the society. Because of these reasons, creative people are often isolated from the society and not considered a part of the society. This, in turn, adversely affects the personality as well as the behaviour of the creative person who may even give up his creative abilities to be accepted as a part of the society.

- **Psychological barriers:** Psychological barriers are by far the most important barriers that hinder the creativity of an individual. Psychological barriers are of different types. Self-imposed psychological barriers are the ones that have been thought of by the creative person on his own. Conformity is another psychological barrier that hinders the creative activity of a person. It means that a person is bound to give an expected answer or needs to conform to the norms specific. This causes a problem for creative people who provide unusual answers and also do not conform to the stated norms.

  There are some people who lack the ability to accept the challenge or to give different answers. In other words, some people prefer to stick to the obvious answer and do not play with different ideas and possibilities to come with something creative and different.

  Another psychological barrier is evaluating too quickly. There are several people who evaluate their ideas too quickly in the sense they either accept

or reject the ideas without reflecting enough upon them. This means that these people do not play with their creative ideas in an effective manner and several ideas which can actually be novel and unique are buried because of too quick evaluation.

- **Functional fixedness:** Functional fixedness means to see only the obvious solution to the given problem. When a person looks at a problem in the most obvious manner, she/he is unable to play with different ideas of solving the problem. The individual just focuses on finding the right answer to the problem and does not want to get out of the comfort zone of solving the problem. This, therefore, does not allow the individual to develop creative thinking skills and abilities.

- **Self-censorship:** Self-censorship is the inner voice of the person that stops him or her from thinking in a creative manner. Most people do not want to come out with new and unique ideas so that they are not laughed at. This prevents these people from thinking in a creative manner. Criticism by others often stops an individual from proceeding with expressing and exhibiting creative ideas as it fosters negative thinking which, in turn, does not allow a person to think in a creative manner.

- **Micro-management:** Micro-management means that an individual provides too much detail related to a given problem. When a person goes into providing too much detail about a specific problem, she/he focuses on the problem but is unable to provide creative solutions to a problem.

- **Over-thinking:** Over-thinking is another barrier to creativity. When a person over-thinks about a specific problem, she/he thinks about the problem in a logical manner and in a conscious state of mind. Creativity, however, comes from the sub-conscious or the unconscious mind and does not involve logical thinking. Therefore, over-thinking about a problem inhibits creativity of an individual.

- **Creativity myths:** There are several creativity myths that act as barriers to creativity as they shape the everyday behaviour of an individual.

- **Lack of time and opportunity:** The lack of time and opportunity is another barrier to creativity. Many people believe the fact that they are too busy with their day to day life and do not get enough opportunities to express their creative abilities. This, therefore, stops people from thinking in a creative manner and expressing new ideas.

- **Lack of sleep:** Lack of sleep is also a barrier to creativity. When the brain is not rested enough, it does not have the ability to think different ideas and therefore, does not get enough creative and novel ideas.

The various barriers to creativity that we have studied have an adverse impact on creativity and affect it in a negative manner. It is therefore essential to overcome the various barriers to creativity. There are various ways in which the barriers to creativity can be overcome. One of the best way to overcome the barriers to creativity is to have a positive attitude. An individual, instead of seeing the barriers to creativity as obstacles, must focus on positive thoughts.

Another way of overcoming the barriers to creativity is that an individual must always be prepared to learn. An individual needs to try again and again before she/he can successfully develop creative skills and frame new and creative ideas.

Making time for creativity is another way of overcoming barriers to creativity. Since many people think that they are too busy in their day to day life to come out with creative ideas, it is essential to manage the day to day operations and also come out with new and fresh ideas and approaches.

Being open minded also helps to overcome the barriers to creativity. New ideas and thoughts come to the mind when a person talks to others or when a person looks at a specific problem from different angles. This helps to develop creative skills and also enables the person to think in a creative manner.

It is important for a person to let go of old and stagnant concepts. Creativity is not based on logical thoughts and involves looking at ideas from a new and fresh perspective. When a person indulges in old thoughts and concepts, she/he does not think of new and novel ideas. It is important to let go of functional and logical approaches to think in a creative manner.

CHECK YOUR PROGRESS

17. How does conformity operate as a psychological barrier to creativity?

18. How do barriers to creativity hinder people from acting and behaving in a positive way?

4.9 SUMMARY

- Creativity is the ability of an individual to develop new ideas.

- When an individual thinks in a creative manner, several problems and hurdles are encountered and the creative process is therefore considered iterative in nature, wherein the individual is involved in the process till the best solution is obtained and arrived at.

- According to American art teacher and author Betty Edwards: 'Creativity is the ability to see problems in new ways, to see things from a new perspective, and the knack of looking for answers in unexpected places.'

- Qualities used to describe the creative personality include self-confidence, independence and openness to experience. They have a sense of humour and playful child-like attitude, a preference for complexity, an acceptance of disorder and a tolerance of ambiguity.

- Creative children have divergent thinking abilities that enable them to think in an unusual manner and make them different, often placing them in the the minority.

- Creative children also find it hard to maintain their creativity around friends who are not as creative.

- Creative children also attempt difficult and different tasks wherein their creativity is applied the most.

- Another problem in maintaining creativity is that creative children are often not provided support from their parents, teachers and peers.

- It is believed that all children are creative and, if they are provided the right environment, they would be able to maintain their creativity in the most effective manner.

- Creative children also threaten ideas of their teachers, which is why there are instances when teachers try to repress creativity of such children.

- Creative children are viewed as different from others and are not treated like other children.

- Creative abilities of the child may even be repressed by parents and teachers who consider the child to be different and may want the child to do better in terms of logical intelligence.

- Lack of encouragement and resources also repress creativity of children. When children do not get the required encouragement from teachers, parents and peers to work on their creative abilities, they tend to let go off their creative abilities.

- Creativity is essential for the emotional development of the children. Social development and physical development are also closely associated with creativity and creative children are not only more social and outgoing but they also enjoy good health.

- The truth is that creativity cannot be taught but can be fostered by providing the child with the right environment and resources.

- To foster creativity in classrooms, teachers must encourage their students to think laterally and find associations between things that are otherwise not connected in any manner.

- Creativity is a lot of different processes in the brain. These include the ability to improvise, the ability to think divergently and also get flashes of insights.

- Flashes of insights are the ideas and thoughts that come to the mind in a spontaneous manner, especially when the brain is in a relaxed state.

- The premise of the relationship between intelligence and creativity is the fact that intelligent people are able to store more information in their brain and therefore, their brain is able to come out with novel ideas often.

- A recent study by Rex Jung was aimed at understanding what happens in the brain when a person is indulged in a creative activity.

- AI recognizes its surroundings and initiates actions that can maximize its chance of success. It includes the ability to make decisions, the ability to show expertise in some specific domain, the ability to learn and understand,

the ability to reason and plan during problem solving, and, the ability to use senses, such as hearing, speech and vision.

- In AI, an Intelligent Agent (IA) is described as an independent entity which perceives through sensors and acts upon an environment using actuators (i.e., as an agent) and directs its activity towards achieving goals (i.e., as a rational).

- A problem solving agent is an agent who decides the series of actions with several options of unknown value by examining the various possible sequences of actions that may lead to states of known value and then select the best sequence.

- Howard Gardner was the first to see the limits of the old way of thinking about intelligence. In his book *Frames of Mind*, published 1983, he proposed that there was not one, monolithic kind of intelligence that was crucial for success, but rather, a wide spectrum of intelligences with seven key varieties.

- The theory of multiple intelligence has evolved to focus on metacognition— that is, awareness of one's own mental processes—rather than on the full range of emotional abilities.

- The theory of multiple intelligence has evolved to focus on metacognition— that is, awareness of one's own mental processes—rather than on the full range of emotional abilities.

- Psychological barriers are by far the most important barriers that hinder the creativity of an individual. Psychological barriers are of different types. Self-imposed psychological barriers are the ones that have been thought of by the creative person on his own.

- It is important for a person to let go of old and stagnant concepts. Creativity is not based on logical thoughts and involves looking at ideas from a new and fresh perspective.

4.10 KEY TERMS

- **Iterative:** It refers to something relating to or involving iteration, especially of a mathematical or computational process.

- **Deigned:** It means to do something that one considers to be beneath one's dignity.

- **Dendroids:** It means a graptolite of a type that formed much-branched colonies, found chiefly in the Ordovician and Silurian periods.

- **Ephemeral:** It refers to something that lasts for a very short time.

- **Effectors:** It means an organ or cell that acts in response to a stimulus.

- **Veridical:** It refers to something that coincides with reality.

4.11 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Creativity is the ability of an individual to develop new ideas.

2. The fundamental problem for creative children in maintaining their creativity is to deal with challenges, issues and discomfort that arise from being different.

3. The main aim of the creative child is to try and achieve uniqueness.

4. Creativity cannot be taught but can be fostered by providing the child with the right environment and resources.

5. An art centre in the classroom must be set up with easy-to-use and accessible materials so that children can explore the various art ideas on their own.

6. On both sides of the brain, there is a brain lobe known as the superior temporal gyrus which is the creative spot of the brain.

7. When a person experiences flashes of insights, the frontal lobes of the brain go into some kind of a temporary sleep mode which then enables ideas to flow into the mind.

8. The three areas of the brain used for creative thinking are:
   - Attention control network
   - Imagination network
   - Attention flexibility network

9. The two most common AI languages are LISP and Prolog.

10. It relates to tasks involving higher mental processes, such as creativity, solving problems, pattern recognition, classification, learning, induction, deduction, building analogies, optimization, language processing, knowledge and many more. Intelligence is the computational part of the ability to achieve goals.

11. Anything that can be observed as perceiving its environment through sensors and acting upon that environment through effectors is considered as an agent.

12. Metacognition is the ability of a person to understand, manipulate and control the cognitive processes.

13. According to Fogarty, the three phases of metacognition are:
    - Plan
    - Monitor
    - Evaluate

14. A paradigm is a belief or a structure within which a person thinks or acts.

15. The study of creativity can be viewed from three paradigmatic stages—the genius stage, the creative person stage, and the social stage.

16. The reversal-de-reversal is a paradigm shift in which the problem in turned upside down and is then solved.

17. Conformity is a psychological barrier which means that a person is bound to give an expected answer or needs to conform to the norms specific.

18. The barriers to creativity negatively affect the attitudes of the creative people who, when they are unable to exhibit and express their creativity in a specific manner, tend to develop personality as well as behavioural problems.

4.12 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the problems faced by creative children in classrooms?
2. What factors are responsible for repressing or encouraging the creativity of a person?
3. What role does time and space play in fostering creativity in children?
4. How can teachers foster creativity in the classroom?
5. How can learners foster and develop a creative attitude?

Long-Answer Questions

1. Describe the relationship between intelligence and creativity.
2. How does AI technique represent knowledge?
3. Briefly explain the I-paradigm or the creative person stage.
4. What are the various barriers to creativity and how can these be overcome?

4.13 FURTHER READING

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UNIT 5   RESEARCH IN CREATIVITY

Structure

5.0 INTRODUCTION

Creativity was initially considered to be a rare and mysterious phenomenon. According to A.K. Hota, creativity could be seen only in a few geniuses like Shakespeare, Da Vinci, and Mozart. Creativity was also shown by some mediocre artists or scientists who occasionally produced creative works. There were several scholars and researchers like Tagore, Kalidas and Plato who associated creativity with divine inspiration. Creativity was also considered to be a work of intuitive genius. In his work 'The Critique', Kant states that 'creativity is natural and therefore cannot be developed'. Another group of scholars considered creativity to involve only enjoyment and fun and therefore negated the option of hard work being involved in creativity. All these beliefs became detrimental in earlier research in creativity.

Today, creativity is considered to be the most important asset of the human race. After 1957, a change in the view of scholars and researchers with respect to creativity became more prominent. Creativity was now seen as a means of achieving world supremacy. Researchers have, since then, started discussing about creativity in business and manufacturing fields. Education is another field in which research on creativity is being done. This unit describes research in creativity in India and abroad.

5.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss research in creativity in India and other countries of the world
- Assess the factors of creativity in teaching
- Provide a review of related research literature

5.2 RESEARCH IN CREATIVITY IN INDIA AND ABROAD

The person who initiated systematic research in creativity was J. P. Guilford. He first presented his ideas on creativity in 1950 in an address to the American Psychological Association. In his address, Guilford stated that creative acts could be expected from almost all individuals. This was a novel view of creativity which, till now, was considered to be an attribute of only a few genius people.

In 1956, Guilford published a paper in which he presented a system through which the various factors of intellect could be arranged. In this model, forty factors were identified. In the latest model of the structure of intellect presented by Guilford, 150 factors have been identified. According to the structure of intellect presented by Guilford, mental activity constituted of three aspects—mental operation, its content, and its product.

Mental operations are further divided into five sub categories, including, cognitive, memory, divergent production, convergent production and evaluation. These categories included visual, auditory, symbolic, semantic and behavioural content, and products such as classes, relations, systems, transformations and implications. Guilford stated that mental operation is information generated from the given information. Content is the raw material to which a mental process is applied and product is the result which is derived when a mental operation takes place with any five kinds of content.

Guilford also suggested that it is divergent thinking that includes creativity, and that creativity remains influenced by factors like fluency, flexibility, originality, elaboration and redefinition. Later, he also suggested that sensitivity to the problem is also important when it comes to creativity. For divergent production, each of the contents will produce six kinds of products. For divergent production, there are thus thirty cells (5 contents × 6 products). Out of these, five are devoted to transformation, i.e., redefinition. The remaining twenty-five cells measure fluency, flexibility and originality. Out of these, five are of implications. These are nothing but elaboration. Hence, there are twenty cells devoted to fluency, for flexibility and for originality. Guilford pointed out that sensitivity to the problem comes under-operation evaluation. For evaluation, there are thirty cells, i.e., sensitivity to the problem has thirty cells. Thus, according to Guilford, in a structure of intellect of 150 cells, sixty (i.e., 40 per cent) are devoted for creative potential.

Researchers define four 'P's of creativity—process, press, product and person. Thus, creativity involves identifying the qualities of the product that make it creative, understanding the characteristics or attributes of the creative personality, investigating the nature of the environment or the press which is conducive to improving creativity and describing the process which is used by creative people to invent or discover something new and unique.

According to Stein, 'creativity is that process which results in a novel work that is accepted as tenable, useful or satisfying by a group at some point in time'.

Henry Miller defines creativity as, 'the occurrence of a composition (product) which is both new and valuable'. Torrance, on the other hand, defines creativity in the following words:

> The process of sensing difficulties, problems, gaps in information, missing elements, something askew making guesses and formulating hypotheses about these deficiencies; evaluating and testing these guesses and hypotheses; possibly revising and retesting them and finally communicating the results.

Thus, on the basis of these definitions:

- Creativity is a process and a product.
- Creativity involves formation of new and valuable product and problem solving.
- Creative people make use of previous experiences and manipulate these in different and unusual ways to develop new and valuable products.

Dilip Mukerjea describes creativity in a new and innovative manner. According to him, 'creativity is the spark that ignites new ideas'. Mukerjea also provides the formula of $C = (ME)?$ for creativity. In this formula, C is creativity, M is the mass of data, information, knowledge and wisdom acquired over life time, and E is the sum of experiences and the enlightenment gained thereby that serves to energize one's life.

Another way of looking at creativity by researchers is to study the creative person himself. According to this view, creative work is the expression of a creative personality. Vernon considers 'creativity as mainly an ability and a form of cognitive activity'. Drevdhal defines creativity as 'the capacity to produce compositions, products or ideas of any sort which prove new or novel and previously unknown to the producer himself'. Several researchers have researched on this aspect of creativity over the years and attempted to find traits of a creative personality. Following traits are considered to be common to all creative people:

- Flexibility
- Openness
- Tolerance for ambiguity

Researchers who view creativity from the viewpoint of a person also suggest that the above listed traits of creative people are also related to the press or environment in which a creative person works.

The environment or the press is not a passive factor or element of creativity. In fact, environment determines what kind of novel idea is produced by the creative person. Environment can either be conducive to the working of a creative person, or it can be inhibitive to the working of a creative person. Research suggests that a particular environment can tolerate only certain creative solutions.

Thus, the social setting or the environment determines what kind of new ideas a creative person will give. Simonton states that the effects of environment are not only specific affecting the creativity of an individual but also general in the sense that it influences the kind of novelty which is produced in the society as a

whole. Following are the environment factors that are important and conducive to creativity:

- Environment must be stimulating so that a creative person can respond to new tasks and challenges.
- Environment should be encouraging and rewarding for the creative person.
- Environment must not induce defensiveness when it comes to influencing the creative person.
- Environment must allow for critical but constructive evaluation.
- Environment must allow for technical training.
- Environment must be conducive to intellectual activity of the creative person.
- Environment must allow for effective performance and make the creative person accountable to society.
- Environment must be such that it allows the creative people to be looked upon as role models.
- Environment must also provide enough physical facilities so that the creative person can work in an effective and efficient manner.

Over the years, research has been carried out on various aspects of creativity. The scope of research on the nature of creativity remains limited in India whereas researchers abroad base a lot of their research on this aspect of creativity. Gupta tried to determine whether or not the dimensions of fluency, flexibility, originality, elaboration, problem inquisitiveness and persistency are fundamental dimensions of creativity. Sharma tried to study the nature of creativity in philosophical, psychological and social domains.

A lot of research in correlates of creativity has been done by Indian scholars. Research suggests that there are several variables that are correlated with creativity and these can be broadly categorized into social, academic, and personality factors.

Research also suggests that social factors do not show a consistent relationship with creativity. The various personality factors which have been found to be related with creativity include intelligence, dominance, autonomy, anxiety, endurance, emotional stability and self-concept. Of these, the most researched factor which is related to creativity is intelligence. A large number of researches have been done to find out whether intelligence increases with creativity or whether they are negatively correlated.

The 'Threshold Theory' of creativity and intelligence states that creativity and intelligence are related only up to intelligence quotient of about 120. However, Mark A. Runco and Robert Albert studied and conducted an empirical test with gifted and non-gifted children, the results of which did not support the threshold theory.

If the other personality factors are considered, researchers like Chauhan, Verma and Kumar suggested that creative people were introverts while Bhargava suggested that highly creative people were extroverts. Jha, on the other hand,

suggested that highly creative people had high ego strength. Research also suggests that people who were highly creative had a positive and high self-concept.

Researchers like Behera, Raina, and Padha concluded that academic factors and creativity are positively correlated. Other researchers like Getzel, Jackson, and Molloy are of the view that there was no relation between creativity and scholastic achievement. Research has also been carried out in India (and abroad) on the relationship between various subjects and creativity. For instance, Katiyar suggested that science students were better in terms of fluency, flexibility and originality as compared to art students. D. Kundu further suggested that science students were more creative than students of art.

Research has been carried out for measurement of creativity and tests have been created o measure it. While some tests were subject-specific, many of them were generic. Examples of these tests include the following:

- Creative testing at primary and middle school age
- Creativity test for school leaving age
- Scientific and creativity test
- Creativity in mathematics

Creativity tests measure four factors, including:

- Consequence
- Unusual uses
- Similarity findings
- Product improvement

Torrance Test of Creative Thinking (TTCT) also measured the above four factors. The tests developed in India were patterned on the lines of Guilford's structure of intellect model. Various tests tested different dimensions of creativity including, fluency, flexibility, originality and elaboration. The items in most Indian tests have been taken from tests developed abroad for measuring creativity.

Researches have also been done on development of creativity in various subjects and several experimental studies conducted for the development of creativity in general. In terms of scholastic subjects, few experiments have been conducted for the development of creativity. Various attempts and experiments for development of creativity have also been carried out on school students.

Research in Development of Creativity Abroad

Meyer attempted to develop mathematical creativity in students of Grade I by using fifteen twenty minute lessons. These lessons consisted on open-ended questions with moderate structures. When the experimental studies were conducted, no specific differences were found between experimental and control group children.

Macaranas and Natividad also used an innovative teaching method in theories of personality class in Eastern New Mexico University. The aim of this method was to foster creativity among students by indulging them in creative or experiential activities and to test for improvement of the students in these activities. The various

creative thinking and problem solving methods included creative diagrams, presentation of theories, films and one page reactions, and presentation of the student's own theory of personality. On applying the test on the experimental group of students, it was found that originality does change in students but such methods of innovative and creative thinking do not influence flexibility and fluency. However, the methods were able to foster creativity in the students.

Research has also been conducted on the techniques for creative thinking. Over the years, researchers have developed several techniques and methods that develop creativity among people. Some of these techniques used include:

- Brainstorming
- Synectics
- Bionics
- Role playing
- Attribute listing
- Zaltman metaphor technique
- Creative problem solving
- Morphological analysis
- Lead user technique
- Out of the box thinking
- Six thinking hats
- Mind mapping
- Scamper

Another area of research with respect to creativity that has gained the attention of many researchers is creativity in teaching.

Research suggests that there is an element of creativity in teaching. The teacher makes use of several of his/her competencies like openness, sensitivity to the problem, originality, elaboration, resourcefulness, fluency, flexibility, redefinition to facilitate the process of learning. Researchers argue that these competencies of the teacher represent his or her creativity. Following are the factors of creativity in teaching that have been suggested by various researchers:

- **Fluency:** It is the ability to generate several ideas, responses, solutions.
- **Flexibility:** Flexibility can either be adaptive or spontaneous. Spontaneous flexibility is the one wherein a variety of ideas are generated with freedom from inertia and preservation. Adaptive flexibility is the one wherein the most unusual type of solution is produced.
- **Originality:** Originality is the ability to generate new, unique, unusual and uncommon ideas or suggestions or way of doing things.
- **Elaboration:** Elaboration is the number of details which are more than are necessary to communicate the basic ideas, figures or objects.

- **Sensitivity to problem:** Sensitivity to problem is the ability to notice and sense defects, gaps, and contradictions.

- **Redefinition:** Redefinition is the ability to improvise on a situation and give up old interpretations related to a specific object or thing.

- **Openness:** Openness refers to the ability of a person to be open to new ideas without being prejudiced.

- **Resourcefulness:** It is the ability of a person to overcome difficulties by using new techniques and methods.

Research has also been done on how to develop and improve creativity in teaching. Researchers, however, suggest that there is no one specific method that can be used to improve creativity in teaching.

Following is an example case study for development of creativity in teachers:

- Cheng Vivian undertook a study into attempt to enhance the creativity of elementary science teachers in Hong Kong institution of education. A program was developed with the use of everyday resources which was meant to enhance the creativity of the teachers. The main aim of the program was to foster the creative attitudes and divergent thinking abilities of elementary science teachers. The program was conducted on almost eighty teachers and proved to be a success.

- The issues and critical problems related to fostering creativity in teachers were also highlighted in the research. The main problems that were faced in fostering creativity in teachers included disciplinary, cultural, managerial and theoretical problems. However, these problems and issues were mainly at a personal level and did not affect the overall development of creativity of the teachers in any manner.

- Another research related to 'Korean Teachers' Understanding of Creativity in Gifted Education' was carried out. The research was carried out on sixty science teachers. An open-ended questionnaire was used for the research purpose. On the basis of the analysis of the answers of the questionnaire, it was found out that science teachers had a complete understanding of the cognitive component of creativity but did not possess awareness of the personal and environmental components of creativity.

CHECK YOUR PROGRESS

1. Who initiated systematic research in creativity?
2. How does J. P. Guilford define content and product?
3. Name the various factors that influence creativity.

5.3 REVIEW OF RELATED RESEARCH LITERATURE

Review of the related literature, besides allowing the researcher to acquaint himself/herself with current knowledge in the field or area in which he/she is going to conduct the research, serves the following specific purposes:

1. The review of related literature enables the researcher to define the limits of his/her field. It helps the researcher to delimit and define his/her problem(s). To use an analogy given by D. Ary, a researcher might say: 'The work of A, B and C has discovered this much about my question; the investigations of D have added this much to our knowledge. I propose to go beyond D's work in the following manner.' The knowledge of related literature brings the researcher up-to-date on the work which others have done and thereby to state the objectives clearly and concisely.

2. By reviewing the related literature, the researcher can avoid unfruitful and useless problem areas. She/he can select those areas in which positive findings are very likely to result and his/her endeavours would be likely to add to the knowledge in a meaningful way.

3. Through the review of related literature, the researcher can avoid unintentional duplication of well–established findings. It is no use to replicate a study when the stability and validity of its results have been clearly established.

4. The review of related literature gives the researcher an understanding of the research methodology which refers to the way the study is to be conducted. It helps the researcher to know about the tools and instruments which proved to be useful and promising in the previous studies. The advantage of the related literature is also to provide insight into the statistical methods through which validity of results is to be established.

5. The final reason for reviewing the related literature is to know about the recommendations of previous researchers listed in their studies for further research.

5.3.1 Identifying Related Literature

The first step in reviewing the related literature is identifying the material that is to be read and evaluated. The identification can be made through the use of primary and secondary sources available in the library.

In the primary sources of information, the author reports his/her own work directly in the form of research articles, books, monographs, dissertations or theses. Such sources provide more information about a study than can be found elsewhere. Primary sources give the researcher a basis on which to make his/her own judgment of the study. Though consulting such sources is a time consuming process for a researcher, yet, they provide a good source of information on the research methods used.

In secondary sources of information, the author compiles and summarizes the findings of the work done by others and gives interpretation of these findings. In

them, the author usually attempts to cover all of the important studies in an area reported in encyclopedia of education, education indexes, abstracts, bibliographies, bibliographical references and quotation sources. Working with secondary sources is not time consuming because of the amount of reading required. The disadvantage of secondary sources, however, is that the reader is depending upon someone else's judgments on the importance of the study.

The decision concerning the use of primary or secondary sources depends largely on the nature of the research study proposed by the researcher. If it is a study in an area in which much research has been reported, a review of the primary sources would be a logical first step. On the other hand, if the study is in an area in which little or no research has been conducted, a check of the secondary sources is more logical. Sources of information, whether primary or secondary, are found in a library. The researcher must, therefore, develop the expertise to use resources without much loss of time and energy. To aid the researcher in locating, selecting and utilizing the resources, a study guide is provided in relation to their use in educational research.

A researcher should be familiar with the library, its facilities and services. He/She should also be acquainted with the regulations governing the use and circulation of materials. Many libraries use a printed guide that contains helpful information. The guide uses a diagram to indicate the location of the stacks, the periodicals section, reference section, reading rooms, and special collections of books, microfilm or microcard equipment, manuscripts, or pamphlets. The guide lists the periodicals to which the library subscribes and the names of special indexes, abstracts, and other reference materials.

The regulations concerning the use of stacks and reserve books, the procedures for securing reference materials held by the library or those that may be borrowed from another library are also included in the guide.

Research scholars and other readers are usually issued a library card giving them access to the stacks. They may take the help of library staff or may carry on the independent search for books and other reference materials. After using the books, it is desirable for the readers to leave them on the tables so that the library staff will return them to their proper position on the shelves.

Sometimes, a reference is not available in the library. In such a situation, the reader must consult the 'union' catalog, which lists references found in other libraries. Such references may be obtained in the following ways:

   (i) **By inter-library loan system:** The reader requests the librarian to borrow the desired reference from other library where it is available.

  (ii) **By requesting a photostat copy:** The reader may request the librarian to obtain the photostat of a page or a number of pages of a desired reference from the source.

 (iii) **By requesting an abstract or translation of the portion of a desired reference:** Some large libraries have abstracting and translating service that provides abstracts, or copied or translated portions of needed materials at an established fee.

(iv) **By requesting microfilm or microfiche:** The reader may purchase a microfilm that can be projected on library microfilm equipment. A microfiche is a sheet of film that contains microimages of a printed manuscript or book. Its development has been one of the most significant contributions to library and information services by providing economy and convenience of storing and distribution of long runs of scholarly materials.

An even more significant development is the ultrafiche. It has the capacity of 3200 pages per fiche.

Various types of cameras are used to record microimage on roll film. Some of which are described below:

- **Planetary camera:** It is either a 35mm or 16mm still camera which is mounted on a vertical column that can be moved up and down as per the requirement. At a time, it can be loaded with 100 feet of roll film. It does not cost much.

- **Step-and-repeat camera:** It is a costly camera which is specifically used to automatically record microimages on microfiche one-by-one.

- **Rotary camera:** This particular type of camera, like the planetary camera, records microimages on roll film and has the capacity to change the reduction ratio as desired.

- **Flow camera:** A flow camera costs less than half of a planetary camera. Its reduction ratio is fixed unlike previously mentioned types of camera.

All these cameras make use of silver, diazo or vesicular film for recording microimages.

Generally, six types of 'Readers' are used for reading microfilms or microfiche:

1. **Cuddly Microfiche Reader:** This is a portable reader and can be used by keeping it in one's lap. It is very cheap and can be lent to library members for home use.

2. **Microfilm and Microfiche Reader:** This is a reader/printer machine that can make copies from both microfilm and microfiche.

3. **Universal Machines:** This type of Reader essentially archives by reading the description, storing it and printing it. The example is Universal Tuning Machine (UTM) or computer.

4. **Reader/Printer:** This is a push-button machine which not only helps in reading a microfilm/microfiche but is also capable of producing a full-sized paper copy of the frame on the screen.

5. **Production Printer/Enlarge Printer:** It is an automatic machine and can print the required number of copies of a microfilm or its selected portions. It is used for mass production of full-sized copies of microfilms.

6. **Xerox Copyflow Machine:** This is a costly machine, and therefore, is beyond the reach of ordinary libraries. It can print out a microfilm into a

readable size, and as such, a single copy of any requisite document can be had at low cost and in less time.

The card catalog is the index to the entire library collection. It lists the details of publications found in the library with the exception of serially published periodicals.

Generally, the card catalog contains the name of the author, title of the book/ journal/magazine, and subject cards arranged alphabetically. A great deal of information about a book can be found on the cards. Besides the title of the book and the name of the author, the reader will find the date of birth of the author, the edition, the publication date, the number of pages, and the name and location of the publisher. Other items listed on the cards are bibliographies, maps, portraits, illustrations, tables, series (if any) in which a book appears, a brief description of the book—whether the book is a translation and who did the translation.

Library classification systems provide ingenious ways of systematizing the placement and location of books. Every system is based upon a methodology that is logical and orderly to the smallest detail. The two principal systems of library classification in the United States are the 'Dewey Decimal' system and the 'Library of Congress' system.

The 'Dewey Decimal' system is a decimal plan with the numbers running from 001 to 999.99. The 'Library of Congress' system is particularly used in large libraries. It provides for twenty main classes instead of the ten of the 'Dewey Decimal' system. The system uses letters of alphabet for the principal headings and numerals for further sub-grouping.

In a library, all books have a call number or letter that appears in the upper left-hand corner of the author, subject or title card, and on the back of the book. These call numbers or letters are used to arrange the books serially on the library shelves and within each classification, the books are arranged alphabetically by author's last name.

Identifying the best available sources pertaining to a problem and extracting the essential information from them is of much importance to a researcher. For this, he/she must develop some library searching techniques so as to save his/her time and effort. Van Dale has suggested the following valuable guidelines for a researcher:

1. Before using a library, you must familiarize yourself with its layout, facilities, services, and regulations.

2. You must learn how to use the microform (microfilm and microfiche) readers, photocopies, and other mechanical aids.

3. It is necessary to look in the stacks and in the periodical, reference, reserved book, and rare book rooms, the materials that you will use frequently are placed.

4. You need to schedule your work session in a library when you will encounter the least competition for resources and services.

5. You must make out call slips for all or most of the books needed in one session.

6. It is necessary to copy all information that the librarian needs to obtain each reference for you, and before closing the periodical index or card catalog, recheck and rectify any errors or omissions.

7. Researchers and scholars need to arrange to spend a block of time in the library that is sufficient to accomplish a specific task.

8. When little time is available, it is important to clear up questions that can be answered quickly through the help of reference books that are readily available.

9. Before initiating search for materials in a library, you must write down questions that cover precisely the information you wish to locate and group the questions in accordance with the areas in the library where the answers may be found.

10. It is necessary to compile a list of the present and any previous names of periodicals, organizations, government agencies, research agencies, collectors of statistics, libraries and museums with special collections and outstanding authorities in your field.

11. It is also important to keep a list of the best reference books, indexes, handbooks, historical studies, and legal references in your area of specialization.

12. You must obtain copies of the best bibliographies and reprints of significant research studies for your files.

13. It is necessary to note which periodicals regularly or occasionally print bibliographies, reviews of literature or such other reference material and the issues in which they appear.

There are a number of references that may be useful to a researcher in the field of education. To facilitate the search for such material, a researcher may consult the following carefully compiled volumes:

- **Constance M. Winchell's** *A Guide to Reference Books,* **8th edition:** This comprehensive work has biennial supplements to bring the up-to-date information in a number of languages. It describes and evaluates about 7,500 references and a section is devoted to education.

- **Albert J. Walford's** *Guide to Reference Material***:** This is a two-volume work which covers science and technology (1966), and philosophy and psychology, religion, social sciences, geography, and history (1968).

- **Mary N. Barton and Marion V. Bell's** *Reference Books***:** *A Brief Guide for Students and Other Users of the Library:* This guide is helpful but considerably shorter.

- *International Guide to Educational Documentation***:** This is a one-volume international guide to educational books, pamphlets, periodicals, occasional papers, films and sound recordings.

- **Arvid Burke and Mary Burke's** *Documentation in Education*: This guide provides an excellent introduction to literature in the field of education.

- *The Standard Periodicals Directory***:** This is a directory of over 30,000 entries and covers every type of periodical, with the exception of local newspapers. It is published every year and covers about 200 classifications which are arranged by subject. An alphabetical index is provided.

- **Christine L. Wyner's** *Guide to Reference Books for School Media Centres***:** This guide includes 2575 entries with evaluative comments on reference books and selection tools for use in educational institutions. It is indexed by author, subject and title.

- *Encyclopedias***:** These serve as a store house of information and usually contain well-rounded discussion and selected bibliographies that are prepared by specialists. Encyclopedias are arranged alphabetically by subject and for each field of research, they present a critical evaluation and summary of the work that has been done. In addition, these suggest the research needed in the field and also provide *a selective bibliography.*

The following list provides a sample of encyclopedias that researchers in the field of education might use:

- **Paul Monroe's** *A Cyclopedia of Education***, 5th volume (New York: Macmillan, 1911-13)**: It is edited by Paul Monroe with the assistance of departmental editors and more than 1000 individual contributors. It provides excellent bibliographies and is extremely useful for historical and biographical purposes.

- **Henry D. Rivlin and H. Schuller's** *Encyclopedia of Modern Education* **(New York: Philosophical Library, 1943):** This comprehensive work of about 200 authorities has been edited by Henry D. Rivlin and H. Schueller. It stresses present day problems, trends, theories, and practices. The articles are accompanied by brief bibliographies and there is a system of cross references.

- **Walter Scott Monroe's** *Encyclopedia of Educational Research* **(New York: Macmillan, 1950):** Monroe's *Encyclopedia* was prepared under the auspices of the American Educational Research Association. It aims to present a critical evaluation, synthesis and interpretation of research studies in the field of education. All the articles, arranged alphabetically, are provided with bibliographies.

- **Chester Harris'** *Encyclopedia of Educational Research***, 3rd edition (New York: Macmillan, 1960):** Harris' *Encyclopedia* is also prepared under the auspices of the American Educational Research Association. It is not merely a revision of earlier editions, but is a completely rewritten volume that has attempts at a new perspective.

- **Robert L. Ebel's** *Encyclopedia of Educational Research***, 4th edition (New York: Macmillan, 1969):** Ebel's *Encyclopedia of Educational Research* provides concise summaries of research and many references for further research. The articles deal with persistent educational problems and continual educational concerns.

- **Lee C. Deighton's** *The Encyclopedia of Education* **(New York: The Macmillan Company and The Free Press, 1971):** The encyclopedia includes more than 1000 articles. It offers a view of the institutions and people, of the processes and products, found in educational practice. The articles deal with history, theory, research, philosophy, as well as with the structure and fabric of education.

- **Harold E. Mitzel's** *Encyclopedia of Educational Research*, **5th edition (New York: The Free Press: A Division of Macmillan Publishing Co., Inc., 1982):** The contents of encyclopedia have been classified under eighteen broad headings alphabetically ranging from 'agencies and institutions related to education, counseling, medical, and psychological services, and curriculum areas to teachers and teaching'. The new concepts and topics, namely, 'computer-based education', 'drug abuse education', 'equity issues in education', 'ethnography' and 'neurosciences' are also included in this volume. These additions reflect recent events and developments in the world to which education must attend.

- **Torsten Husen and T. Nevel Postlethwaite's** *The International Encyclopedia of Education* **(New York: Pergamon Press, 1985):** This publication is the first major attempt to present an up-to-date overview on educational problems, practices and institutions all over the world. The information available in this volume provides answers to three basic questions—what is the state of the art in the various fields of education; what scientifically sound and valid information is available; what further research is needed in various aspects of education?

- **T. Neville Postlethwaite's** *The Encyclopedia of Comparative Education and National Systems of Education* **(New York: Oxford Press 1988):** This encyclopedia is in two parts: the first part presents a series of articles about comparative education; the second part provides description of 159 different systems of education in various countries.

- *International Encyclopedia of the Social Sciences* **(New York: Macmillan Co. 1968):** It was prepared under the direction of ten learned societies. This reference work covers topics in all of the social sciences.

- *Encyclopedia of Child Care and Guidance* **(Garden City, New York: Doubleday and Co. 1968):** It is a comprehensive treatment of the nature of the problems of childhood. It also suggests the methods of dealing with such problems.

- *Encyclopedia of Social Work* **(New York: National Association of Social Workers, 1965):** This reference work presents extensive articles on all aspects of social work.

- *Encyclopedia of Philosophy* **(New York: McGraw-Hill Book Co. 1971):** This encyclopedia contains more than 7000 articles written by more than 2000 contributors in all areas of science and engineering.

- *Encyclopedia of Philosophy* **(New York: Macmillan, Free Press 1967):** It is an authoritative and comprehensive reference work covering both Western and Eastern thought—ancient, medieval and modern.

- *Encyclopedia of Indian Education* **(New Delhi: NCERT 2004):** It provides a comprehensive description of various concepts, themes and systems pertaining to Indian education in ancient, medieval, pre-independence and post-independence periods.

- *Dictionaries:* They serve as constant guides to the researcher.

Details of a few known dictionaries are given below:

- *Dictionary of Education* **(New York: McGraw-Hill Book Co. 1973):** This dictionary covers 33,000 technical and professional terms. It also includes educational terms used in various countries.

- *Comprehensive Dictionary of Psychological and Psychoanalytical Terms* **(New York: David McKay Company):** It contains more than 13,000 terms. All these are defined in non-technical terms.

- *Dictionary of Sociology* **(New Jersey: Littlefield, Adams and Co.):** In this dictionary, sociological terms are defined in non-technical language.

- *Roget's International Thesaurus of Words and Phrases* **(New York: Crowell, Collier and Macmillan):** A thesaurus is the opposite of a dictionary. One turns to the thesaurus when one has an idea, but does not yet have appropriate word to convey it. Thesaurus lists together the synonyms and antonyms of words. A researcher should use this reference in conjunction with a good dictionary to ensure precision of expression.

- **Yearbooks, Almanacs and Handbooks:** A large amount of current information on educational problems, thoughts and practices may be found in yearbooks, almanacs and handbooks. Some yearbooks cover a new topic of current interest each year and others provide more general reviews of events.

Given below is a small list of yearbooks, almanacs and handbooks:

- **N. L. Gage's** *The Handbook of Research on Teaching* **(Chicago: Rand McNally & Co. 1963):** This handbook presents a comprehensive research information on teaching with extensive bibliographies.

- **Arthur W. Foshay's** *The Rand McNally Handbook of Education* **(Chicago: Rand McNally & Co. 1963):** It is a convenient source compilation of the most important facts about education in the United States. This handbook provides a quick-reference comparison of education in England, France and Russia.

- *Education Yearbook* **(New York: Macmillan Co. 1972-till date):** This is an annual publication. It includes statistical data on major educational issues and movements with a comprehensive bibliography and reference guide.

- *Mental Measurement Yearbook* **(Highland Park, New Jersey: Gryphon Press 1938-till date):** It is compiled by Oscar K. Buros and provides a comprehensive summary on psychological measurement and standardized tests and inventories. It is published every four years and includes reviews on all significant books on measurement and excerpts from book reviews appearing in professional journals.

- *Indian Mental Measurement Hand Book: Intelligence and Aptitude Tests* **(New Delhi: National Council of Educational Research and Training (NCERT) 1991):** The handbook is one of major efforts of National Library of Educational and Psychological Tests (NLEPTs) published by NCERT to present before researchers, a review of the standardized tests, particularly in the areas of 'intelligence' and 'aptitude'.

It makes available the organized information on tests developed in India and the Indian adaptations or standardization of foreign tests. The information covers not only tests which are commercially available to test users and for restricted use, but also tests for which only specimen sets are available. Test reviews have been included in this handbook in order to help the readers to evaluate the tests more critically.

- *The Student Psychologist's Handbook: A Guide to Sources* **(Cambridge, Mass: Schenkman Publishing Co. 1969):** This handbook describes the major content areas of psychology with sources of information, methods of data collection, and the use of reference materials.

- *Data Processing Yearbook* **(Detroit: Frank H. Gille 1952-till date):** This yearbook is published irregularly and includes articles on equipment, techniques, and developments in data processing. It also provides information about institutions offering data processing and computer courses.

- *United Nations Statistical Yearbook* **(New York: United Nations, 1949-till date):** This is an annual publication. It presents statistical data on population, trade, finance, communication, health and education.

- *World Almanac-Book of Facts* **(New York: Newspaper Enterprise Association, 1968-till date):** This reference guide is published annually. It provides up-to-date statistics and data concerning events, progress and conditions in social, educational, political, religious, geographical, commercial, financial and economic fields.

- *The Standard Education Almanac***:** It provides a record of facts and statistics on virtually every aspect of education.

- **Directories and Bibliographies:** Directories are used by a researcher to locate the names and addresses of persons, periodicals, publishers or organizations when he/she wants to obtain information, about financial assistance or research materials and equipments. Directories may help a researcher to find people or organizations who have similar professional

interests or who can answer his/her queries or help to solve his/her problems.

A few important directories in the United States and the United Kingdom are as follows:

- *Guide to American Educational Directories***:** It lists in one volume over 12,000 educational and allied directories. The directories are listed alphabetically and are arranged under subject headings.

- *The Education Directory* **(Washington: United States Office of Education, Superintendent of Documents, 1912-till date):** This directory is published annually in five parts. It deals with names, educational agencies, officials, institutions and other relevant data.

- *NEA Handbook for Local, State and National Associations* **(Washington, DC: National Education Association, 1945-till date):** This is an annual publication and contains listings and comprehensive reports of state and national officers of affiliated associations and departments.

- *Educator's World* **(Englewood, Colo.: Fisher Publishing Co. 1972-till date):** This is an annual guide to more than 1600 education associations, publications, research and foundations.

- *National Faculty Directory* **(Detroit: Gale Research Co. 1964-till date):** This annual publication alphabetically lists the names and addresses of more than 3,00,000 full-time and part-time faculty members and administrative officials of colleges and universities in the United States.

- *Encyclopedia of Associations* **(Detroit: Gale Research Co. 1964-till date):** This directory lists alphabetically more than 14,000 national associations of the United States. It includes information on membership, addresses, names of executive secretaries and statement of purpose of these associations.

- *Directory of Exceptional Children* **(Boston: Porter Sargent Publishing Co. 1962-till date):** This directory provides a description of schools, camps, homes, clinics, hospitals and services for the socially mal-adjusted, mentally retarded or physically handicapped in the United States.

- *Mental Health Directory* **(Washington: National Institute of Mental Health, Government Printing Office 1964-till date):** This annual publication lists national, state and local mental health agencies in the United States.

- *American Library Directory* **(New York: R. R. Bowker Co. 1923-till date):** This directory provides a biannual guide to private, state, municipal, institutional and collegiate libraries in the US and Canada. It includes information on special collections, number of holdings, staff salaries, budgets and affiliations.

- **Thomas Kelley's** *Select Bibliographies of Adult Education in Great Britain* **(London: National Institute of Education 1952)**
- Blackwell, A.M. *A List of Researches in Educational Psychology Presented for Higher Degrees in the Universities of the United Kingdom and the Irish Republic from 1918.* (London: Newnes Educational Publishing Co., 1950).

In India, a very few bibliographical guides to educational research on a national basis have appeared. *Bibliography of Doctorate Theses in Science and Arts* accepted by the Indian Universities for 1946-48 and 1948-50 was published by the Inter-University Board of India. These are listed under the respective universities with subject sub-headings including education.

The Index: A periodical index serves the same purpose as the index of a book or the card file of a library. It identifies the source of the article or of the book cited by listing the titles alphabetically, and the readers should read all such directions before trying to locate the references.

A list of some important educational indexes is given below:

- **Education Index (New York: H. W. Wilson Co. 1929-till date):** One valuable and work saving guide created for educators is Education Index. It is published monthly (September through June), cumulated annually and again every three years. It contains more than 250 educational periodicals, many yearbooks, bulletins, and monographs published in the United States, Canada, and Great Britain.

  The material on adult education, business education, curriculum, educational administration, educational psychology, educational research, exceptional children, higher education, guidance, health and physical education, international education, religious education, secondary education and teacher education are included in this index.

- **Canadian Education Index (Ottawa, Ontario: Canadian Council for Educational Research, 1965-till date):** This index is issued quarterly and indexes periodicals, books, pamphlets, and reports published in Canada.

- **Current Index to Journals in Education (New York: Macmillan Information, 1969-till date):** This index is published monthly and cumulated every six months and annually. It indexes about 20,000 articles each year from more than 700 education and education-related journals under author and subject headings.

- **ERIC Educational Documents Index (Washington, D.C.: National Institute of Education, Government Printing Office, 1966-till date):** This index is published annually. It is a guide to all research documents in the 'Educational Resources Information Centre' or ERIC collection.

- **Index of Doctoral Dissertations International (Ann Arbor, Mich.: Xerox University Microfilms, 1956-till date):** Published as the Issue 13 of *Dissertation Abstracts International* each year, it consolidates

into one list all dissertations accepted by American, Canadian, and some European universities during the academic year, as well as those available in microfilm.

- **International Guide to Educational Documentation (Paris: UNESCO):** This guide is published every five years. It indexes annotated bibliographies covering major publications, bibliographies and national directories written in English, French and Spanish.

- **British Education Index:** This index is compiled by the Librarians of Institutes of Education and includes references to articles of educational interest published during the period of four years. The index covers more than fifty periodicals.

- **Index to Selected British Educational Periodicals (Leeds: Librarians of Institutes of Education, 1945-till date):** This index is issued thrice annually and covers forty-one educational periodicals, excluding those on fundamental and adult education.

Information about new ideas and developments often appear in periodicals long before it appears in books. There are many periodicals in education and in other closely-related areas that are the best sources for reports on recent research studies. Such periodicals give much more up-to-date treatment to current questions in education than books possibly can. They also publish articles of temporary, local or limited interest that never appear in book form. The periodicals of proper dates are the best sources for determining contemporary opinion and status, present or past.

It has been estimated that there are about 2100 journals that are specifically related to the field of education. In all such journals, one may also find articles of interest devoted to psychology, philosophy, sociology, and other subjects.

All those engaged in educational research should become acquainted with certain educational periodicals, and should learn to use the indexes to them. Knowledge about the editor of a periodical, the names of its contributors, and the associations or institutions publishing it may serve as clues in judging the merit of the periodicals.

Ulrich's Periodicals Directory, a classified guide to a selected list of current periodicals, foreign and domestic provides a comprehensive list of periodicals relating to education. In this directory, periodicals are grouped in a subject classification and alphabetically arranged. Each entry includes title, sub-title, date of origin, frequency of publication, annual index, cumulative indexes, and item characteristics of each periodical.

In India, many periodicals are published by some associations or institutions. They provide a medium for dissemination of educational research and exchange of experience among research workers, teachers, scholars and others interested in educational research, related fields and professions.

Abstracts include brief summaries of the contents of the research study or article. They serve as one of the most useful reference guides to the researcher and keep him/her abreast of the work being done in his own field and also in the related fields.

In America, the most useful of these references are the following:

- **The review of educational research:** It gives an excellent overview of the work that has been done in the field and about the recent developments. This publication, between 1931 and 1969, reviewed about every three years each of the given eleven major areas of education, namely:

  (*i*) Administration

  (*ii*) Curriculum

  (*iii*) Educational measurement

  (*iv*) Educational psychology

  (*v*) Educational sociology

  (*vi*) Guidance and counseling

  (*vii*) Language arts, fine arts, natural sciences, mathematics

  (*viii*) Research methods

  (*ix*) Special programmes

  (*x*) Mental and physical development

  (*xi*) Teaching personnel

  Since June 1970, the *Review of Educational Research* has pursued a policy of publishing unsolicited reviews of research topics of the contributor's choice. The role played by this publication in the past has been assumed by the *Annual Review of Educational Research.* Some of these are mentioned below:

- **Research in Education (RIE):** This represents the most comprehensive publication of research materials in education today. RIE is published monthly since 1966 by the Educational Resources Information Centre (ERIC) and indexed annually. Each monthly issue of RIE is divided into three sections:

  1. Document section

  2. Project section

  3. Accession numbers section

- **Psychological abstracts:** This useful reference is published by the American Psychological Association since 1927. It is published bi-monthly and contains abstracts of articles appearing in over 530 journals, mostly educational periodicals. The bi-annual issues (January-June, July-December) contain both author and subject index.

- **Education abstracts:** This is a publication of UNESCO, which began in 1949 and has been published monthly except in July and August. Each introductory essay devoted to a particular aspect of education is followed by abstract of books and documents selected from various countries dealing with the topic under consideration.

In addition to the above periodicals, a researcher may also consult the following publications:

(1) *Annual Review of Psychology* (1950-till date)

(2) *Child Development Abstracts and Bibliography* (1927-till date)

(3) *Psychological Bulletin* (1904-till date)

(4) *Sociological Abstracts* (1952-till date)

(5) *Educational Administration Abstracts* (1966-till date)

(6) *Sociology of Education Abstracts* (1965-till date)

(7) *Mental Retardation Abstracts* (1964-till date)

(8) *Dissertation Abstracts International* (1952-till date)

In India, National Council of Educational Research and Training (NCERT) has been publishing *Indian Educational Abstracts* to serve the cause of educational research through disseminating information about educational researches available in public domain.

The information contains abstracts of the researches carried out in India and abroad relevant to Indian educational scene with bibliographic information. This bi-annual periodical also includes abstracts of doctoral theses, research projects, published researches in the form of books and articles in the reputed journals.

Many professional periodicals and year books, in India and abroad, include some reviews of research and technical discussions of educational problems in one or all the issues of their series. A list of some of the publications are as follows:

- **USA:** *Journal of Educational Research, NEA Research Bulletin, Educational and Psychological Measurement, Journal of Experimental Education, Research Quarterly, Journal of Research in Music Education, American Educational Research Journal, Reading Research Quarterly, Journal of Educational Psychology, Journal of Psychology, Journal of Social Psychology, Journal of Applied Psychology, Sociology of Education, American Journal of Sociology, American Sociological Review, Sociology and Social Research, Harvard Educational Review, Journal of Teacher Education, Elementary School Journal, History of Education Quarterly, and Educational Forum.*

- **UK:** *British Journal of Educational Psychology.*

- **India:** *Indian Educational Review, Journal of Psychological Researches, Indian Journal of Applied Psychology, Indian Journal of Experimental Psychology, Journal of Education and Psychology, The Education Quarterly, Perspectives in Education, Journal of Educational Planning and Administration, University News, Journal of Higher Education, Indian Journal of Education.*

Theses and dissertations are usually preserved by the universities that award the authors their doctoral and masters degrees. Sometimes these studies are published

in whole or in part in various educational periodicals or journals. Because the reports of many research studies are never published, a check of the annual list of theses and dissertations issued by various agencies is necessary for a thorough coverage of the research literature.

In the US, references of doctoral dissertations in all fields, including education, can be found in sources compiled by various agencies. For the period 1912-1938, the Library of Congress issued the annual *List of American Doctoral Dissertations* for published studies. The Association of Research Libraries published the list of *Doctoral Dissertations Accepted by American Universities* from 1933-1934 to 1954-1955. This service was continued by the Index to *American Doctoral Dissertations* 1956-1963, which became the *American Doctoral Dissertations*. It lists all doctoral dissertations accepted by the American and Canadian universities and other educational institutions.

Dissertation Abstracts International, May 1970, presents abstract dissertations in the humanities, social sciences, physical sciences and engineering. It is published monthly. For each dissertation, there is a 600-word abstract that provides the researcher enough information to satisfy his/her needs. If a researcher wants to read a complete copy of a dissertation that is presented in *Dissertation Abstracts International,* she/he can purchase a microfilm or xerox copy from the University Microfilms. The reference number for placing an order and price are provided in the abstract.

In India, only a few universities publish abstracts of dissertations and theses that have been completed at the institution.

Kurukshetra University, Kurukshetra (Haryana) published *Abstracts of M.Ed. Dissertations* Vol. I, 1966, *Abstracts of M.Ed. Dissertations* Vol. II, 1967, *Abstracts of M.Ed. Dissertations* Vol. III, 1968, *Abstracts of M.Ed Dissertations* Vol. IV, 1969, *Abstracts of M.Ed. Dissertations* Vol. V, 1970, *Abstracts of M.Ed. Dissertations and Ph.D. Theses* Vol. VI, 1973.

M. B. Buch's *A Survey of Research in Education* contains all the research studies in education completed in Indian universities up to 1972. The break-up of the studies in the said volume is 462 Ph.D. studies and 269 project research. The abstracts of all the studies have been classified into seventeen meaningful areas of education. These are:

    (*i*) Philosophy of education

   (*ii*) History of education

  (*iii*) Sociology of education

  (*iv*) Economics of education

   (*v*) Comparative education

  (*vi*) Personality, learning and motivation

 (*vii*) Guidance and counseling

(*viii*) Tests and measurement

  (*ix*) Curriculum, methods, and textbooks

   (*x*) Educational technology

(*xi*) Correlates of achievement

(*xii*) Educational evaluation and examination

(*xiii*) Teaching and teaching behaviour

(*xiv*) Teacher education

(*xv*) Educational administration

(*xvi*) Higher education

(*xvii*) Non-formal education

M. B. Buch's *Second Survey of Research in Education* (1972-1978) incorporates 839 research studies completed during the period 1972-1978 and follows the same pattern of organization of seventeen research areas as *A Survey of Research in Education* (1973).

The first chapter gives a broad perspective of the place and function of research for educational development including historical account of the development of educational research in India. Each subsequent chapter includes a report based on the abstracts of research studies giving the trend of research in the area, including the gaps and high-lighting the research priorities as perceived by the author.

The abstracts are arranged alphabetically for each area and continuously numbered throughout the volume. Each abstract contains the title of the study, the objective and/or hypotheses examined, methodology including the sample, tools of research, the statistical techniques used, and the findings.

A special feature of this publication is the incorporation of a large number of studies on educational problems completed in the university departments of social sciences and humanities other than the departments of education. The trend reports are based not on the research completed during the period 1972-1978, but on the total research activities during the period 1940-1978.

M. B. Buch's *Third Survey of Research in Education* (1978-1983) comprises twenty chapters beginning with a comprehensive review for the general trend of research in education in India based on a quantitative and qualitative analysis of the studies. The trend reports in different areas of education have been developed by eminent educationists on the basis of studies conducted during the period of four decades, from 1943 to 1983.

In all, 1481 research abstracts have been presented after being classified under the seventeen areas. Each research abstract reports in brief the problem, objectives of the study, research techniques adopted, the findings and conclusions of the study. A special feature of the volume is the chapter on 'Research on Indian Education Abroad' which presents a review of 192 doctoral dissertations submitted to American and British universities, covering a period of around two decades.

Another significant inclusion in the volume is the chapter on 'Priorities in Educational Research'. The volume also makes available at one place a complete list of all researches in education conducted in India till 1983.

M. B. Buch's *Fourth Survey of Research in Education*, available in two volumes, covers researches in education till 1988. It comprises thirty-one chapters

beginning with a comprehensive review of the general trend of research followed by trend reports in different areas of education developed by eminent educationists on the basis of studies conducted during the period of about four-and-a-half decades, from 1943 to 1988.

In all, 1652 research abstracts have been presented after classification in twenty-nine areas. The volume makes available a complete list of all the 4703 educational researches conducted in India since 1943. The *Fourth Survey* has a new dimension. There is a chapter on review of researches at the M.Phil level in Indian universities.

Fifth Survey of Educational Research is also available in two volumes and covers researches in education conducted during 1989-1992. It dealt with all the areas of research which were covered in the *Fourth Survey* with the addition of a chapter on researches in 'Distance Education and Open Learning'.

Sixth Survey of Educational Research was released in 2006 and with its second volume still awaited. The researches in the areas of philosophy of education, teacher education, vocational education, science education, distance education and open learning, women education, guidance and counseling, physical education, health education and sports, language teaching, inclusive education, educational technology and population education conducted in India during the period 1993-2000 have been reported in the first volume.

Many articles of particular interest to a researcher may be located through pamphlets and newspapers. Current newspapers provide up-to-date information on speeches, seminars, conferences, new trends, and a number of other topics. Old newspapers, which preserve a record of past events, movements and ideas are particularly useful in historical inquiries. Some libraries catalog pamphlets and newspapers in their reference sections.

Government documents are a rich source of information. They include statistical data, research studies, official reports, laws and other material that are not always available elsewhere. These are available in national, regional, state as well as local level government offices.

Monographs are another major source of information on ongoing research. In the United States, universities and teachers' colleges publish many research studies on education in the form of monographs. A few examples of these are *Supplementary Educational Monographs, Educational Research Monographs,* and *Lincoln School Monographs.* In England too, various institutes of education publish monographs from time to time. In India, only a limited number of monographs are published by some universities and research organizations.

School Research Information Service (SRIS), Direct Access to Reference Information (DATRIX), and Psychological Abstract Search and Retrieval Service (PASAR) in the United States provide a number of computer-generated reference sources that may save a great deal of time and effort of the researcher.

SRIS, operated by Phi Delta Kappa, provides a computer printout of abstracts for a moderate fee. DATRIX, a development of the University Microfilms provides computerized retrieval for *Dissertation Abstracts*. The researcher can procure

information on microfiche or xerographic copy of the complete dissertation which he needs, from University Microfilms on payment. The PASAR furnishes printouts of abstracts of psychological journal articles, monographs, reports, and parts of books for a moderate fee.

5.3.2 Organizing the Related Literature

After making the comprehensive survey of related literature, the next step for the researcher is to organize the pertinent information in a systematic manner. It should be done in such a way so as to justify carrying out the study by showing what is known and what remains to be investigated in the topic of concern. Concerning this, Ary writes the following:

> The hypotheses provide a framework for organizing the related literature. Like an explorer proposing an expedition, one maps out the known territory and points the way to the unknown territory he proposes to explore. If the study has several aspects, or is investigating more than a single hypothesis, this is done separately for each facet of the study.

One should avoid the temptation to present literature as a series of abstracts. Rather, it should be presented in such a way as to lay a systematic foundation for the study.

The organization of the related literature involves recording the essential reference material and arranging it according to the proposed outline of the study.

Once pertinent information has been identified, the researcher should record certain essential information for locating the material on 3×5 inch index card to serve as a bibliography card. To make writing of the final report simpler, it is desirable that the information recorded in the bibliography card should appear, in content and style, exactly as it will appear in the final report.

The basic information in the bibliography card should include name of the author with the last name first, title of the book or article, name of the publication (for articles), name of the publisher, date of publication, volume number, page numbers and library call number (for books). If some of this information is not available, the specified space should be left blank so that the missing information can be included immediately upon locating the references.

After recording the essential information on the bibliography cards, it is necessary to arrange the cards according to the location of the material in the library. For example, the researcher may list together all cards pertaining to the material located in the periodical section. Similarly, all material located in the reserve section may constitute another list, and so on. Then the researcher should make a systematic review of the material located in a specific section of the library and after reviewing each reference on the list, he/she should proceed to another list.

All information likely to be used in the final report should be recorded on 4×6 inch card to serve as content card. The information to be recorded on the content cards will depend on the source from which it is taken. If it is from a primary source, it may include brief bibliographic information comprising author's last name, brief title of the report, specific page numbers on which information is located, sentence

statement of the problem, brief description of the study, statements of findings or conclusions (or both), a card code as to the aspect of the research to which the material most closely relates.

The information to be recorded from the secondary source is somewhat different from the primary source. Turney and Robb have given the following suggestions for recording information from a secondary source:

1. Provide brief bibliographic information (as with a primary source)

2. Record on a single card only those statements that are related to the same topic (if all the information cannot be placed on one card, continue statements on another card and staple to the first card)

3. Paraphrase, in complete statements, the most relevant ideas and record direct quotations only if they are stated concisely and effectively, and if there is a chance that paraphrasing might change the meaning

4. Place a page number and a paragraph number after each separate statement indicating its location in the reference in case you need to review it again

5. Code the cards (probably in the upper-right hand corner) according to topic(s) to which it most closely relates

For the preparation of the report of related literature, the researcher should arrange the bibliographic and content cards according to the proposed outline of the problem. This can be done with the help of card code.

Report of the related literature should begin with an introductory paragraph describing the organization of the report. After the introduction, the researcher should present the studies most relevant to each aspect of the proposed problem outline. Studies with similar and contradictory results should be reported alongside, without using excessive space.

CHECK YOUR PROGRESS

4. What is a microfiche?

5. List the various types of cameras used to record microimage on roll film.

6. What are the two principal systems of library classification in the United States?

5.4 SUMMARY

- Creativity was initially considered to be a rare and mysterious phenomenon.

- In his work 'The Critique', Kant states that 'creativity is natural and therefore cannot be developed'.

- After 1957, a change in the view of scholars and researchers with respect to creativity became more prominent.

- Researchers have, since then, started discussing about creativity in business and manufacturing fields.

- In 1956, Guilford published a paper in which he presented a system through which the various factors of intellect could be arranged.

- According to the structure of intellect presented by Guilford, mental activity constituted of three aspects—mental operation, its content, and its product.

- Mental operations are further divided into five sub categories, including, cognitive, memory, divergent production, convergent production and evaluation.

- Guilford stated that mental operation is information generated from the given information.

- Guilford also suggested that it is divergent thinking that includes creativity, and that creativity remains influenced by factors like fluency, flexibility, originality, elaboration and redefinition.

- Researchers define four 'P's of creativity—process, press, product and person.

- According to Stein, 'creativity is that process which results in a novel work that is accepted as tenable, useful or satisfying by a group at some point in time'.

- Henry Miller defines creativity as, 'the occurrence of a composition (product) which is both new and valuable'.

- Dilip Mukerjea describes creativity in a new and innovative manner.

- Mukerjea also provides the formula of C = (ME)? for creativity. In this formula, C is creativity, M is the mass of data, information, knowledge and wisdom acquired over life time, and E is the sum of experiences and the enlightenment gained thereby that serves to energize one's life.

- Several researchers have researched on this aspect of creativity over the years and attempted to find traits of a creative personality.

- The environment or the press is not a passive factor or element of creativity. In fact, environment determines what kind of novel idea is produced by the creative person.

- Simonton states that the effects of environment are not only specific affecting the creativity of an individual but also general in the sense that it influences the kind of novelty which is produced in the society as a whole.

- The scope of research on the nature of creativity remains limited in India whereas researchers abroad base a lot of their research on this aspect of creativity.

- Research also suggests that social factors do not show a consistent relationship with creativity.

- A large number of researches have been done to find out whether intelligence increases with creativity or whether they are negatively correlated.

- The 'Threshold Theory' of creativity and intelligence states that creativity and intelligence are related only up to intelligence quotient of about 120.

- Researchers like Behera, Raina, and Padha concluded that academic factors and creativity are positively correlated.
- Research has been carried out for measurement of creativity and tests have been created o measure it.
- Researches have also been done on development of creativity in various subjects and several experimental studies conducted for the development of creativity in general. In terms of scholastic subjects, few experiments have been conducted for the development of creativity.
- Review of the related literature enables the researcher to define the limits of his/her field.
- By reviewing the related literature, the researcher can avoid unfruitful and useless problem areas.
- Through the review of related literature, the researcher can avoid unintentional duplication of well-established findings.
- The advantage of the related literature is also to provide insight into the statistical methods through which validity of results is to be established.
- The first step in reviewing the related literature is identifying the material that is to be read and evaluated. The identification can be made through the use of primary and secondary sources available in the library.
- In the primary sources of information, the author reports his/her own work directly in the form of research articles, books, monographs, dissertations or theses.
- In secondary sources of information, the author compiles and summarizes the findings of the work done by others and gives interpretation of these findings.
- To aid the researcher in locating, selecting and utilizing the resources, a study guide is provided in relation to their use in educational research.
- In a library, all books have a call number or letter that appears in the upper left-hand corner of the author, subject or title card, and on the back of the book.
- Information about new ideas and developments often appear in periodicals long before it appears in books.
- The periodicals of proper dates are the best sources for determining contemporary opinion and status, present or past.
- In India, many periodicals are published by some associations or institutions. They provide a medium for dissemination of educational research and exchange of experience among research workers, teachers, scholars and others interested in educational research, related fields and professions.
- Theses and dissertations are usually preserved by the universities that award the authors their doctoral and masters degrees.

- After making the comprehensive survey of related literature, the next step for the researcher is to organize the pertinent information in a systematic manner.

- One should avoid the temptation to present literature as a series of abstracts.

- Once pertinent information has been identified, the researcher should record certain essential information for locating the material on 3×5 inch index card to serve as a bibliography card.

- After recording the essential information on the bibliography cards, it is necessary to arrange the cards according to the location of the material in the library.

- For the preparation of the report of related literature, the researcher should arrange the bibliographic and content cards according to the proposed outline of the problem.

- After the introduction, the researcher should present the studies most relevant to each aspect of the proposed problem outline. Studies with similar and contradictory results should be reported alongside, without using excessive space.

5.5 KEY TERMS

- **Diazo:** It refers to a copying or coloring process using a diazo compound decomposed by ultraviolet light.

- **Microform:** It is a general term for any material that contains a small image or microreproduction of a document.

- **Neurosciences:** It refers to any or all of the sciences, such as neurochemistry and experimental psychology, which deal with the structure or function of the nervous system and brain.

- **Biennial:** It refers to something that takes place every other year.

- **Almanacs:** It means an annual calendar containing important dates and statistical information such as astronomical data and tide tables.

- **Tenable:** It refers to something that can be maintained or defended against attack or objection.

- **Dissemination:** It refers to the act of spreading something, especially information, widely; circulation.

5.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The person who initiated systematic research in creativity was J. P. Guilford.

2. According to Guilford, Content is the raw material to which a mental process is applied and product is the result which is derived when a mental operation takes place with any five kinds of content.

3. Creativity is influenced by factors like fluency, flexibility, originality, elaboration and redefinition.

4. A microfiche is a sheet of film that contains microimages of a printed manuscript or book.

5. The various types of cameras used to record microimage on roll film are:

   - Planetary camera
   - Step-and-repeat camera
   - Rotary camera
   - Flow camera

6. The two principal systems of library classification in the United States are the 'Dewey Decimal' system and the 'Library of Congress' system.

5.7 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is the importance of survey of related literature in educational research?

2. Illustrate by taking a specific research problem as to how the survey of the related literature can be helpful at various stages.

3. What library skills are required for a thorough survey of literature related to a research topic in education?

4. Name some important reference books with authors' names and some important educational journals you would like to consult in connection with the problem you have selected for research.

Long-Answer Questions

1. Discuss the factors that J. P. Guilford consider necessary for divergent production.

2. Evaluate environment as a determining factor for creativity.

3. Describe the procedure that a researcher should adopt in identifying related literature, and in locating, selecting and utilizing the primary and secondary sources of information available in the library.

4. Describe the procedure that a researcher should adopt in organizing the related literature in a systematic manner.

5.8 FURTHER READING

Marshall, Catherine; Gretchen B. Rossman. 2006. *Designing Qualitative Research*. London: Sage Publications.

Fink, Arlene. 2013. *Conducting Research Literature Review: From the Internet to Paper*. University of California: Sage Publications.

Anderson, Garry; Nancy Arsenault. 2005. *Fundamentals of Education Research*. London: Routledge.

Jha, Avdhesh S. 2014. *Social Research Methods*. New Delhi: McGraw Hill Education (India) Private Limited.

Research in Creativity

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