UNIT 6 TEACHING FOR EFFECTIVE LEARNING: DEVELOPMENT OF CONCEPTS OF SKILLS AND COMPETENCIES

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6.1 INTRODUCTION

You have already studied the meaning of the term teaching and also of related concepts. In this unit, you will study about teaching skills. In the beginning, an analysis of functions of a teacher is given. After this, the concept of teaching skills is explained. It is followed by an explanation of some of the important teaching skills. Finally the microteaching approach is discussed.

6.2 OBJECTIVES

After studying this unit, you should be able to:

- make an analysis of teacher functions,
- explain the concept of teaching skills,
- explain the nature of micro teaching,
- describe inquiry training and synectics in teaching.
6.3 TEACHING: AN ANALYSIS

Teaching can be analysed in terms of teacher behaviour at least at three levels, namely, teaching skills, general teaching behaviours and specific teaching behaviours. At the first level, teaching can be analysed into component teaching skills. Following the analysis at this level, teaching can be defined as a set of component skills for the realization of a specified set of instructional objectives. It means teaching itself is a complex skill comprising of a set of teaching skills. These teaching skills can be further analysed into sets of general teaching behaviours at the second level. Thus, teaching skills can be defined as a set of interrelated teaching behaviours for the realization of specific instructional objectives. The set of instructional objectives to be realized by a particular skill will be limited in number as compared to the totality of instructional objectives. These teaching behaviours can be further analysed into specific teaching behaviours at the third level of analysis. These teaching behaviours of a skill, therefore, can be defined as a set of interrelated specific teaching behaviours contributing to the realization of some aspects of the instructional objective to be realized by a particular teaching skill.

6.4 CONCEPT OF TEACHING SKILLS

According to Clarke, "teaching constitutes activities that are designed and performed to produce change in student behaviour." Komisar has pointed out that various specific activities included in teaching are introducing, demonstrating, citing, reporting, confirming, questioning, elaborating etc., which may be considered as constituent skills of teaching. In simple words, teaching constitutes a number of verbal and nonverbal teaching acts like questioning, accepting student responses, rewarding, smiling, movements, gestures, etc. These acts in particular combinations facilitate the achievement of objectives in terms of student growth. A set of related teaching acts or behaviours performed with an intention to facilitate students' learning can be called a teaching skill.

According to Gage, 'teaching skills are specific instructional techniques and procedures that a teacher may use in the classroom'. The Asian Institute for Teacher Educators has defined teaching skills as 'specifically those activities of teaching that are especially effective in bringing about desired changes in students'. Mc Intyre and White have defined the term teaching skills as 'a set of related teaching behaviours which in specified types of classroom interaction situations tend to facilitate the achievement of specified types of educational objectives'.
6.5 TEACHING SKILLS

You have already understood the concept of a teaching skill. Let us now try to know about some important teaching skills in details. These are given below.

6.5.1 Introducing a Lesson

When one introduces a stranger to you, your reactions towards him/her or your responses during the conversation with him/her depend upon the introductory statements that are made about him/her.

Similarly, when a teacher introduces a lesson or a unit, he/she gives a brief introduction about the lesson or the unit, in order to draw the students’ attention to it. Generally, an introduction to a lesson includes what the teacher does with or without the help of the students up to the stage of stating the aim of the lesson. Teachers differ from each other in the way they introduce a lesson. Studies have shown that the students’ learning of the new lesson or unit largely depends on the way the lesson is introduced. A teacher must possess the necessary skill to introduce a lesson or unit in an effective manner.

The components of the skill of introducing a lesson are:

(a) Desirable behaviours

- Using previous knowledge: The previous knowledge refers to knowledge already possessed by the students. If any new knowledge is to be added to the previous knowledge, there should be a logical continuity between them. New knowledge should also be relevant to previous knowledge of students. When we present new knowledge to
the students, we have to bring their previous knowledge to their conscious level.

- Using appropriate devices: Here, 'device' refers to the technique that a teacher uses while introducing a lesson. Such devices can be (a) use of examples (b) questioning (c) lecturing/ describing/ narrating (d) story telling (e) dramatization (f) audio-visual aids and (g) experimentation. The appropriateness of the use of each of these devices depends on its suitability to the maturity level, age level, grade level, interest, experience of the students and also on the lesson to be taught.

' (b) Undesirable behaviours

- Lacking in continuity: Continuity refers to the sequence of ideas or information being presented. While introducing a lesson, continuity breaks when the statements made for questions asked by the teacher are not logically sequenced.

- Making irrelevant statements: A statement or a question which a teacher makes while introducing a lesson, is said to be irrelevant when it is not related to the aim of the lesson. Such statements or questions do not contribute to the effectiveness of the skill in terms of establishing rapport with the students. Sometimes such statements also confuse the students.

6.5.2 Explaining

In our day to day life you find persons explaining some idea or phenomenon by going deep into the matter with appropriate examples, logically organizing the ideas, using certain nonverbal gestures etc. You also find persons who cannot explain clearly. They jumble up ideas. They not only confuse the audience but also get confused themselves. This is because they do not present ideas in a logical sequence.

In classrooms right from grade I through higher grades, a teacher explains ideas and concepts. It is a most commonly used skill and is the essence of instruction. When a student does not clearly understand the ideas which his/her teacher tries to convey, he/she generally asks for an explanation.

A teacher is said to be explaining when he/she is describing 'how', 'why' and sometimes 'what' of a concept, phenomenon, event, action or condition. Explanation can also be defined as an activity to bring about an understanding in someone about a concept, principle etc. Explanation involves filling up the gap in one's understanding of the new phenomenon by relating it to his/her past experience. Thus, explanation depends on the type of the past experience, the type of the new phenomenon and the type of relationships between them.

In a classroom, an explanation is a set of interrelated statements made by the teacher related to a phenomenon or an idea, in order to bring about or increase understanding of the students about it. While giving explanation, we generally explain causes of the phenomenon, reasons for the action, various steps involved in arriving at the particular result, or various events that have occurred earlier resulting in the event being explained. All such causes, reasons, steps, events, etc., are called 'antecedents'. Such antecedents result in
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the phenomenon, event, result or action. Each of these is known as a consequent. Thus an explanation involves giving antecedents to a consequent, which can be diagrammatically presented as follows:

<table>
<thead>
<tr>
<th>Antecedents</th>
<th>Explanation</th>
<th>Consequent</th>
</tr>
</thead>
<tbody>
<tr>
<td>(causes, reasons, actions, steps, events)</td>
<td>(Phenomenon, action, result, event, condition)</td>
<td></td>
</tr>
</tbody>
</table>

There are various techniques through which we can explain an idea, phenomenon etc. They are question-answer technique, use of audio-visual aids or by making certain related statement concerning what we have to explain. Sometimes we use all the techniques simultaneously to make explanation more effective.

To summarise, the desirable teacher behaviours for effective explanation should include, using only relevant statements, having continuity in statements, using vocabulary which the students know, being fluent in speech, avoiding vague words and phrases, using beginning and concluding statements and testing students’ understanding by putting a few questions.

Check Your Progress 2

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Mention two desirable and undesirable behaviours in introducing a lesson.

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2. Describe the term ‘explanation’ in teaching.

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6.5.3 Questioning

Questioning is an important teaching skill that a teacher must learn. A teacher needs to put meaningful questions to the students during the teaching-learning process. You may be curious to know more about ‘meaningful questions’. Let us try to know what makes a question meaningful by considering (i) structure, (ii) process, and (iii) product of questioning.

Structure refers to the grammatical aspect and the content part of the question. Various criteria for a well structured question are (i) grammatical correctness, (ii) conciseness, (iii) relevance, and (iv) specificity.
(i) Grammatical correctness: A question should be grammatically correct. If it is not correct, it will create confusion in the minds of the students. Therefore, a teacher should be careful while framing a question.

Examples of grammatically incorrect questions are given below:

(a) When did Olympic games started?
(b) Where is Laxmibai born?

The above questions can be asked correctly as follows:

(a) When did Olympic games start?
(b) Where was Laxmibai born?

(ii) Conciseness: A concise question does not have unnecessary or extra words. A question should be direct and straightforward.

Examples for such questions are given below:

(a) When did India get freedom?
(b) Who is the President of India?

The teacher should not frame the questions in the manner given below:

(a) Does any one know when did India get freedom?
(b) Who can tell me the name of the President of India?

(iii) Relevance: An irrelevant question is that which is not related to the topic concerned. A question is also irrelevant when it contains terms which are not explained earlier.

(iv) Specificity: A specific question calls for a single and specific answer. It increases the fluency in questioning.

Examples for specific question are given below:

(a) Which is the highest mountain peak in the world?
(b) Who discovered America?

Process: The word ‘process’ implies the way of asking questions. The following two issues need to be mentioned:

i) Speed of asking questions: The teacher should ask question neither too hurriedly nor too slowly. If the questions are asked too rapidly, the students may find it difficult to comprehend. They will take much time to understand the question. On the other hand, if the questions are uttered too slowly, they will decrease the fluency as it is time consuming.

ii) Voice of the teacher: Teacher’s voice should be audible and clear to all the students in the class otherwise they may not follow the question. They may ask the teacher to repeat the question or may not respond at all.

Product: The term ‘product’ refers to students’ responses. Sometimes even when nothing is wrong with the structure or the process of questioning...
students do not give any response. The reasons for such a situation could be (i) the students may not be intelligent enough to understand the questions, (ii) they may not be interested in the lesson, (iii) they may lack the previous knowledge, and (iv) there may not be any rapport between the student and the teacher.

6.5.4 Increasing Student Participation

You must be aware that when a student participates in the learning process, his/her learning becomes more effective. A student is said to participate when he/she takes active part which is observable by responding to what the teacher asks for, by contributing his/her own ideas related to the topic being taught by the teacher or by reacting to others’ ideas in the classroom. Student participation is an observable behaviour of students and includes responding and initiating. When a student is listening to the teacher he/she is not participating, because listening behaviour of the student is not observable.

Student participation in the classroom is essential for the following reasons:

i) Students are more attentive towards the lesson when they are participating.

ii) Students’ urges of social recognition and social acceptance are satisfied.

iii) There will be better understanding on the part of the students when they participate.

iv) A teacher can evaluate his/her teaching, that is, whether it is being effective in bringing about learning or not.

Skill of increasing student participation involves integrating the various components of the skill, namely, creating set, questioning, encouraging student participation and pausing in such combinations and proportions so as to maximize student participation. These components are explained below:

i) Creating Set: ‘Set’ in a class room may be defined as mental readiness on the part of the students before learning any task. If the students have to participate in the classroom discussion, they should be mentally ready, emotionally as well as cognitively. This can be done by posing to students a problem or situation which they discuss with the help of the teacher.

ii) Questioning: A question is a stimulus in the classroom that elicits student participation in terms of student response. You are aware that a good question is well structured i.e., precise, direct and grammatically correct. It is also put with proper tone modulation and made audible to all the students. To increase student participation the teacher should (a) avoid repeating questions, (b) avoid answering his/her own questions, and (c) avoid asking a number of questions.

iii) Encouraging Student Participation: In order to encourage student participation, we use two types of behaviours – verbal and non-verbal. Sometimes we may use both simultaneously. When the student gives the correct response we may say ‘yes’, ‘correct’, ‘very good’ and such other expressions. We may repeat student response to encourage. We may nod, smile and sometimes-pat the student who has responded. When the student gives a wrong response, we may say ‘think again’, ‘it is good that you have
attempted' and such other expressions. When the student has not given any response, we may say ‘come on’, ‘try’, etc.

iv) Pausing: Pausing can be defined as deliberate silence introduced by the teacher during classroom interaction so as to increase student participation. When the teacher pauses, the students are stimulated to participate. Pausing should be accompanied by nonverbal cues which would elicit more student participation.

Check Your Progress 3

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Mention the components of the skill of questioning.

2. How can we increase student participation?

6.5.5 Providing Reinforcement

You know that all the students need social approval for their behaviour. When they are answering or responding in the class, they are eager to know whether their answers or responses are correct or not. When the students come to know that the answers given by them are correct, they feel happy and get encouraged. Thus, their participation in the class increases. In such a situation, we say that the student’s behaviour of responding correctly is ‘reinforced’ or strengthened. In other words, it may be said that there is positive reinforcement in the student’s behaviour.

In providing reinforcement important points to be remembered are as follows:

(1) Positive reinforcement means strengthening of desirable behaviour. It increases student participation in the class. Positive reinforcers are those behaviours of the teacher which encourage students to participate more and more.

(2) Negative reinforcement means weakening of undesirable behaviour. It decreases students’ participation in the class.

(3) Negative reinforcers are those behaviours of the teacher which discourage the students to participate. Skill of reinforcement involves more and more the use of the positive reinforcers and decrease the use of negative reinforcers so that the students participate to the maximum.
i) In positive verbal reinforcement the teacher gives positive reinforcement through various verbal (with words) expressions. The teacher makes encouraging remarks such as ‘that’, ‘good’, ‘right’, ‘yes’, ‘correct’, ‘excellent’, ‘well done’, ‘continue’, etc.

ii) Positive nonverbal reinforcement occurs when the teacher wants to reinforce positively a desired student response. The teacher may use certain nonverbal (without words) expressions like nodding of head, smiling, moving towards the responding student, keeping eyes on the student, writing the response of the student on the blackboard or any other nonverbal action indicating pleasure at the student’s response.

iii) Negative verbal reinforcement interferes with the learning of the students. It affects learning negatively and decreases the motivation of the students. We should avoid giving this type of reinforcement. The teacher should avoid discouraging expressions such as ‘you are not good’, ‘wrong’, ‘nonsense’, ‘incorrect’, ‘stop it’, ‘do something else’, etc. The negative remarks of this type should be avoided if the students are to participate more in the class.

iv) Negative nonverbal reinforcement is given by using such behaviours as moving away from the responding student, keeping eyes on the student with discouraging looks, hard and disapproving stares, not looking at the responding student, tapping foot impatiently and walking around etc. The teacher should be conscious of such behaviours and avoid them as far as possible if the skill of reinforcement is to be used effectively.

6.5.6 Using Teaching Aids

Sometimes it is difficult to convey the meaning of abstract ideas or concepts to students. A teacher needs to know how to bring clarity, simplicity and interest in his/her teaching. The skill of using teaching aids helps in this regard. It involves the principle of securing and sustaining attention of students and hence creates interest in the lesson. Teaching should not be tedious and boring to the students. In the prescribed curriculum there are many abstract ideas, which a learner has to learn. In order to convey these abstract ideas, concepts and laws, the teacher needs to arouse interest and curiosity in the students. The skill of using aids involves describing an idea, concept or principle as by using various teaching aids.

General advantages of using teaching aids:

- By using audio-visual materials, inaccessible processes, materials, events and objects could easily be brought to the class.

- Use of audio-visual materials results in greater acquisition of knowledge of facts and ensures longer retention of the information gained.

- Use of audio-visual materials in the classroom can provide effective substitutes for direct contact of students with environment.
- Use of audio-visual materials involves more than one sense and hence it would be easy to secure and retain attention of students.

- Audio-visual materials could be used to motivate and stimulate interest of students to gain further knowledge.

Some important types of teaching aids are explained below:

i) Objects: Real objects can be used as examples to clarify some concepts and principles. Usage of parts of flowers and branches of trees in botany lessons; cycle pumps, thermometers in science lessons; beads, match sticks, etc. in mathematics lessons are the common examples of objects being used during teaching.

ii) Models: Models are specially prepared to describe, illustrate an idea, concept or principle. They are replica of reality. A good model should have all the necessary characteristics of reality. When models are specially prepared to illustrate a concept and can be detached in its parts for closer examination, its value in a classroom can be more than the original object itself. For example, use of a model of an eye instead of the real one is more appropriate.

iii) Pictures: When objects are not available for use in classrooms, pictures may be used for explaining an idea or concept or principle. Pictures are handy and sometimes economical too. Pictures themselves can be abstract, but they can help in illustrating a point with oral explanation.
iv) Diagrams, maps and sketches: These are useful in teaching history, geography, science etc. They help in clarifying and bringing out essential points in a lesson. In science lessons, diagrams and sketches help a lot in describing an idea or principle. The teacher can draw them on the blackboard. A teacher who wants to describe parts of the body like eye, ear, muscular system etc., can take the help of diagrams and sketches.

v) Practical demonstration: This is an important device in the teaching of science and geography. In physics when a teacher explains a principle or
law, he/she can do it with the help of experimentation. In order to describe the idea that sunlight is essential for plant in food preparation, a teacher can conduct the required experiment.

Thus, there are various types of teaching aids. But none of them can be effectively used without an oral explanation either by teachers or by students. It is also essential to see that the teaching aid used is appropriate to the age level, grade level, maturity level of the students and to the topic taught.

Check Your Progress 4

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Differentiate between positive reinforcement and negative reinforcement.

2. Mention any four advantages of using teaching aids.

3. Name some important types of teaching aids.

4. In the teaching of which subject the technique of practical demonstration is more useful?

6.5.7 Writing on the Board

You know that black board or chalk board is the visual aid most widely used by the teacher for classroom instruction. The components of the skill of using black board are: (i) legibility of handwriting (ii) neatness in the black board work and (iii) appropriateness of written work on the black board. Now, let us discuss about them in detail.

(i) Legibility of handwriting: The handwriting is said to be legible when there is maximum ease in reading it. This includes the following points:
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- Every letter should be distinct.
- There should be adequate spacing between two letters and two words.
- Slantness of each letter should be as far as possible vertical.
- Size of the letters should be large enough to be read from the farthest end of the room.
- Size of the capital letters should be just bigger than that of the small letters.
- All capital letters should be of the same size and all small letters also should be of the same size.
- Thickness of the lines should be of same width.

Samples of legible writing and not very legible writing are given below:

<table>
<thead>
<tr>
<th>Not very legible writing</th>
<th>Legible writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement motive can be developed not only at early stage but also at later stages. Experimenting with people from U.S.A., Italy, Poland, and India, McColland and his group found that in all cases training programmes were successful in increasing individual need for achievement.</td>
<td></td>
</tr>
</tbody>
</table>

(ii) Neatness in blackboard: To decide about the neatness of blackboard work the following points are to be considered. You will remember here that the board can be black, white or green in colour.

- Words and sentences should be written in the horizontal lines parallel to the base of the black board.
- There should be adequate spacing between the lines.
- There should be no overwriting that makes black board work untidy.
- Relevant matter which is under focus of classroom discussion should be retained on the black board.
(iii) Appropriateness of work on the blackboard: The appropriateness of the work includes continuity, brevity and simplicity and drawing attention and focusing. The following are the important points to be remembered regarding appropriateness of the content.

- Write only the salient points one after another as they are being developed.
- The points written on the blackboard should have continuity (one point logically linked with the previous one) in them.
- The blackboard summary should be brief and simple so that the students can recollect the whole lesson at a glance.
- Underline only those points to which you want to draw the students' attention.
- Use coloured chalks sparingly to bring about contrast with other matter presented on the blackboard.
- Illustrations and diagrams should be simple, large and clear enough to convey the ideas presented.

An example of blackboard work is given below.

**Human Rights & Indian Constitution**

A number of provisions under Fundamental Rights and Directive Principles of State Policy stated in the Indian Constitution are directly related to human rights.

The following are some examples:

i) Right to equality
ii) Right to freedom
iii) Right against exploitation
iv) Cultural and educational rights
v) Right to freedom of religion
vi) Right to constitutional remedies

Some of the Directive Principles of State Policy are:

i) Facilitate organisation of village panchayats
ii) Facilitate participation of workers in the management of industries
iii) Secure uniform civil code for all citizens
iv) Make provision for free and compulsory education for children up to the age of 14 years.

**Source:** Self Learning Material for Teacher Educators (vol. I) NCERT, New Delhi, 1998.
Apart from the various components of good blackboard work, which have been discussed above, we need to take care of the following points for the effective use of black board:

- Check the condition of the blackboard for its useability.
- Check the lighting. Light falling on the blackboard should neither be dim nor too bright.
- Check whether the blackboard is clean before and after use or not.
- Keep required amounts of chalks – both white and coloured.
- Stand on one side of the blackboard and do not come in between the students and the black board.
- Use a pointer, if needed, for explaining the various points especially in the diagrams.
- Avoid squeaking noise of the chalk while writing.
- Avoid committing mistakes in the content written on the blackboard.

**6.5.8 Evaluating**

Learning requires continuous evaluation. Evaluation is a technique through which the teacher becomes aware of the factors that affect his/her instruction. Evaluation helps to determine the level of success. It identifies defects and failures. It also reveals the value of methods, procedures, techniques, materials and equipment being used and where they should be improved and supplemented. There exists interrelatedness between objectives (end), learning experiences (means) and evaluation (evidence). Objectives remain central to both learning experience and evaluation. Evaluation comes in at the planning stage when objectives are formulated. Learning experiences are also planned in terms of objectives. At every point of learning, evaluation is an attempt to discover the extent of effectiveness of a learning situation in bringing about desired changes in students. Thus, evaluation is concerned with what has been learnt. A variety of devices and techniques should be used in the evaluation programme. The evaluation tools include achievement tests, psychological tests, questionnaires, checklists etc. A variety of techniques like anecdotal records, interviews, observations etc. are also used. Selection of a tool or technique of evaluation depends primarily on the nature of the objective to be evaluated. Each objective implies several behavioural changes. Therefore, no single technique can effectively evaluate different types of behavioural changes. Each behaviour may need a different kind of technique. Hence, we may have to use as many different techniques as possible to evaluate change in behaviour.

Proper records of work done by each student should be maintained. Diaries of students, anecdotal and cumulative records maintained by teachers are very good evaluation devices.
Check Your Progress 5

Notes:  
a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Mention the components of the skill of using blackboard.

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2. Mention four points for effective use of blackboard.

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3. Explain the importance of evaluation?

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6.6 MICRO TEACHING APPROACH

Microteaching technique was first adopted at Stanford University, USA, in 1961 by D.W. Allen and his coworkers. Microteaching is a training procedure aiming at simplifying the complexities of the regular teaching process. You know that teaching constitutes a number of verbal and nonverbal acts. "A set of related behaviours or teaching acts aiming at specific objectives and performed with an intention to facilitate student's learning can be called a teaching skill." All these teaching skills which go to make good teaching can be defined, observed, measured and controlled by means of practice. Microteaching concentrates on specific teaching behaviours and provides opportunity for practising these teaching skills under controlled conditions. Microteaching is a scaled down teaching procedure. A teacher trainee should not be exposed to real situation in the beginning itself. He/she should teach in a less risky situation where mistakes may be made without damage to students and to him/her. The complex act of teaching is broken down into simple components making the task more manageable. Only one particular skill is attempted and developed during microteaching session. "How to teach" is considered more important than "what to teach". This technique is useful in preservice as well as inservice training of teachers.

Microteaching provides teachers with a practice for teaching in which the normal complexities are reduced in terms of:

- length of the lesson (a single concept is chosen),
- scope of the lesson,
- number of students, usually 4 to 6, preferably peers,
- class time, usually 5 to 10 minutes.
Microteaching involves a programme of the following type:

- A particular skill is defined to student teachers in terms of specific teaching behaviours.
- Teacher educator gives a demonstration lesson to student teachers where a particular skill is employed.
- Student teacher prepares a lesson plan based on the predecided model on a suitable topic relating to the particular skill which he/she proposes to practice.
- Student teacher teaches the lesson to a small group of students in a simulated condition.
- Feedback is provided immediately to the student teacher by audio tape or video tape recorder.
- In the light of feedback and supervisor's comments, student teacher replans the lesson in order to use the skill more effectively.
- The revised lesson is taught to a different but comparable group of students.
- The lesson is again observed or video taped or audio taped and observations are noted in the proforma. Feedback is again provided to the student teacher. This step is called the refeedback session.

The plan, teach, feedback, replan and refeedback sessions will constitute a single microteaching cycle.

Supervisors play an important role in microteaching, particularly in preservice training programmes. Role of supervisor is one of continuous consultation so that the trainee can perfect his/her performance in the particular teaching skill.
Check Your Progress 6

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Name the person who propounded microteaching.

2. Explain ‘microteaching’ technique.

3. Mention the stages in microteaching.

6.7 PROBLEM SOLVING

Research on problem solving has had a varied history. Before the 1930’s, most textbooks still treated logic in considerable detail, making it the basis for intelligent or rational behaviour. This was quite natural since psychology was an offshoot of the philosophy of mind. Later, text books carried chapters on thinking, and questions of consciousness, imageless thought, associative ‘set’ and concept formation were the subject matter or research in thinking (Woodworth, 1938).

Perhaps the greatest impetus to research in problem solving came from studies of animals seeking to investigate into the rationality. History reveals that philosophers had attributed reason and soul to man alone. Thorndike initiated an experimental approach to the analysis of problem solving behaviour by developing the problem box and observing how cats found their way to food. This led to a whole series of problem box investigations, and Watson described problem box mastery as the development of motor habits and grouped it with maze learning. The problem solving became classified with learning. The method used in the problem solving has been referred to as trial and error method.

Various types of puzzles have been used to study human problem solving, as a result, trial and error has become a generally accepted mechanism. Dewey used the concept to account for human problem solving by describing a process he called mental trial and error. In this way, the problem solving capacity of the trial and error process was expanded. At the same time, it gave man a kind of superiority over animals in that he could eliminate incorrect alternatives without trying them out behaviourally.
It was only after World War II when research funds for investigations of creativity and originality were made available, a new name for a higher type of problem solving was accepted, the implication being that creativity included more than learning and intelligence. Although it had long been recognized that intelligence and problem solving ability had a limited relationship, the recent research had revived the importance of distinguishing between intelligence (the ability to learn) and creativity. The work of Getzels and Jackson (1962), and Torrance (1965) reveal this trend, which lays emphasis on unusual innovative types of personality. This, of course, is required when an individual is faced with a new situation that poses a problem. A problem becomes difficult when its solution requires responses that deviate from the common ones or from previously learned ones. Approached in this way, it follows that the creative person should be a good problem solver because he/she can solve not only routine problems but all those that require more than a learning mechanism.

Problem solving methods being used are often classified as 'traditional' and 'new'. Traditional methods are more rational and logical while the new methods attempt to train the individual through freeing him/her from his/her emotional inhibitions. Generally problem solving method involves the following steps:

- Definition of the problem: It involves definition of the initial problem as well as establishment of the problem.
- Searching for methods: It involves searching for different methods, evaluating them and finally selecting the suitable method.
- Preparation of the design: An outline of the design is prepared, test is conducted and evaluation is done.
- Results and solutions: It involves generalizing the results and arriving at the best solution.

These steps are shown in Figure 6.2.

**Steps of problem solving**

- Definition of the problem
- Searching for different methods & selection of a suitable method
- Preparation of the design
- Implementing the strategy
- Generalizing the results

Fig.6.2

There are different techniques of creative problem solving such as, attribute listing, brain storming, inquiry training and synectics. These techniques
facilitate solutions that are creative, i.e. solutions characterized by freshness, appropriateness, imagination, new relationship between even common place facts or ideas, and significant transformation of the initial definition of the problem.

6.8 ATTRIBUTE LISTING

The technique of attribute listing was developed by Robert Platt Crawford (1954). This is a useful technique for designing or redesigning a specific product or activity or service. According to Crawford, “magic inspiration is not the only, or even major source of creativity”. Much creativity arises from changing the attribute of an object or an activity, or from grafting on to the object or an activity, an attribute or attribute of some other object and activity. For example, many years ago traveling bags used to be made of metal to ensure durability; today durability is ensured by making much lighter plastic substitutes.

In attribute listing, the attempt first is made to list the basic but modifiable attributes or properties or specifications of a particular object or activity. Then an attempt is made to search for alternatives to the present attribute. An example of ‘attribute listing’ can be seen in the search for a better method of cutting cheese. At first, the initial problem is how to develop a better knife; this problem leads to another problem, i.e., how to arrange attributes of a better wedge; also the undesirable attributes are listed that are to be eliminated. Finally, if any other problem arises, its attributes both desirable as well as undesirable, are listed, and the undesirable are to be eliminated to arrive at the best possible solution.

Attribute listing is a very powerful technique for improving product design. The list of the modifiable attributes of a product—be it a commercial product, or a service, or even some activity, often leads to suggestions for improvement. So long as one thinks of a comb, without thinking of various properties of a comb, one is not likely to come up with better ideas about improving its design, (easy to keep, easy to clean, durable, sharp enough to massage the scalp but not to hurt it, easy to handle, attractive in appearance, cheap, etc.). A large number of alternative designs, colours, materials, manufacturing processes, and so on, may come to mind. In this way, generation of more ideas will lead to improvement of the product design.

In attribute listing, it may very often be useful to list abstract attributes of a concrete object or activity. This may help in generating more ideas than if the concrete attributes are listed. For example, if one wants to seek ideas for redesigning a cup, it may be better to conceive it as a container than as a tea cup, for thinking of the cup as a container makes possible designs that enable the use of a cup not only for drinking tea but also a variety of other fluids, and not only for drinking from but also to eat from, use as a flower vase, cook in, etc. Similarly, it may be better to consider handling conveniences as an attribute rather than the cup as having a handle to hold it. Next, seeking what function a current attribute serves, and then looking for alternative ways of meeting the function is a way of thinking about the abstract properties or attributes of an object or activity.
Crawford has laid down the following principles of attribute listing:

- Creation is not inspiration alone – it is largely adaptation and experimentation.

- Creation is not just mechanically combing different ideas, rather it is useful modification of an attribute, or assimilation of attributes of other objects.

- Creation is not simple stating of ideas; it is continuing array of modifications suggested by ideas in use which result over time into greatly changed objects or products like the thousands of modifications incorporated into the automobile over the years.

- It is desirable to search for concrete alternatives during the process of modifying the current attributes of an object. For example, if one is seeking to change hard railway seats, he/she should think not of just soft seats, but seats with the softness of a pillow or foam or vinyl.

- Creativity can be systematized by looking first for closely related substitutes of the current attributes and then progressively going in more and more for far out alternatives.

It is important to note that the attribute listing would give better results when the object or activity one wishes to change is more specific; when the modifiable attributes are separated from the unmodifiable attributes of the objects in order to concentrate one’s attention on the modifiable attributes.

Some important points that need to be considered in attribute listing are explained briefly as under:

- First, list exhaustively all the obvious attributes of an object or activity such as, the present size, colour, shape, function, weight, major components, material etc., for an object; and present duration, function, steps, sub-programs, etc., for an activity.

- Second, identify some of the attributes that can possibly be changed without destroying the main function of the object or activity.

- Third, the changeable attributes may be stated in more abstract terms. Thinking what functions these attributes perform and how critical these functions are to be for the main use of the object or activity would not only help an individual in listing necessary attributes in abstract terms, but also help in fixing priorities of attributes and in encouraging to look for alternative ways of satisfying functional requirements.

6.9 MORPHOLOGICAL ANALYSIS

Morphological analysis is a variant of attribute listing. This technique was developed by Fred Zincky (1957) in California. It facilitates the imagination by enabling the individual to focus on one aspect of the object or activity at one time. It involves combining the modifiable attributes of the major variables of problem into grid so that all possible combinations can be considered. The first task relates the identification of the major variables; next, the attributes of the major variables are listed; and finally, the possible combinations of the
attributes are considered so as to generate a large number of ideas. Similarly, also other aspects of the problem are analysed in regard to its attributes and possible combinations, which ultimately lead towards the best possible solution of the problem in question. For example, the problem may be how to fabricate a new type of building material. First of all, the identification of attributes of the material is done, followed by possible techniques of binding the material; and finally, methods of fabricating are plotted into a grid which may extend to any number of possible combinations.

In morphological analysis, the basic idea is to identify the critical modifiable attributes, and listing several alternatives; for each of the attributes enables one to generate a very large number of alternatives of an object or an activity. As an example, consider dissemination of daily news. Alternatives for the attribute of medium of disseminating daily news can be done by newspapers, radio, television, fax, telephone, or direct briefing. The second attribute can be frequency—once a day, twice a day, thrice a day and so on. The third attribute can be of coverage, i.e., local, regional, national, international. The fourth attribute can be of content, i.e., Economic, Social, Political, Scientific, Cultural. In this way, one can list these under ‘four’ headings where in six ‘medium alternatives’ are listed under one heading; ‘three frequency alternatives’ are listed under the second heading, and ‘four coverage alternatives’ are listed under the third heading, and the ‘five content’ are listed under the fourth heading, thus totaling $6 \times 3 \times 4 \times 5 = 360$ alternatives through which the daily news can be disseminated.

Arnold has pointed out that there is one basic difference between attribute listing and morphological analysis. Attribute listing works best when the object, activity, product sought to be modified is very specific such as ‘this chair’ rather than ‘chair’ in general. On the other hand, morphological analysis can also be applied profitably to modify general objects or activities, such as air transportation, health care or political machinery etc.

Attribute listing and morphological analysis are not mere techniques, they embody important values and attitudes favouring to creativity. The chief such value is one of trying out a new combination which fosters experimental; innovative bent of mind and also alerts one to possible new application of ideas.

### 6.10 BRAINSTORMING

Brainstorming is a popular method of group thinking. Alex Osborn established the ‘Creative Education Foundation’ at the University of Buffalo in 1957; it is here that he developed the method of brainstorming. This method is widely used by businessmen, scientists and others to tap the tremendous source of creative power. It is a technique with which problem is attacked from all possible angles to generate a large number of ideas in order to arrive at the best solution.

Brainstorming has been widely used in American Government and Industry; Osborn, the father of brainstorming, has cited several examples. In one brainstorming session in a federal government officers’ conference, the group brainstormed on ‘what can federal employees do to give visitors to Washington a truer and better impression of their government? Within 30 minutes, 121 ideas were elicited. In another brainstorming session, some U.S. Treasury
personnel produced 103 ideas in 40 minutes on ‘How can we get more federal employees to sell more U.S. saving bonds?’ In yet another brainstorming session, the group brainstormed on ‘How to reduce absenteeism?’ They produced 89 ideas in 30 minutes, and on ‘How to free bond-selling employees from office duties’ they produced 61 ideas in 30 minutes. In a telephone company, a brainstorming panel brought out over 100 new ways to recruit employees.

In a brainstorming session, a group of people sits around a table to brainstorm a specific problem. Each participant presents the ideas, that come to his/her mind. No member of the group is allowed any criticism on the idea put forward by another member. The objective underlying this is that of freeing a person from the usual inhibitions that operate to block his/her creative process.

**Principles:** The main principles of brainstorming are:

i) Deferring evaluation during the idea production phase, especially evaluation of a negative, critical kind. This means that the participants must withhold adverse judgement of ideas put forward by other members of the group.

ii) Free wheeling of ideas should be encouraged rather welcomed. The participants must cheerfully accept even wild, silly and crazy ideas put forward by other members. The more fantastic the ideas, the better it is. A fantastic idea can be one that does not seem at all practical but still it serves the important function of going off the beaten track, i.e., thinking divergently instead of conventional patterns of thinking. While the idea itself may not be practical, somehow it may hit upon other ideas that might not only be novel but also useful.

iii) Quantity begets quality: The more the ideas are generated, the higher will be the probability of hitting upon some brilliant ones. Participants must express ideas that come to their mind readily and spontaneously. The objective is to generate more and more ideas, i.e., first quantity and then it would lead to quality.

iv) Hitch-hiking on previously expressed ideas. Participants should aim at building upon and improving each other’s suggestions. Besides contributing their own ideas, the participants should suggest how ideas of others can be turned into better ideas or how different ideas can be joined together into new possible combinations to form new ideas. Moreover, no participant should feel ashamed of in building on others’ ideas or one’s own previous ideas. This simply means one should be open to the suggestive power of others or one’s own earlier ideas.

v) In one session, one aspect of the problem should be brainstormed so that a large number of ideas are collected.

In view of the usefulness and practicability of brainstorming, educationists, teachers, and students can use this technique very successfully to find out the best solutions to the problems that are faced by the existing system of education. For example, in the classroom it can be used to promote discipline, teaching-learning process; check delinquency, truancy, dropping out tendency of students; causes as well as preventive measures can be identified in regard to student unrest and copying in the examinations. This technique can be of great help to the teachers in developing problem-solving attitude among students and also in stimulating their imaginative and creative powers. This is
possible only when teachers or others who wish to use brainstorming are fully abreast with its inherent potential.

i) Brainstorming is not useful as a technique where the solution of a problem can be reached by analysis. For instance, if the problem is to find the square root of 5000, there is no need of brainstorming. It is particularly useful for problems that can have multiple solutions, of which some may be better than others, such as, ‘how one can make a child more interested in studies’.

ii) Brainstorming gives fruitful results when the topic selected for brainstorming is specific. If the topic is vague, the brainstorming will carry different frames of reference and the ideas generated will have a diffused applicability. For instance, the topic ‘how to get ahead in life’ is not clear. Different people will draw different meanings out of it. No doubt, it may generate many ideas, but since what ‘to get ahead’ means to different people is not clear, the ideas generated are likely to be too disparate. On the other hand, a topic like ‘how to get promoted in a particular organisation’ is likely to yield more useful and pertinent solutions.

iii) During the brainstorming session, the leader should encourage the members to provide concrete suggestions or ideas instead of abstractions. These abstractions sometimes become not only difficult but also impossible to turn into practice. Sometimes members also provide such suggestions, which are mere good intentions, but it is difficult to put them to actual use. The members should, therefore, be advised and encouraged to concretize their ideas. The concrete ideas stimulate hitching and action orientation. They have an energy charge that abstractions lack. It is better that the ideas expressed should be concise, brief, clear and specific.

iv) In order to select the most useful ideas among the host of generated ideas, it is necessary to identify a few ideas for more intensive investigation. One useful technique can be to have each member of a panel vote on the potential of each idea for solving the problem in hand or the ideas can be grouped into classes and then each idea within a group may be voted upon. Better it would be to formalize the criteria first for assessing the potential of the ideas generated before the ideas are voted upon.

If the ideas initially generated are large, voting may have to be done more than once. That is to say, ideas voted the best in the initial round of voting may again be put to a vote to get a small number of high potential ideas. These ideas may then be taken up for much more intense scrutiny. In this way, high potential ideas are selected and put to use.

The research of Sidney Parnes (1959) indicates the positive effects of ‘brainstorming’. His research also provides evidence that creative productivity can be developed by deliberate procedures. He studied the development of creative behaviour by devising several courses for the students of various streams. While evaluating the problem solving course he demonstrated that the students who completed the creative problem solving course performed significantly better on six out of eight tests of creative thinking than did comparable students who had not taken the course. His second observation was that increased productivity in creative thinking produced by the creative problem solving course persists for a period of eight months or more after the completion of the course. His research also provides evidence that individuals working along often accumulate more and better ideas than they do when
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working in a group. On the basis of research findings he mentions certain points that need to be considered in the conduct of brainstorming sessions:

- The first of these is the principle of deferred judgement during the idea production phase.
- Avoiding critical analysis of the idea after a quantity of alternatives is listed.
- Extended effort in idea production; Extended effort in idea production will lead to an increasing proportion of good ideas with increased production. Since brainstormers are able to generate more (quantity) and quality ideas in the second half than in the first half of the brainstorming session, Parnes suggests that the session should be broken into two halves. By doing so, brainstormers learn from the experiences of the first session and also are stimulated by each other's ideas. Thus, extended effort results in the production of new and better ideas than the earlier ones.

To conclude, brainstorming facilitates the development of divergent thinking abilities in human beings in more than one ways. In a brainstorming session, people drop their defensiveness, and instead of competing for power and status, they compete for excellence and creativeness of their ideas. Secondly, brainstorming reinforces a sense of participation especially if brainstorming is followed by voting on the best ideas. As is well known, participation increases commitment to implement the participatively chosen course of action. The host of ideas it produces is a clear demonstration of the power of the human mind to overcome obstacles.

Check Your Progress 7

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. List the steps that are generally followed in problem solving method.

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2. Differentiate between the techniques of attribute listing and morphological analysis.

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3. Fill in the blanks with suitable words in the following sentences.

i) Brainstorming method is widely used to tap the tremendous source .................

ii) Brainstorming is not a useful technique where solution of a problem can be reached by ......................

iii) Brainstorming technique gives useful results when the topic selected for brainstorming is .................

iv) Brainstorming technique facilitates the development of ............. thinking abilities in human beings.
Inquiry training model was developed by Richard Suchman (1962) to teach students a process for investigating and explaining unusual phenomena. The main objective underlying the model was that the scientific process skills are developed in the students to enable them to organize data, reason about cause and effect, and build and test theories. He modelled the model along the lines of the methods employed by creative researchers especially scientists. He identified the components of the inquiry process and built them into an instructional model which he called ‘inquiry training’.

Suchman bases his inquiry training approach on four postulates. First, children are curious and eager to grow by nature. He emphasizes that when children are faced with a puzzling situation they naturally get motivated to explore the data surrounding the discrepant event and think of arranging the data in a new way to find answers to the problem. The general goal of inquiry training is to help students develop the intellectual discipline and skills necessary to raise questions and search out answers stemming from their curiosity. Secondly, the process of inquiry can be taught to students. Suchman believe that students can become increasingly conscious of their process of inquiry, and that they can be taught scientific procedures directly. He emphasizes that we can not analyse and improve our thinking unless we are conscious of it. Thirdly, team approach is more useful than the individual approach to find solution to a problem. Suchman believes that the view point of a second person enriches our thinking; and that it is the cooperative inquiry that leads to the development of new knowledge. Fourthly, all knowledge is tentative. Suchman emphasizes that the students should be made aware of the fact that all knowledge is tentative. Scholars constantly generate theories and explanations. After sometime, these theories are replaced by new ones, which conveys that there are no permanent answers to problems; new and sophisticated ways are investigated to reach the solution of the problem, or new ways are detected to look at the problem itself.

6.11.1 Inquiry Training Process

In ‘Inquiry training’, the students are presented with a problem situation such as, an episode, experiment, story, etc., and are asked to inquire into it. In whatsoever form it is presented, it must essentially carry a discrepancy leading to a puzzle. Since the ultimate goal is to have students experience the creation of new knowledge, the confrontation should be based on discoverable ideas.

After the presentation of a puzzling situation, the students are encouraged to ask questions. These questions have to be worded in the way that they are answered by a ‘yes’ or ‘no’. The students are not to ask the teacher to explain the phenomenon to them, however, they can ask questions that are responded by the teacher only in a ‘yes’ or ‘no’. Whenever a question can not be replied in a ‘yes’ or ‘no’ response, the teacher reminds them of the rules, and waits until they find a way of rephrasing the question in proper form. Comments such as, ‘can you restate this question so that I can answer it with a ‘yes’ or a ‘no’ are common teacher responses when students slip out of the inquiry mode’.

Thus, at the first stage of the inquiry process, the students are taught to verify the facts of the situation, i.e., the nature and identity of the objects, the events,
and the conditions surrounding the puzzling event. As the students become aware of the facts, they form hypotheses, which guide them in their future inquiry. Using their knowledge about the behaviour of objects, students can turn their questions to the variables in the situation. This they can do by conducting verbal or actual experiments to test these causal relationships, selecting new data, or organizing the existing data in a new way to see what will happen if things are done differently. It may not be possible for the students to frame proper questions to test the causal relationships between variables unless they have sufficient information about the nature of the problem situation and its elements, and it is likely that they are to be overwhelmed by the many possible causal relationships.

Finally, the students try to develop hypotheses that will fully explain what happened. In other words, it means that they reach the final explanation. However, they need to be cautioned that there can be many possible explanations, therefore, they should not be satisfied with the first explanation that appears to fit the fact.

The main emphasis in this approach is on becoming aware of and mastering the inquiry process and not the content of any particular problem situation. The teacher also need not be too concerned with subject matter coverage or ‘obtaining the right answer’ for the reason that it would violate the real spirit of scientific inquiry, which emphasizes team approach of searching together for more accurate and powerful explanations for every day phenomena.

### 6.11.2 Phases in Inquiry Training

There are five phases (steps) in the inquiry process. The first phase is the student’s confrontation with the puzzling situation. The second and third phases concern with the data gathering mechanisms of verification and experimentation. In the fourth phase, students organize the data and try to explain the discrepancy. Finally, in the fifth phase, the students reflect on the problem solving strategies they use during the inquiry. These phases are explained in some more details given below:

**Phase-I: Encounter with the problem:** In this phase, the teacher is required to present the problem situation or puzzling event and explain the inquiry procedures to the students. The teacher is required to satisfy himself/herself that the students have understood the inquiry procedure (pattern of the yes-no question) and also the objectives fully. Then he/she can present problem situation to the students, which should essentially carry a discrepancy. The problem to be posed should be simple such as a puzzle, riddle, or magic trick that does not require much background knowledge. However, every puzzling situation can not be a discrepant event. It is, therefore, important to note that distinguishing feature of the discrepancy events is that it involves illogical phenomena that conflicts with the notions of reality. A problem may be puzzling simply because we do not know the answer, but simultaneously we do not need new concepts to understand it and therefore we do not need to conduct an inquiry. Thus, the problem to be taken for inquiry should essentially accompany a discrepancy but care needs to be taken that it matches with the cognitive level of the students.
Phase-II: Data gathering verification: In this phase, students gather information about the problem in hand through observation or experience. They are required to ask questions about objects, properties, conditions, and events in order to verify the information. Objects refer to determining the nature or identifying of objects. Properties refer to verifying the behaviour of objects and events are related to verifying the occurrence of an action. Wherever students deviate from verifying all the aspects of the problem, the teacher reminds them of the rules of the process and makes them aware of the type of information they are likely to seek and put them to work to change the questioning pattern.

Phase-III: Data gathering experimentation: In this phase, students introduce new elements into the situation to see if the event happens differently. Exploration serves two functions, that is, exploration and direct testing. Exploration refers to changing things in order to see what will happen though it is not necessarily guided by a theory or hypothesis, but it may suggest ideas for a theory. Direct testing refers trying out a theory or hypothesis. The hypothesis determines the direction of data gathering. If the gathered data do not support a hypothesis, it is rejected and consequently alternate hypothesis is formulated and the process is repeated.

Although verification and experimentation are described as separate phases of the inquiry training approach, yet the students’ question usually alternate between these two phases of data gathering. The teacher does not need to be very rigid in following these two phases separately instead he/she should encourage students to generate questions that pertain to data gathering and consequently lead them to formulate the explanation.

Phase-IV: Formulating an explanation: In this phase, the teacher calls on the students to formulate an explanation. It is possible that different students may put forward different explanations, however, some students may have difficulty in making the intellectual leap between the data they have gathered and a clear explanation. It is also possible that they may give inadequate explanations omitting essential details. It has been experienced that sometimes several theories or explanations are possible based on the same information. In view of this, it is useful to ask all the students to state their explanations so that the range of differences is revealed. It is believed that the groups together can shape the explanation that fully responds to the problem situation.

Phase-V: Analysis of the inquiry process: In this phase, the students are asked to analyse their pattern of inquiry. This would help them in finding out the questions that were most effective; the lines of questioning that were most productive and those that were not; or the type of information they needed but could not obtain. The teacher asks students to recall the question they have raised and to identify those questions that led them to explanation but not others. In this way, the teacher goes on repeating the whole process of inquiry so as to make students aware about the pattern of questions needed to be raised during the phases of verification and experimentation that have helped them to reach at final explanation and also making the inquiry process conscious one so that steps are systematically taken to improve it.

Inquiry training approach promotes active, autonomous learning as the students themselves formulate question and test ideas. It calls upon students to take courage to ask questions, and helps them to become more proficient in
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verbal expression as well as in listening to others and remembering what has been said. The chief learning outcomes of this approach are the involvement of varied processes such as observing, collecting and organizing data, identifying and controlling variables, framing and testing hypotheses, formulating explanations and drawing inferences. The magnificent integration of these several process skills into a single, meaningful unit of experience is the chief characteristic of this approach.

This all depends when both the students and the teacher try for their balanced roles. The teacher selects the problem situation in accordance with the students' cognitive level; acts as a referee throughout the inquiry process; responds warmly to students' question; brings them back on the right track if they deviate; facilitate discussion and interaction among students; and finally helps them to arrive at explanations. The students on the other hand, actively participate in finding out the discrepancy from the problem; raising pinpointed questions; process data in a systematic sequence; tolerating ambiguity; and formulating explanations.

6.12 SYNECTICS

The word 'Synectics' has been adapted from the Greek word 'Synecticos' meaning fitting together diverse elements. Synectics is based on the use of metaphors and analogies within a systematic framework to achieve creative results. The central idea is that better understanding of a problem is attained when it is strange or unfamiliar and allows us to think of an analogy or metaphor that makes it more familiar and hence more amenable to a creative solution. In synectics, then the problem as one is presented with, it initially has to be restated and looked at in various ways through the use of metaphors or analogies. During the course of this process, the individual goes on what synectics proponents call an 'excursion' and as a result of such a trip creative solutions are attained.

Initial work with synectics procedures began about 1944 when William J.J. Gordon undertook an intensive study of individual and group processes in creativity. This was followed with a systematic exploration of his ideas in 1948 with a group of artists and then went on forming synectics groups in several companies. Finally, he and his associates designed this new approach 'synectics' for the development of creativity at Cambridge, Massachusetts in 1961.

Gordon and his associates believe that the group process in creativity is analogous to the individual process; that the creative process can be understood, described and taught; and that individuals can increase their creativity if they understand and use the process. He also believes that creativity in arts is analogous to creativity in sciences, and that emotional and intellectual, rational and nonrational components are involved in creativity.

In synectics, nonrational processes are engaged through the purposeful use of metaphors. Since many researchers have attempted to define the roles of the preconscious and unconscious mind in the creative process, the credit goes to synectics proponents who have so systematically tried to engage these sources of creativeness. What they have sought out to do is to imitate the processes of incubation in the preconscious mind as incubation is thought to be the phase of
problem solving in which the preconscious mind is working out the solution to a complex problem without the conscious and being aware of this. The preconscious mind does not think logically; it thinks analogically, associatively and visually. Rational and logical processes are also used in synectics. They too are valued, encouraged, and enhanced in a group situation that is free, easy-going and accepting. Moreover, regardless of the emphasis placed on non-rational factors, the whole synectics process occurs within a framework that has very practical goals.

Among the various factors that play important roles in synectics are five psychological states involved in the creative process. The five psychological states are:

i) **Involvement and detachment**: This state refers to the relationship between the individual and the problem on which he/she is working. Involvement refers to understanding and interacting with the components of the problem. Detachment refers to detaching from and becoming distant from the problem. By this we mean that the creative process involves both the capacity of involvement of the individual with the problem on the one hand and getting detached from the problem on the other in order to view it objectively.

ii) **Deferment**: Experience has shown that quick and immediate solutions to a problem are likely to be premature and superficial. They should, therefore, be deferred until best solutions are arrived at. Deferment refers to the capacity of both the individual and the group to defer these quick solutions until they have arrived at the best one.

iii) **Speculation**: Speculation refers to the type of thinking in which individuals are able to let their minds run free so that they can come up with ideas, hypotheses and solutions.

iv) **Autonomy of object**: As the creative process proceeds and a solution is approached, there is a feeling that the solution has an entity and demand quality of its own. The individual or group must be willing and free enough to allow this feeling to develop and to follow it.

v) **Hedonic response**: Synectics involves, among other factors, play with 'apparent irrelevancies', to generate energy for problem solving and to evoke new views of problems. One of irrelevancies is an emotional factor referred to as 'hedonic response' which serves as an 'irrelevance filter'. The feeling involved in the hedonic response is very subtle and is similar to the inspiration or intuition that is sensed prior to arriving at a solution to a problem. It is the pleasurable sensation that accompanies the feeling of being right about a hypothesis or a solution before it has been proven correct. There are both aesthetic and pleasurable elements in hedonic response. It is of great importance, if an individual could learn how to recognize it, then he/she would probably not waste so much of time and energy in the creative process; the individual would have that 'feeling' aesthetic or otherwise that would tell him when to follow up a hypothesis and when to pursue a tentative idea to solution.
The psychological states are induced by operational mechanisms. The individual who is working on a problem actually utilizes these operational mechanisms. If they operate effectively, then the psychological states function very quietly and 'take care of themselves'. One of the functions of these mechanisms is to make the familiar strange. In doing so, one of the important psychological functions that is accomplished to increase the distance enables the individual to avoid becoming stuck with what he/she already knows about a problem and being limited to it. The four mechanisms are:

i) Personal analogy: Here the individual attempts to imagine himself/herself to be the object with which he/she is working. Gordon (1971) believes that the critical elements in personal analogy is empathic identification: that the person is asked to retain his/her individual human sensibility but is simultaneously asked to transpose himself/herself into a situation and to report what he/she feels, sees, hears, thinks, etc. For instance, if the discussion is about static in the radio, the leader may ask group members to imagine themselves to be a radio and to tell the group what they see, feel, think, etc.

There are four levels of involvement in personal analogy. (a) The first person description of facts: It involves a mere statement or listing of facts. (b) The first person description of emotions: It represents the lowest order of identification. These two levels are considered the lowest level analogies. (c) Empathic identification with a living thing: Since it represents both kinesthetic and emotional involvement with object, it is regarded as 'true' personal analogy. (d) Empathic identification with a nonliving object: This is the most sophisticated type of empathy as it is much more difficult to attribute human emotions with nonliving objects. On the other hand, it may be easy to do so with living objects as in the case of level.

ii) Direct analogy or example: In this facts, knowledge, or technology from one field are used in another field. Direct analogy involves seeking a direct comparison of the phenomenon under discussion with some other phenomenon that is similar enough. For example, if aerodynamics of a plane is under discussion, the group may think of and explore how birds manage to fly into a plane's aerodynamics. For many problems, the synectics people have found analogies from biology particularly useful in generating fruitful insights, however, whatever other information an individual has at his/her disposal may be helpful to him/her in direct analogy.

The more far fetched the analogy, the greater the probability that the angle suggested by the analogy has not previously been thought of by anybody. Gordon (1971) says that analogies with small psychological distance from the problem can be effective for problems being worked on for the first time; but for problems that have been worked on great deal, analogies that reflect great psychological distance - those that are rather remote from the individual's experience - are required.
Direct analogy is the basic mechanism by which an individual tries to see problems in new contexts. A direct analogy is clear and straightforward. It produces immediate results and its process can be reproduced (Gordon, 1971).

iii) Symbolic analogy: The symbolic analogy is also called ‘book title’, essential paradox, and compressed conflict. This form of analogy makes use of objective and impersonal images to describe the problem. An individual effectively uses symbolic analogy in terms of poetic response; he/she summons up an image which, though technologically inaccurate, is aesthetically satisfying.

The function of ‘book title’ is to generalize about some specific matter and to use the generalization to suggest a direct analogy. This helps people who stay close to the problem to get away from it. In a ‘book title’ there is both essence of and a paradox involved in a particular set of feeling (Prince, 1970).

iv) Fantasy analogy: Fantasy analogy is based on Freud’s idea that creative work represents wish fulfillment. The individual states a problem in terms of how he/she wishes the world would be. In it, the group members are urged to imagine a constraint free solution in much the same way as our wish fulfilling day dreams. Group members are asked to fantasize some perfect solution even if it flies in the face of known scientific principles. Gordon regards fantasy analogy as an excellent bridge between problem stating and problem solving because it also tends to evoke the use of the other mechanisms.

Thus, synectics in the course of problem solving situations attempts to make the familiar strange and to make the strange familiar through the use of the different types of analogies. These analogies enable the individual to look at the problems in new ways, and thereby hopefully gain new insights into the problems.

Synectics also attempts to make conscious what goes on in the unconscious by means of operational mechanisms. The psychological states are also induced by these mechanisms. These states create the psychological climate necessary for creating activity.

Steps in synectics process: The main steps involved in the synectics process as proposed by Gordon are briefly discussed as under:

(i) Problem as given (PAG): The problem may be posed by an outside source or by an individual in the group and may be explained to the group by an expert.

(ii) Short analysis of the PAG: At this stage, the expert starts by explaining the problem in sufficient detail that the group has a common understanding. Since the expert is also a participant, he/she does not need to reveal all the minute details of the problem, which can come out later during the session. In order to understand the problem, and to unravel the hidden elements, the group members attempt at making the strange familiar.
Teaching Learning Strategies

(iii) Purge – immediate suggestions: At this stage, individuals participating in the process are likely to think of and present varied suggestions or solutions. Such suggestions are not likely to be perfect solutions; however, they should be verbalized. The leader should urge group members to rid themselves of the superficial ideas and attempt at turning to more innovative possibilities.

(iv) Problem as understood (PAU): If the problem remains unsolved, the leader asks the members of the group to state the problem as they understand it, this is called the ‘problem as understood’ phase. The group member may either state the problem as he/she sees it, i.e., a simple paraphrase of the actual problem, or he/she may state in any other manner as he/she thinks desirable not worrying whether it is realistic or not. The leader then asks the group members to put the problem out of their minds and to concentrate on what he/she asks. Essentially, he/she now starts to take the group on a mental excursion.

(v) Excursion: It is at this stage that an extended process of the problem solving starts. According to Prince, this stage is likely taking an artificial vacation or a holiday from the problem in which the participants are asked to put the problem out of their minds. He is aware that if they are capable to do so, they will put it out of their conscious minds but still shall continue to work on it in their preconscious minds.

It is during this stage of the synectics process that the different operational mechanisms and the different kinds of analogies are used. Essentially, it is at this stage that the group tries to make the familiar strange. The leader questions the members and attempt at evolving responses to his requests for different kinds of analogies. Next, the leader may ask an evocative question; such as, an example from some other field, of an aspect of the chosen problem as understood. For instance, an evocative question may be ‘can you think of a crowded situation from biology?’ Here the leader is asking for what is called a direct analogy. A number of responses may be made to the evocative question ‘flies on cow dung’ ‘virus culture’ ‘drop of sperm’ etc. could, for example be such responses to the above said evocative question concerning a crowded situation. At the appropriate time, the leader may request for a personal analogy. For instance, he/she may take up ‘virus culture’ and asks each group member to imagine himself/herself as virus in a virus culture. He/she may ask them to explain how it feels to be a virus in this culture. Group members may come forward with different types of responses.

The leader may also ask group members to fantasize (without reservations) about how one could, as a virus set out to conquer the world. This kind of analogy is referred to as fantasy analogy. Then, the leader may ask for a symbolic analogy (book title) – to give book title comprised of two or three words, poetic or otherwise, that captures the essence of a key work such as virus culture and contains a paradox. The participants may respond with different types of title.
(vi) Force fit: This involves two stages, i.e., (i) Fantasy force fit, (ii) Practical force fit. According to Gordon an attempt is now made to force a fit between the analogy and the problem as understood. In forcing a fit a very obvious attempt is made to make effective use of the last analogy to solve the problem. Gordon calls this stage fantasy force fit because fantasy provides the individual with greater license and freedom for response.

During this stage, if the leader senses that a potentially useful approach to the original problem is at hand, he/she may ask for a force fit, i.e., he/she may ask the group members to try to think how the present idea or analogy could suggest a solution to the original problem. The next step is then to come up with a practical application of the analogy to the problem, i.e., practical force fit.

(vii) View point: The problem solving process ends either in a viewpoint that could be used for solution, or in a new problem as understood, and the recycling of the process takes place again.

Prince emphasizes that a viewpoint remains a possibility until leads to a possible solution are developed. He uses the word possibility instead of viewpoint because every viewpoint is regarded so until it has been implemented and found workable. It is the implementation stage, which is too difficult, and a solution that actually works may be several times removed from anyone's viewpoint. The objectivity of any viewpoint is judged by the new elements it has and it should be a promising one. Thus, it is finally the viewpoint which leads to arrive at a solution of the problem at hand.

Steps

Steps involved in the synectic process are summarized below.

**Synectic Process**

- Problem as given (PAG)
- Short analysis of PAG
- Purge immediate suggestions
- Problem as understood (PAU)
- Excursions
- Force fit
- View point
Check Your Progress 8

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Write four objectives of inquiry training process.

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........................................................................

2. Name five psychological states involved in the creative process that play important roles in synectics.

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3. List the main steps involved in the synectics process.

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6.13 LET US SUM UP

Teaching can be analysed in terms of teacher behaviour at three levels, namely, component teaching skills, component teaching behaviours and atomistic teaching behaviours. A teaching skill refers to a set of related teaching acts or behaviours performed with an intention to facilitate student’s learning. Introduction, explanation, questioning, increasing student participation, providing reinforcement, use of aids, blackboard work and evaluation are some of the important teaching skills. Microteaching is a scaled down teaching situation. It provides teachers with a practice for teaching situation. It provides teachers with a practice for teaching in which normal complexities are reduced in terms of length of the lesson, scope of the lesson, number of students and class time. Supervisors play an important role in microteaching particularly in preservice training programmes. Role of supervisor is one of continuous consultation so that the trainee can perfect his/her performance in the particular teaching skill.

Problem solving methods being used are often classified as ‘traditional’ and ‘new’. The former (traditional) methods are more rational and logical while the latter (new) methods attempt to train the individual through freeing him/her from his/her emotional inhibitions. Problem solving methods involve five steps, namely, definition of the problem, searching for different methods and selecting the suitable one, preparation of the design and its execution, and generalizing the results and arriving at the best solution. Some of the techniques of creative problem solving are attribute listing, brainstorming, inquiry training and synectics. These techniques facilitate solutions that are creative.
6.14 UNIT-END EXERCISES

1. Analyse the concept of teaching.

2. Explain the concept of teaching skills.

3. Explain the following teaching skills in terms of their components:
   (i) Introducing a lesson
   (ii) Explaining
   (iii) Questioning
   (iv) Increasing student participation
   (v) Providing reinforcement
   (vi) Using teaching aids
   (vii) Blackboard writing
   (viii) Evaluating

4. Explain the microteaching procedure. Bring out its importance in teacher training.

6.15 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress 1

1. Teaching skills, general teaching behaviour, and specific teaching behaviour.

2. Teaching is defined as a set of component skills for the realization of a specified set of instructional objectives.

3. A teaching skill is a set of related teaching acts or behaviours performed with an intention to facilitate student's learning.

Answers to Check Your Progress 2

1. The two components of the skill of introducing are:
   (i) Desirable behaviours
      (a) Using previous knowledge
      (b) Using appropriate devices
   (ii) Undesirable behaviours
      (a) Lacking in continuity
      (b) Making irrelevant statements

2. Explanation is a set of interrelated statements made by the teacher related to a phenomenon, an idea, etc., in order to bring about or increase understanding in students about it.
Answers to Check Your Progress 3

1. The components of the skill of questioning are:
   (i) Structure (ii) Process (iii) Product

2. Student participation can be increased by integrating the various components, namely, creating set, questioning, encouraging student participation and pausing in appropriate combinations and proportion.

Answers to Check Your Progress 4

1. Positive reinforcement means strengthening of desirable behaviour. It increases students’ participation in the class. Negative reinforcement means weakening of undesirable behaviour. It decreases students’ participation in the class.

2. (i) Objects can be brought to the classroom.
   (ii) Acquisition of knowledge of facts.
   (iii) Involve more than one sense.
   (iv) Motivate and stimulate interest of students.

3. Some important types of teaching aids are objects, models, pictures, diagrams, maps, sketches and experimental demonstration.

4. Science, Home Science etc.

Answers to Check Your Progress 5

1. The components of the skill of using blackboard are:
   (i) legibility of hand writing
   (ii) neatness in the blackboard work and
   (iii) appropriateness of written work on the blackboard

2. For effective use of blackboard the following points may be taken care of:
   (i) Check the condition of the blackboard for its useability.
   (ii) Light falling on the blackboard should neither be dim nor too bright.
   (iii) Keep sufficient amount of chalks.
   (iv) Use a pointer.

3. Evaluation provides the measure of success. It identifies defects and failures. It also reveals the value of methods, procedures, techniques, materials and equipment being used and where they should be improved.

Answers to Check Your Progress 6


2. Microteaching is a scaled down teaching situation. It provides teachers with a practice for teaching in which normal complexities are reduced in terms of length of the lesson, scope of the lesson, number of students and class time.
3. i) Defining a particular skill.
   ii) Demonstration lesson by a teacher educator employing the particular skill.
   iii) Preparation of a lesson plan on the particular skill by a student teacher.
   iv) Teaching of the lesson by a student teacher to a small group of students.
   v) Feedback to the student teacher.
   vi) Replanning the lesson in the light of feedback.
   vii) Reteaching the revised lesson to another comparable group of students.
   viii) Refeedback session.

Answers to Check Your Progress 7

1. Problem solving methods generally involve the following steps:
   (i) Definition of the problem.
   (ii) Searching for different methods and selecting the suitable methods.
   (iii) Preparation of the design.
   (iv) Generalizing results and arriving at the best solution.

2.Attribute listing works best when the object, activity or product sought to be modified is very specific. Morphological analysis is a variant of attribute listing and can be applied profitably to modify general objects or activities.

3. (i) creative power
   (ii) analysis
   (iii) specific
   (iv) divergent

Answers to Check Your Progress 8

1. (i) Logical thinking
   (ii) Scientific process skills
   (iii) Creative inquiry skills
   (iv) Independent learning

2. (i) Involvement and detachment
   (ii) Deferment
   (iii) Speculation
   (iv) Autonomy of object
   (v) Hedonic response
3. (i) Problem as given (PAG)
   (ii) Short analysis of the PAG
   (iii) Purge – immediate suggestions
   (iv) Problem as understood (PAU)
   (v) Excursion
   (vi) Force fit
   (vii) View point

6.16 SUGGESTED READINGS


