APPENDIX - N

INTEGRATION OF TEACHING SKILLS

UNIT FIVE

Enquiry Approach for Teaching Science

Synopsis :

1. Programme
2. Terminal Behaviours
3. Instructional Material
4. Guidelines for Discussion
5. Exercise

---

1. Programme :

1. Reading on instructional material
2. Discussion
3. Lesson Planning
4. Practice on Enquiry Approach.

2, Terminal Behaviour :

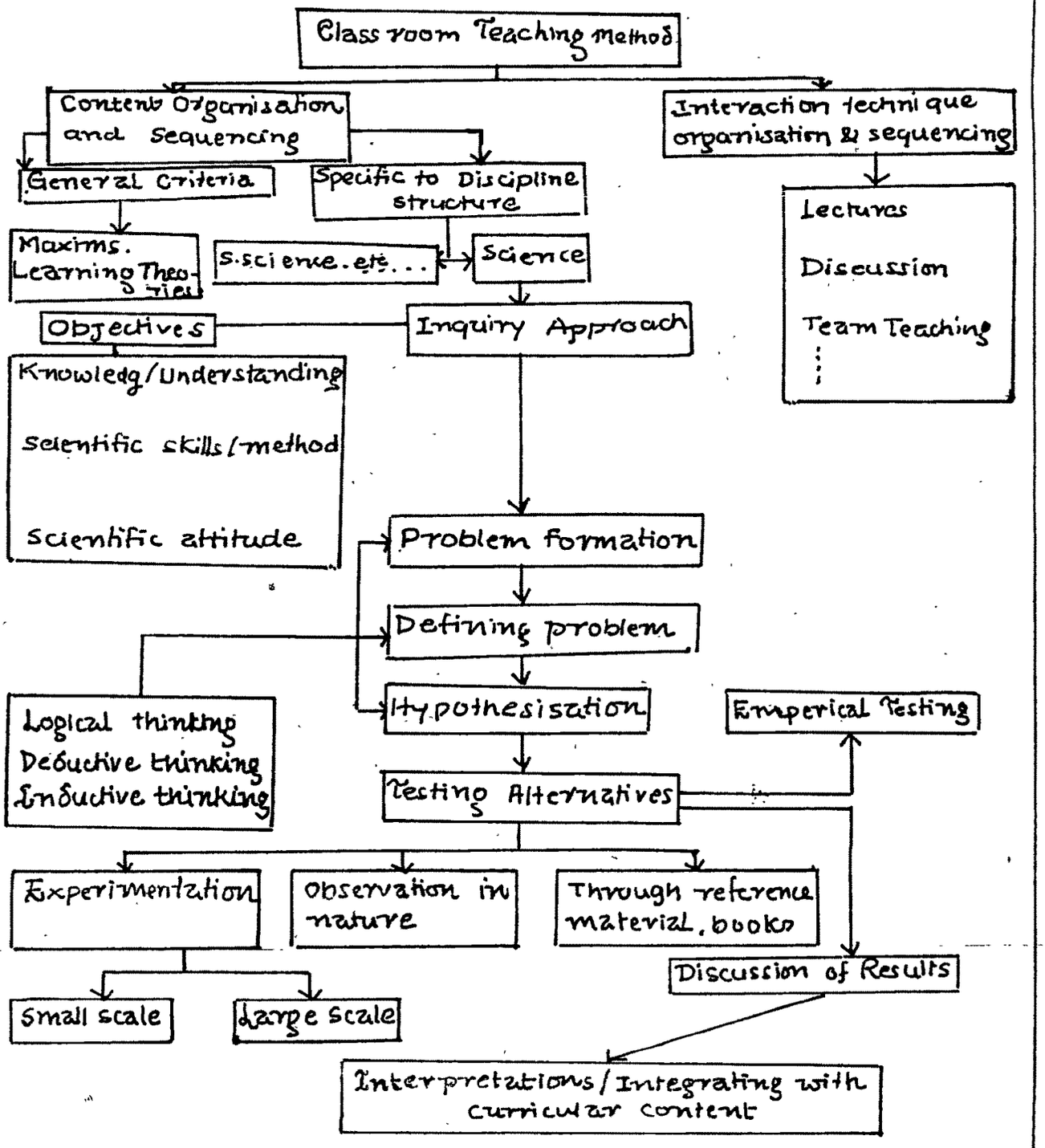
1. Student teacher will recall the characters of scientific method, and scientific attitude.
2. Student teacher will recall the significance of enquiry approach for teaching science.
3. Student teacher will recall the steps to be followed for teaching science through enquiry approach.
4. Student teacher will recall the different operation to be carried during each step of enquiry approach.
5. Student teacher will be able to relate the evolution of science and enquiry approach.
6. Student teacher will be able to apply the steps of enquiry approach while teaching in classroom teaching.

FIG : A-5

FLOW CHART

METHODS OF TEACHING : INQUIRY APPROACH

[with special reference to science]



3. Instructional Material :

' Enquiry Approach for Teaching Science '

Prepared by : Eknath Ekbote

Synopsis :

1. Introduction
2. Significance of Enquiry Approach
3. Steps in Enquiry Approach
   - (i) Evolving a Problem
   - (ii) Defining the Problem
   - (iii) Finding Alternative Solutions (Hypothesis Formation)
   - (iv) Testing Alternative Solutions
   - (v) Discussion of Results
   - (vi) Concluding the Knowledge

Introduction :

In the previous exercises the integration skills namely formation of interaction patterns with explaining skill and questioning skill, use of visual media and blackboard, use of reinforcers has been provided. All these exercises were basically aimed to organise and sequence, students overt behaviours and teachers overt behaviours. The different mode of organisation and emphasis on certain skills results in different types of interactions namely discussions, lectures, and combination of the two. This formation of specific interaction pattern is one dimension of instructional system. The other dimension will be to organise and sequence content and learning experiences. The organised content and learning experience are carried upon by teacher through different communicative technique as mentioned earlier. This unit will be dealing with content and learning experience, Organisation and sequencing.

During the practice of skill of illustrating with examples, you have practiced simple form of sequencing experiences for teaching namely, inductive and deductive approaches. Inductive approach (Sometimes called as method) refers to the use of sequentially arranged set of examples, common characters undeflying the concept to be understood. In other words, the set of example clarify the concept and communicates in term understzndable by the learner. In the deductive approach importance is given to logically understand a concept or evolve a concept, through deduction. The so formed concept will be further tested using different examples. Inducto-deductive method forms a synthesis of both complimenting each other in understanding the evolving ever-dynamic knowledge, these methods are invariably used in the class consciously or unconsciously while teaching.

Significance of Enquiry Approach :

The major aim of science teaching to learner is, (a) to provide adequate amount of scientific knowledge (b) to develop the abilities for application of scientific skills and methods, (c) to develop scientific attitude as a personality trait. Achievement of these objectives is closely related with communication interaction pattern, content selection and approach adopted for teaching achievement of objective as mentioned in 'a' can be achieved by following suitable maxims namely known to unknown, concret to abstract, simple to complex etc. To achieve the other two objectives mere following of these maxims will not ensure certainty. They have to be supported by scientific method. Science deals with study of physical, chemical or biological properties of living and non-living bodies. To reveal these property one has to inquire into the behaviours of these bodies under various conditions and contexts. The knowledge will not emerge unless one is able to organise the related ideas and frames, specific questions. The nature of discovering scientific knowledge requires the application of scientific method with a bent of mind for scientific enquiry. The synthesis of these two aspects namely, scientific method and scientific enquiry forms enquiry approach. By following the enquiry approach for teaching, the learner will be able to trace the footsteps of scientific evolution, thereby by achieving the objectives of developing scientific method and scientific attitude differs. The enquiry approach differs from the rest of the teaching method by not accepting the scientific knowledge unless the hypothesis is tested through scientific method. The present unit will aim to understand and practice teaching of science through inquiry approach.

Steps in Enquiry Approach :

As stated before this approach follows scientific method and enquiry skill to understand scientific knowledge. The detailed procedure - steps followed is presented in different forms and variations depending upon the needs of application. Following are the steps presented for enquiry approach teaching suitable for class room teaching.

Step 1 : Evolving a Problem : This step is to initiate the topic wherein the teacher initiates the teaching with an interesting problem to solve. In science the knowledge discovery is usually due to questions faced by the scientist. Science knowledge evolves gradually while answering the confronted questions by scientists. Similarly child learns the generated body of scientific knowledge by adopting discovery method, wherein he will be posed with problem to solve about, thereby understanding science knowledge. This does not mean everything provided in the curriculum is always presented in the form of problem, and every classroom period should start with a problem. The initiation with problem is required for every major concept to be taught. The initiated problem acts as a carrier for understanding the predecided science knowledge. The nature of the problem should create curiosity amongst students to search for

knowledge. The initiation can be from showing small experiments which look like magic or wonders, by putting question orally using logical analysis but contridicting to what learner knows or by asking him to relate two previously studied concept. Use of examples to initiate helps to motivate students leading to greater involvement. Following are a few of the examples of such initiations:

1. When a glass filled with water till its brim is added with substantial amount of alcohol, it accomodates without over spilling.
2. Why did scientists define removal of hydrogen as a process of oxidation ?
3. Why do usually plants are green ?
4. Why some objects sink and some float in liquid ?

Step II : Defining the Problem : During the first step the students are posed with a problem, which motivates and initiates to focus their thinking on related ideas and content. To accelerate his thinking in the related sphere the problem should be further defined and pin-pointed. This step usually involves eliminating the examples, and instances that generated problem and unfold problems in terms of scientific principles or in its basic form. Further, the problem will be limited to particular levels only depending upon the class level, ability of students, time, and requirement of curriculum. This is achieved through the process of cross questioning students to pinpoint the problem. At this stage student should involve to respond and clarify the problem with the help of teacher by application of scientific method. Teacher should act as a mediator between the problem and learner. Teacher involvement by providing directly the correct answers so as to economise the time will weaken the process of developing scientific method. The examples that were set in Step 1 are further defined as follows.

1. When two volumes are added together they together will have volume equal to the additive property. In the present case, it is not following the principle above mentioned. The reason is to be discovered.
2. From our previous studies we know that addition of oxygen to form a new compound is referred as oxidation. Oxidation is the process related to addition and elimination of oxygen to chemical substances. Without involving oxygen how oxidation is possible ? The new definition requires discovery of new information.
3. It is everyday observation that, plants basically have green colour. Is it incidental or purposive ? If purposive what is the reason ?
4. From our previous study and observation we know that stone andany other solids sink in liquid. Sometimes they do not. Is there any relation between the liquid and sinking/floating body or is it a random phenomenon ?

Step III - Finding out alternative answers/solutions/possibilities:

At this stage learners are asked to form possible solutions and substantiate their solution with sufficient reasons. This requires to think logically solve problem at cognitive level with the information already the learner has. Students may doubt the correctness of some of the information they have already accepted. The present solution may falsify the previous concept the child has. Teacher should encourage students to form as many alternatives as possible so as to provide them opportunity to develop the ability of hypothesis formation. After arriving at a list of alternative the group can further screen and select a few alternatives which stand to the knowledge they have about the problem and accepted by the group. The examples listed in previous step are further dealt below with few alternative solutions.

Example 1 : This problem has the following possible solution: (a) This is an exceptional example. (b) What apparently appears is not true, if observed with measuring flask the volume will be additive of two. (c) These two liquids are chemically interacting forming new substance, changing the volume. (d) This phenomenon must be happening with other liquids also, only in this case we are able to observe in substantial amount.

Example 2 : (1) Oxidation is not necessarily related to oxygen involved reaction, there is something else as a principle. (2) Oxidation is related to increase and decrease in atomic weight. (3) Oxidation is related to change in electronic configuration of chemicals. (4) Oxidation is related to specific change in properties of chemicals due to chemical reactions.

Example 3 : (1) Plants have some chemical substance when exposed to sublight becomes green. (2) It is not necessary that, plant should have green substance, it is incidental. (3) It is necessary and is related to certain physiological functions.

Example 4 : (a) Sinking property is related to the weight of the solid. (b) It is related to the volume of liquid. (c) It is related to the shape of solid and shape of liquid containers.

Step 5 : Testing the alternative possibilities/solutions/ hypotheses : In previous phase many alternatives are formed. All of them may not be correct, they require to be tested through further observations or experimentation. Some of the natural observation may act to support or disqualify some of the alternative, in other cases it may require to design and emperically test through experimentation. The detailed procedure to be followed for experimentation is already given in Unit IV. Experimentation for convenience can be grouped in two classes. The first is small experiment involving 5 - 10 minutes duration and the other requiring more than 10 minutes extending to hours. The large scale experimentation requires preparation of experimental design, selecting equipments and improvising some

equipments, preparing observation schedules, conducting experiments etc. Both types of experimentation should be used depending upon the need and context.

In case of density example listed before all small experiments involved can be done on the spot, whereas example on photosynthesis requires extraction of green pigments from leaf. This involves designing, planning and conducting experiment with several steps. The oxidation concept may be tested further by collecting large number of examples so as to answer the question under study.

Step VI : Discussion of Results : During this stage the obtained findings are related to the set problems and possible answers. Some of the alternatives will be rejected and some are accepted. Sometimes all the solution may have to be rejected. The teacher at this stage should provide deeper insight into findings, by providing sufficient reason for getting specific type of results. The detailed procedure is presented in the Unit IV.

Step VII : Concluding the knowledge : The teacher at this stage should be able to process the findings into general principles and concept. Further they should be accommodated as required by the curriculum and knowledge the student has. Relating the results with other phenomenon, examples, situation will widen the scope of comprehension of concept and its application by learner.

Teachers Manual

Discussion Session
Duration : 60 Minutes

IV. Guidelines for Discussion on Instructional Material 'Enquiry Approach for Teaching Science.'

1. Structure of science knowledge, evolution of science knowledge.
2. Importance of discovery in generation of scientific knowledge.
3. Discovery learning and guided discovery learning for science learner.
4. Characters of scientific method.
5. Significance of teaching science through enquiry approach.
6. Steps in enquiry approach and their importance.
7. Sequencing of content for enquiry teaching.
8. A few examples from Physics, Chemistry and Biology showing content sequencing to teach through enquiry approach.
9. Demonstration of at least one small lesson through enquiry approach.
10. Process emphasis in enquiry approach.

Student Manual : Simulated Practice Teaching

V. Exercise Duration : 4 Sessions of 150 Minutes each.

Students,

You will practice to teach through enquiry approach, following the simulation practice as mentioned for experimentation. You will be selecting a concept and prepare a flow chart of content. The approach will be basically decided during content sequencing. You may contact personally to take guidance for planning the lesson. The lesson should take almost thirty to forty minutes. You should involve small experiments. If it is not possible to involve all the steps of enquiry you may take only a few steps. The spirit of enquiry should be felt during the teaching. Since this practice teaching will be taking lot of time, the group will be divided in two sub groups. Both the sub-groups will be teaching at the same time as did during 'visual media practice'. Those student-teachers who feel defident may take more than one lesson.

Teachers Manual Simulated Practice Session

Exercise : Duration : Four sessions of 150 minutes each

Following are the few directions which will be helpful to the supervisor to organise the exercise.

1. The group of 12 students can be divided into two sub-groups. This becomes essential to economise on time.
2. The supervisor should critically go through the lesson plans and suggest the suitable sequencing of learning experiences.
3. Before starting the exercise he should brief the peers to act supportively to practice the lesson.
4. Supervisor should concentrate while providing feedback on the enquiry approach, specifically to what an extent the teacher is able to define the problem, formation of hypothesis, testing and arriving at results with major contribution from learners.
5. Appreciation of scientific method and enquiry approach should be part and parcel of the discussions.
