UNIT 3 PLANNING AND DESIGNING FOR EFFECTIVE INSTRUCTION IN SCIENCE

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3.1 INTRODUCTION

Planning is important in every walk of life. The success of a piece of work is ensured if the work is properly planned. Without planning we shall be aimlessly loitering about, applying means without aiming at the achievement of ends. Just as planning is important in our daily life, likewise planning is of unique importance in the teaching-learning process. As an experienced teacher you may have observed that on some days, your pupils are restless and least interested in the material you are trying to present. On some other day, the teaching becomes enjoyable. The atmosphere of your classroom is relaxed. Goals are attained smoothly. What is the reason you think explains the difference between these two types of classroom situations? The answer is careful planning done in the latter situation. Careful planning is the key to effective instruction. A good teacher, thus, avoids frustrating situations and experiences in the conduct of his lesson. He is able to anticipate not only his but also his pupils' likely difficulties. In what follows, an attempt has been made to help you to plan and design your instructional work for smooth transactions not only in the classroom situations but in the science laboratory too.

3.2 OBJECTIVES

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

- explain the need and purpose of planning of instructional work,
- identify different skills for designing the format of presentation,
- identify the basic skills required for effective management of science laboratory.
3.3 PLANNING FOR INSTRUCTIONAL PROCESS

3.3.1 Need for Planning

Teaching occupies the central core of your life as a teacher. The teaching includes instruction in classroom, tutorials, laboratory, workshop, and excursions etc. Teaching is a process involving teacher, students and a set of activities designed primarily to bring desirable changes in the behaviour of the students. It is a very important question whether you should plan for your teaching or you can do without it. The obvious answer to this is that planning is important. By planning, a teacher is able to emphasize the different aspects of the subject. Otherwise it is just possible that one aspect may be over emphasized and some other aspect may be just touched upon and another one may be completely ignored. You should plan your teaching work because:

- you can present material in a logical, systematic and effective way;
- you can obtain adequate coverage of the subject matter;
- you can achieve the instructional objectives in a stipulated time;
- you can achieve economy of time and effort;
- it helps in maximum development of children with minimum of resources;
- it fosters self-confidence and pride in our work.

3.3.2 Advantages of Planning

Planning is necessary for enabling the teacher (you) to organize and select science materials suitable for your teaching. Good planning has the following advantages.

- it facilitates verbal learning by the use of appropriate teaching aids and strategies of teaching;
- it provides opportunity for relating subject structure to teaching structure;
- it helps to plan varied learning activities catering to individual differences; and
- it brings orderliness and development in thinking about teaching; etc.

3.3.3 Strategies for Planning

Systematic planning of your teaching work require systematic organization of time in the institution. This could be done on long term and short term basis.

i) Long-term planning

At the beginning of the academic year, all teachers make a plan for organizing an year’s academic work. This long-term planning of time is more related to academic activities of a year’s work load in any educational institution. In other words, the teachers are required to formulate a course of action for carrying out instruction over a school year. The instructional activity is the basic unit of planning and action in the classroom spread over one academic year presents the total picture of planning. All teachers prepare their yearly plan and study the prescribed syllabus and text-books. The whole course is divided into units and the units into daily lessons. The yearly plan provides a fresh look to learning experiences to be arranged for pupils. We can categorize the topics and attribute the method of teaching and evaluation of learning. Apart from theory courses, teachers also plan for practical activities, projects and science exhibitions etc. In brief, one can say that a yearly plan is based on course purpose, course concepts, units, lessons and evaluation items.

ii) Short-term planning

In short term planning teachers are to be more concerned about the specific activities that they undertake in the classroom. This is actually what is meant by lesson plan at school level. It is essential for each of you as teachers, to organize the contents according to the time available to make the class a success. Selection of content is followed by organization of content to be completed within the prescribed time limit. This demands a structure for each class. As a science teacher you should learn the art of lesson planning. In the following section designing of lesson plans is presented in detail.
3.4 DESIGNS OF LESSON PLANNING

3.4.1 Defining a Lesson

The term lesson is interpreted in different ways by different people. Generally, teachers take it as a job to be covered in a class period which runs over 40-50 minutes or in two or three periods. A lesson is defined as a blueprint, a guide map, a plan for action in the near future. Lesson planning refers to sequencing of teaching acts or events or episode, that we plan, organize and carry out in order to generate a learning environment for our students.

N.L. Bosson in his "Teaching in Secondary Schools" proposes the following definition of a lesson plan:

'Lesson plan is the title given to a statement of all achievements to be realized and the specific means by which these are to be attained as a result of the activities engaged day to day under the guidance of the teacher.'

The Dictionary of Education defines a lesson plan as a teaching outline of the important points of a lesson arranged in the order in which they are to be presented, it may include objectives, questions to be asked, references to materials, evaluation, assignments, etc.

Now you must be clear in mind that lesson planning is a product of short term or micro level planning involving:

- identification of definite objectives;
- selection of appropriate content and activities;
- selection of procedures and methods for presentation of the content;
- selection of evaluation exercises; and
- selection of follow up activities; etc.

3.4.2 Approaches to Lesson Planning

There are various approaches to lesson planning. They are Herbartian approach, Unit approach, Evaluation approach and Project approach. A brief description is provided for your sensitization.

i) Herbartian approach is based on apperceptive mass theory of learning. The student is considered to be a clean slate and all the knowledge is to be given from outside. If new knowledge is based on old knowledge of the student (his previous knowledge or experiences), it may be acquired easily and retained for a longer period. Herbart has given five steps: introduction, presentation, organization, comparison and evaluation. The main focus is on content presentation.

ii) Unit approach of Morrison is based on unit planning and transaction. The plan of teaching is cyclic, Morrison has given five steps for his 'cycle phase' of teaching: exploration, presentation, assimilation, organization and recitation.

iii) Evaluation approach of B.S. Bloom consider education as objective centered rather than content centered. It takes into consideration the learning objectives, methods of providing learning experiences on the basis of the objectives and assessing learning outcomes.
Then, a decision can be taken about objectives of learning and these evidences may provide the basis for revision and improving the learning experiences. The focus in this approach is on objective based teaching and testing.

iv) Project approach originated by Dewey and W.H. Kilpatrick stresses on self activity, social activity and experiences of real life situations. It is also a pupil planned purposeful task accomplished in a social environment.

3.4.3 Factors Affecting Lesson Planning

There is no certainty that a lesson plan developed by a teacher for his/her use will be a success at every place and any time. The reason is simple. Many factors influence lesson planning such as

- location of the school
- size of the class
- age wise composition of the class
- availability of teaching aids.
- the nature of the topic etc.

This list is not exhaustive. You may add few other factors from your own experiences.

3.4.4 Writing the Lesson

There are various forms of written lesson plans used by practicing teachers. A teacher needs some information about the class, students and their background before he/she attempts to plan a lesson. Usually a lesson is divided into many stages or steps. When a detailed lesson plan is being developed, all these steps are used in some form or the other. In the above section we have given you an idea about some of the approaches of lesson planning. In this section we will help you to write your plans based on different approaches.

a) Herbartian approach

The steps of the Herbartian approach are given below:

i) General information regarding the subject, topic, class, age level of children, estimated time.

ii) Instructional Objectives

(a) General Objectives

(b) Specific Objectives

You are aware that different subjects at different grade levels have some general objectives whereas specific objectives are written in behavioural terms as they focus on the expected outcomes of our teaching the topic over a given period of time. These specific objectives, also known as instructional objectives must be measurable and observable. You are required to identify your behavioural objectives and state them in a clear and unambiguous language.

iii) Instructional aids

Select teaching aids which you think proper for clarifying the concepts to be taught: List all such teaching aids used in the form of charts, static or dynamic model, real specimens, etc.

iv) Testing of previous knowledge

Development of the lesson is based on the previous knowledge of your students. We have to assume the previous knowledge of students related to the content to be taught and test it through a single direct question.

v) Introduction

This step mainly concerns with introducing a topic through introductory questions or by creating the appropriate situation. The focus is on preparing our students to receive new knowledge by linking it with their previous knowledge.

vi) Presentation

Presentation comprises of the ways in which relevant content is presented. Most of the teachers develop their lesson with the help of developing questions and using students’ responses for
further presentation of the content. This presentation or development stage is interactive in the real classroom situation, it depends on teachers' communication skills and teaching skills like questioning, explaining, giving demonstration and providing reinforcement on desirable student behaviour.

vii) Recapitulation
Recapitulation of the lesson helps the teacher to find out the extent of learning that occurs during the period of instruction. It can be done by asking several questions. This stage provides feedback to the teacher about his/her teaching process.

viii) Black Board Summary
Teacher writes the summary of his teaching points and explanations. It is to be developed simultaneously when lesson is being developed.

ix) Home Assignment
At the end of the session, suitably and thought provoking questions or activities must be planned and given to the students. It gives a chance of repetition or practice to the students. It also gives an opportunity to them to assimilate, whatever they have learned.

(b) Evaluation approach
The design of lesson plan according to this approach consists of three aspects: (i) Input, (ii) Process and (iii) Output.

i) Input
It includes the identification of objectives in behavioral terms. They are known as Expected Behavioural Outcomes (EBOs). The entering behaviour of the learners are also identified. The sequence of instructional procedure is determined with the help of these instructional objectives. These objectives are broadly classified into four categories: knowledge, understanding, application and creativity. You have to write objectives in behavioural terms.

ii) Process
This is an interactive stage when you are actually in the classroom and communicating with your students. You have to select different teaching strategies, audio-visual support materials for effective presentation of the content.

iii) Output
This aspect of instructional procedure refer to real learning outcomes (RLOs). This is equivalent to terminal behaviour which are usually measured by using oral and written questions. Output aspect is concerned with evaluation of the desirable behavioural change among students.
3.5 ILLUSTRATION OF LESSON PLANNING

3.5.1 Format of Presentation

Effective teaching needs proper planning, transaction in the classroom and feedback. Practically there are three stages of a planned lesson: pre-active, interactive and post-active. Pre-active stage is a stage of planning before going to the classroom. The interactive stage is a stage of interaction between teacher and his/her students in the real classroom situation. Post active stage is a stage of self evaluation of our teaching work.

There cannot be a single format for writing a lesson plan because it varies from teacher to teacher and subject to subject, the only thing which can be suggested is that it should be a well-ordered structure which follows some basic fundamental parts of a lesson. Some of the formats based on different approaches to lesson planning discussed in Section 3.4.2 are suggested below for your guidance. You are free to make changes according to the objectives you plan to achieve and the nature of the subject etc.

(i) Herbartian Lesson Plan Format

Subject: Date:
Unit: School:
Topic: Class:
Duration: Period:

1. General Objectives:
2. Specific Objectives:
3. Teaching Aids:
4. Method:
5. Previous Knowledge:
6. Introduction:
7. Statement of the Topic/Aim:
8. Presentation or Development of the Lesson:

<table>
<thead>
<tr>
<th>Teaching Points</th>
<th>Teacher’s Activity</th>
<th>Students’ Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Objective</td>
<td>Teaching-Learning Activities</td>
</tr>
</tbody>
</table>

9. Recapitulation:
10. Black Board Summary:
11. Home Assignment:
12. Reference:

Note:

i) Order of S. No. 1 to 5 may be changed according to your needs.

ii) In presentation/development objectives, teaching-learning activities and evaluation are in relation to particular teaching point/content.

iii) If evaluation of students learning is done for each teaching act/episode, then you may ignore recapitulation at the fag end of the lesson.

iv) Black board summary should be developed as the lesson progresses.
### ii) Bloom's or Evaluation Lesson Plan Format

<table>
<thead>
<tr>
<th>Objective</th>
<th>Teaching Method &amp; Aids</th>
<th>Teacher's Activities</th>
<th>Students' Activities</th>
</tr>
</thead>
</table>

6. Evaluation:
7. Home Work:
8. References:

**Note**

i) The objectives are to be written in behavioural terms.

ii) The teaching activities are to be related to the learning structures.

iii) Black Board Summary should be developed as the lesson progresses.

### iii) RCEM Lesson Plan Format

<table>
<thead>
<tr>
<th>Expected Behavioural Outcomes (EBOs)</th>
<th>Sequential Learning Experiences/Activities (LEs)</th>
<th>Real Learning Outcomes (RLOs)</th>
</tr>
</thead>
</table>

7. Black Board Summary:
8. Home Assignment:
9. References:

**Note**

i) RCEM is Regional College of Education, Mysore.

ii) Concepts are to be identified through content analysis.

iii) Black Board Summary to be developed as the lesson progresses.
3.5.2 Characteristics of Lesson Plan

You may plan your lesson based on any format discussed above, but a good lesson plan must have the following characteristics:

i) it must be flexible;

ii) its contents are organized in the light of attainable objectives;

iii) it is rich with respect to students activities and evaluation exercises;

iv) it has link with the previous and future lesson;

v) it includes relevant home assignment and activities for students.

3.6 USE AND MANAGEMENT OF SCIENCE LABORATORY

3.6.1 Importance of Laboratory Work

Our teaching should be consistent with the nature and structure of the area or discipline being taught. The demonstrations, experiments, projects should be developed consistent with the nature and structure of science. Science is both a product (body of knowledge) and process (approaches of acquiring and refining of new knowledge). It is impossible to imagine teaching of science without practical work. We must accept that science teaching in our secondary schools emphasizes the product aspect of science. In other words it is based on providing knowledge of scientific facts, concepts, principles and broad generalizations. Seldom the students are given an opportunity to work in the laboratory as young scientists. They are restricted to do repetitive type of exercises in which they simply verify the already known knowledge.

No one will dispute that laboratory work should occupy a central position in any programme of science education. Through laboratory activity it is quite possible for you as a science teacher to realize the following process objectives of science teaching:

- development of scientific concepts and principles;
- improving the understanding of various methods and procedures of scientific inquiry;
- development of scientific attitudes, interest and appreciation;
- provide training in scientific method;
- designing and planning an activity in a scientific manner, etc.

3.6.2 Planning of Science Laboratory

To achieve these goals of laboratory teaching, the science laboratory of your school must be well equipped so that our students get first hand experiences through direct observations and experimentations. A good science laboratory has most of the following characteristics:

- space;
- provision of elements of flexibility for effective teacher demonstrations, individual and small group work;
- ample physical and material facilities;
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- ample storage facilities for chemicals and equipments;
- arrangement for good lighting and proper ventilation; and
- regular supply of water and gas etc.

But the science teachers of India cannot be very ambitious about their laboratories because of imperative need for economy. Their dire need is to establish functional laboratory. For this, you should keep in mind the following considerations for determining the total area of a science laboratory:

- number of pupils working at a time,
- minimum space necessary for comfortable work;
- need for ancillary accommodation for storage.

We propose a simple but convenient plan of a science laboratory for our secondary schools (see the layout plan). It has two demonstration rooms and one store-cum-preparation room. The two demonstration rooms can be converted into rooms for experimentation or for science club activities. Only the demonstration table has water taps and sinks. The chemicals and other materials are stored in the show cases built inside the walls. Other valuable equipments and hazardous chemicals are stored in the store room. Teachers can make improvement in this plan as and when more funds are available. You must remember that “a science lab is never so good that it needs no changes - or so bad that it must be abandoned as hopeless.”

3.6.3 Procurement and Maintenance of Laboratory Equipment

Every laboratory requires the procurement and maintenance of equipment. What is your basis of procuring laboratory equipment? Perhaps you will agree that it has considerations such as (i) budgetary provision, (ii) specification of needs of various experimental programmes and (iii) replacement of obsolete or unserviceable equipment.

An acceptable streamlined procedure is to be adopted for the procurement of the equipment. First of all you have to make the list of such equipments giving their precise specifications and their required quantity. This list will get the approval and sanction of your head of institution. Then the usual practice is to obtain tenders from manufacturing firms or wholesale/retail suppliers. The purchase order is usually placed with a concern which quotes the lowest price. In some states the Directorate of Education approves the names of firms or suppliers with which you may place the order for supply of your needed material or equipment. You must acquaint yourself with the procedure of procurement followed in your institution.

Maintenance of the procured equipment is equally important. The proper care and maintenance by subject teacher, laboratory assistant and students can increase the life span of an equipment.

3.6.4 Storage of Science Materials

The chemicals, equipments and other materials are expensive so they are to be placed with care in a store room. Expensive equipments and chemicals must be placed in the safe custody of laboratory incharge. The store-room must be spacious in size and have many shelves or compartments. There should be separate shelves for glass-ware, acids, chemicals, and other equipments. The items must be stocked in such a way that their quick issuing is possible.

3.6.5 Management of Safety

The science laboratory being a place of potential dangers, both teachers and students must be careful while engaging in laboratory activities. The freedom of the students in the laboratory has to be considerably restricted. It is important to train students in the use of laboratory equipment, fire extinguishers and first aid box. Hazardous chemicals must be placed beyond the reach of students. One must be aware of the following precautions while working in the laboratory:

- knowledge of the nature of material, especially chemicals, which require considerable care and caution;
- location of fire extinguishers, and fire exit;
- location of first aid box;
- location of master shut off controls of the lines for gas, water, electricity; etc.
3.7 LET US SUM UP

In this unit we have discussed the need for planning our curricular work for a class and subject on yearly and daily basis. Good planning helps us in smooth transaction of curricular materials to the learners in an effective way. We have also highlighted the various approaches to planning the lesson. A detailed attempt has been made to help you to design your own lesson plan by presenting different formats. In the last section of this unit we have discussed the management of science laboratory in which we have touched upon the broad aspects such as laboratory objectives and problems of procurement, maintenance and storing of equipments and other science materials in a safe way.

3.8 UNIT-END EXERCISES

1. You are a practising teacher in a school. Analyze and compare the different lesson plan formats presented in this unit, with regard to:
   a) extent of their relevance in teaching of science.
   b) extent of their suitability for child centred activities.
2. Choose a topic from your science syllabus and prepare a detailed lesson plan taking any one format of your choice.
3. Draw a layout of your school science laboratory and suggest improvements.

3.9 ANSWERS TO CHECK YOUR PROGRESS

1. The long term level planning helps a teacher to identify the activities to be undertaken by him/her in a year’s time whereas the short term level planning helps him/her to organize content and activities by anticipating the difficulties of a student for one period of class instruction.
2. The main focus in Herbartian approach is on the presentation of content whereas in evaluation approach the focus is on objectives of teaching.
3. Learning is accomplished with change in behaviour of the learner. The behaviour can be observed and measured. Hence classroom teaching objectives are written in behavioural terms.
4. a) flexibility
   b) proper linkage with the previous and future lesson.
5. a) It gives certain orientation or application of basic scientific theories to practical problems.
It improves the process of scientific inquiry.

6. a) Specification of needs of various experimental programmes.
   b) To replace obsolete materials and equipment.

3.10 SUGGESTED READINGS


