Farook Training College Innovative Academia (FTCIA)

# Online Collaborative Learning Project (OCLP)

## Pre-Edited Version of Study Materials.

(Chance for minor errors)

Farook Training College Innovative Academia (FTCIA)

# Online Collaborative Learning Project (OCLP)

## Project Team:

**Project Head: Dr. T. Mohamed Saleem. Principal**
**Project Director: Dr. K. Vijayakumari. Associate Professor**

**Associate Directors:**
**1. Dr. G. Manoj Praveen. Associate Professor.**
**2. Dr. Niranjana. KP. Assistant Professor**

**Student Directors:**
**Afrah B.Ed Natural Science**
**Anuraj B.Ed Social Science**
**Ranisha B.Ed Malayalam**
**Ayisha Jubna B.Ed Mathematics**
**Anjana B.Ed Physical Science**
**Rahma B.Ed English**

*The entire materials are prepared by the B.Ed students (2020-22) of Farook Training College, Calicut, Kerala.*

*It is expected that this will be a support for those who need simplified, concise but comprehensive study materials for their examination preparation. It is a smart footstep to self learning and peer learning.*

*A note of appreciation to all student teachers who are the workforce behind this great endeavor.*

Team OCLP

FTC

# Group Members

1. Anita James
2. Ishbana .K
3. Jumana Haseen .P
4. Mafeeda .P.K
5. Muhammed Hadi
6. Nusaibath .C.V
7. Ragi Babu
8. Rifa. T
9. Rohini Krishna .P.T
10. Ruby Mumthaz .P
11. Rushda. E.P
12. Shahna Sherin. T
13. Suneera Chukkan

EDU.05.11. THEORETICAL BASES OF TEACHING NATURAL SCIENCE

# Unit 1
# Introduction to science discipline

Jumana Haseen P
Ishbana K

# Science – its meaning, definitions and nature

- The term ‘science’ has been derived from the Latin word ‘scientia’ which means knowledge.
- Science is the systematized body of knowledge.
- It is the study or collection of knowledge in a logical and orderly fashion, and its interpretation.

## Definitions of science

- “Science is trained and organized common sense” – Huxley
- “Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring and refining knowledge” – Fitzpatrick
- “An interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation and are fruitful of further experimentation and observation” – James B. Conant

# Nature of science

- The nature of science can be understood on the basis of three basic principles
    - Science is a body of knowledge
    - Science is a method of enquiry, a way of investigation
    - Science is an attitude towards life

    The nature of science includes concepts, processes and social aspects of science

# Cont…

- Some educators and philosophers have explained the nature of science in three parts, such as:
    - Substantive nature – it describes the knowledge, concepts and conceptual schemes of science which includes definitions, knowledge statement, etc
    - Syntactical structure of science – it includes processes of science such as observation, measurement, classification, drawing inferences, prediction, experimentation, developing hypothesis, using numbers etc.
    - Social perspective of science – aspects which show the relationship of science, technology and society. .

# Science as a product

- Whatever the information or ideas we acquire through various processes of science
- The basic components of the product of science are facts, concepts, principles, theories and laws.
- Still due to the dynamic nature of science, scientific information is constantly being rearranged and reoriented in the light of new knowledge.

# Science as a process

- In science, the ways of gathering information, thinking, measuring, problem solving are called processes of science.
- Basic processes of Science are observation, comparison. Classification, communication, measurement, estimation and prediction.
- The abilities of prediction, explanation and generalisation together form the process of making inferences.
- Sharp observation will lead to sound and accurate knowledge.
- The quality of knowledge acquired in science depends on the quality of process skills applied.

# Cont…

- The various processes of science can be classified into five categories.
    - Collection of data
    - Analysis of data
    - Synthesis of data
    - Evaluation of data
    - Application of generalisations to new situations

# Science as an ongoing process of enquiry

- Science is an ongoing process of enquiry that involves asking questions, observing, making inferences and testing hypothesis.
- Science is continually refining and expanding our knowledge.
- It leads to new questions for future investigation. Science will never be finished.
- The product of science are derived from process and these products lead to further process.
- Thus science is a continuous search for new knowledge through continuous enquiry.

# Cont…

- Both basic process skills and integrated skills are required for understanding the process of science.
- Integrated process skills include identifying and controllingvariables, defining operationally, forming hypotheses, experimenting, tabulating and graphing, interpreting data, testing hypotheses and drawing conclusions.
- “To learn science is to do science, there is no other way of learning science” – Dr. D.S. Kothari

# Importance of science as a school subject.

- Science education in schools serves three main purposes;
  - It prepares students to study science at higher levels of education.
  - It prepares students to enter the workforce, pursue occupations, and take up careers.
  - It prepares students to become more scientifically literate citizens.

# Cont…

- It gives an essential background of knowledge for cultural development. It expands the pupils knowledge of the universe and its position in it; it helps in the appreciation and enjoyment of nature and life.
- It gives many opportunities to foster the scientific method and discipline, since it traines to observe and think clearly, critically.
- It stresses the need to appreciate the meaning of scientific life, spirit and endeavour – open mindedness, intelluctual honesty, self sacrifice.
- It helps the pupil to develop a logical mind, critical judgement and a capacity for methodicalorganization.

# Scientific method

- The method or procedure adopted by scientists in their investigations of natural phenomena, the way in which scientific generalisations are arrived at and made use of is called Scientific method.
- It is a systematic and orderly method of solving problems.
- The scientific method involves following steps; Sensing the problem, defining the problem, proposing a tentative solution, collection of data, organising data, deducing conclusions.

# Steps of scientific method

1. Sensing the problem : A problem is a felt difficulty. And a problem always arise out of a situation. A problem is felt only when one gets involved.
2. Defining the problem : In this step one defines his problem in a concise, definite and clear language. This provides some well defined direction to the problem that could be completedwithin the time limit. Stating the problem or wording it is also an important aspect at this stage.
3. Proposing a tentative solution : Here some intelluctual guess works are made . Through analysis and synthesis, methodical inference and imagination, several hypotheses are made.

# Cont…

4. Collection of data : Depending upon the nature of the problem, one can gather the data using different methods. Collection of specimen, survey or experimentation may be done to collect relevant data. Field trip, reference from books and internet and conducting interview with the experts are also required. This is a crucial and time consuming step.
5. Organising data : The collected data is subjected to various treatments. This includes drawings, preparation of charts, tables and graph.
6. Deducing conclusion : at this stage, one should apply intelligence, reflective thinking, and critical thinking to draw conclusions. The data become meaningful when interpreted in the light of the stated objectives.

## SCIENTIFIC ATTITUDE

- Condition of mind generating emotional states.
- Can be created by studying science.
- Is a pre- requisite for science study.
- Does not necessarily imply interest in scientific activities.

## SCIENTIFIC APTITUDE

- Inherent ability
- Can not be created
- Even if there is no aptitude, you can teach science to an average level.
- Implies interest in science activities.

# LANDMARKS IN THE DEVELOPMENT OF SCIENCE EDUCATION (INDIA)

Pre independent Period:-

- Ancient period
- Medieval period
- Modern period - Commissions before independence

Post independent Period – Commissions after independence

# Ancient period

- India made pioneer headway in science till 600 A.D
- Oldest Indian scripture- Rigveda(4000years ago) refers to physician-speaks healing power of medicine.
- Upanishads Vaisheshika discuss the concept of atom and formation of world.
- The sankya phylosophy by Kapila - similar to Darwinism.
- Upaveda or secondary vedas discuss science
- Ayurveda consists 6 books on surgery Nosology, anatomy, therapeutics , toxicology and supplementary section.
- The materia medica – vast collection of drugs- adopted by western physicians.
- Due to knowledge centered round individuals lost most of the scientific knowledge and traditions.

# Medieval period

- Next stage of development not happened.
- Philosophy of buddhism discouraged development of life science.
- Rules of cast become stronger.
- Gradual conquest of country by invaders.
- They bought many scientific ideas in India origin.

# Modern period

- Bring another break in scientific thought and tradition with the conquest of British.
- Experimentation developed as a technique for acquiring information.
- At these time,- language of science got a definite shape.- institutions developed, growth of technology
- But the development of science not made a significant role in India ,because :- not an organic extension of earlier traditions- but it is an implant by British in an alien language

## During British rule

- British government took various steps to improve level of education
- Establishment of a Commission known as Royal Commission of Education.
- Report- very few schools taught science as an independent subject.
- Before 1813, there were several initiatives had taken place in non-formal

## Important commission in the field of science education are:

- The charter act of 1813
- Mount stuart elphinstone’s minutes on education 1823
- The lord Macaulay minutes 1835
- Lord Curson’s education policy 1904
- The Sadler (Calcutta) university commission (1917-19)
- Sargent Plan on Education

## Post independence period

### MUDALIAR COMMISSION

- The secondary education commission
- Chairman Dr. Lakshman Swami Mudaliar
- Aim was to examine the existing system of secondary education in the country, to suggest measures to improve it.
- Submitted its report in august 1953 on almost all aspects of secondary education.

# KOTHARI COMMISION

- National education commission
- Formed on 14 July 1964
- Chairman Daulat singh kothari
- The authorization felt a need of drastic reconstruction in Indian education.

# ISHWARBHAI PATEL COMMISSION(1977)

- Chairmanship of Ishwarbhai Patel(1977) recommended that science at the secondary stage (8-10) should be offered through two equivalent alternate courses : Course A and Course B.
- Course B – composite course in science to be taught through a single textbook.
- Course A recommended a discipline orientated approach in which physics, chemistry and biology were to be taught as separate subjects.

## NATIONAL POLICY ON EDUCATION(NPE-1968)

- First education policy of independent India.
- Formulated on the recommendation of Kothari commissionn
- First attempt of the country to give some direction to the country's education system.
- Its recommendation in respect to science

  i .Science and math are incorporated as compulsory subjects till the end of the school subjects.

  ii. Science education and research should be given high priority with a view to accelerate the growth of the national economy.

# National policy on education (NPE-1986)

- NPE 1986 marked a significant step in the history of education in Post Independence India.
- Adopted by Parliament in May 1986.
- Introduced by Prime Minister Rajiv Gandhi.
- Named as " special emphasis on the removal of disparities and to equalize education opportunity.
- Aimed to promote national progress, a sense of common citizenship and culture and to strengthen national integration.
- Laid stress on the need for radical reconstruction of the education system, to improve its quality at all stages and gave much greater attention to "Science and Technology" , the cultivation of moral values and a closer relation between education and the life of the people is the aim of NPE 1986.

## National education policy (NEP 2020)

- Ambitious policy by Narendra modi government
- K. Kasturirangan is the head of the committee for creating anew education policy for India.
- Recommendations in respect to science
- Science will be introduced at middle stage only laying a solid foundation through interactive classroom learning in the earlier stage.
- Science curriculum will be reduced to make space for critical thinking, discovery based, inquiry based, discussion based learning .
- There will be no rigid separations between arts and sciences.eg: mix and match physics with history
- Department of applied science will be introduced in all higher education institution.

# NATIONAL CURRICULUM FRAMEWORK
# NCF -2005

- By NCERT
- Chairman Prof. Yash pal , assisted by 21 focus groups.
- Country wide agenda for activated school education
- It provides the framework for making syllabus, text books and teaching practices in India
- Good science education is true to the child, true to life and true to science

## BASIC CRITERIA OF VALIDITY OF A SCIENCE CURRICULUM

- 1) Cognitive validity
- 2) Process validity
- 3) Historical validity
- 4) Environmental validity
- 5) Ethical validity

## The Curriculum At Different Stages

### Primary stage

- To nurture the curiosity of the child about the world
- To have the child engage in exploratory and hands on activities for acquiring the basic cognitive and psycho motive skills through observation, classification , inference

### Upper primary stage

- Child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and module
- Scientific concepts are to be arrived at mainly from activity, survey and experiments
- Group activities, discussions with peers and teachers, organization of data and their display through exhibitions in school should be important components of pedagogy
- There should be continuous as well as periodic assessments

## Secondary stage

- Students should engage in learning science as a composite discipline
- Analyzing on issues concerning the environment and health including reproductive and sexual health
- Systematic experimentation and working on locally significant project involving science and technology

## Higher secondary stage

- Science should be introduced as separate disciplines with emphasis on experiments or technology and problem solving

# KERALA CURRICULUM FRAMEWORK (KCF)-2007

- NCF 2005 and the positive papers provided grounds for introspection and formulation of the KCF-2007
- Kerala's effort to develop a curriculum framework is a turning point in the history of the state.

## Aim of science education as in KCF,2007

- Development of scientific temperament and its application in daily life
- Engagement in scientific methods like observation, experimentation, data collection, interpretation of data ,analysis, theorizing, examining for construction of knowledge
- Nurturing lateral thinking ability
- Developing scientific literacy

# 2 Mark Questions

1. Define hypothesis
2. List out any two disadvantages of process and product approach
3. Comment on teaching science by process approach
4. Write down any four objectives of teaching natural science with respect to KCF 2007
5. Write down any four objectives of teaching natural science with respect to NCF 2005

# 4 Mark Short Essays

1. What are the values that can be inculcated among students through the teaching of Natural science? Explain.
2. Briefly explain the product and process aspects of Science.
3. What do you mean by nature of science?
4. How is life science useful for human welfare?
5. Justify the concept ‘science is as scientist does’?
6. Describe the method , which was used by scientists to explore new knowledge.
7. List out the process skills in Biology. Explain how you would develop these skills in students?
8. How will you develop scientific attitude in your students
9. Mention the qualities of a person with scientific attitude

# 10 Mark Essays

1. Explain the different steps involved in scientific method. Also mention how this method helps nurturing process skills?
2. Citing a suitable example, enumerate the steps in scientific method and its significance in the teaching of Biological science.

EDU.05.11. THEORETICAL BASES OF TEACHING NATURAL SCIENCE

# UNIT 2

# MICROTEACHING AND MODELS OF TEACHING

MAFEEDA. P.K
MUHAMMED HADI

# MICROTEACHING

## Meaning

- First adopted at stanford University, USA in 1961 by Dwight W.Allen.
- It is a scaled down sample of teaching in which a teacher teaches a small unit to a small group of 5-10 pupils for a small period of 5 to 10 minute

## Definition

- Micro teaching is defined as " scaled down teaching encounter in a class size and class time"(Allen).

- Also defined as " a teaching training procedure which reduces reduces teaching situation to simpler and more controlled encounter in achieved by limitingthe practice teaching to a specific skill and reducing teaching time and class size ".

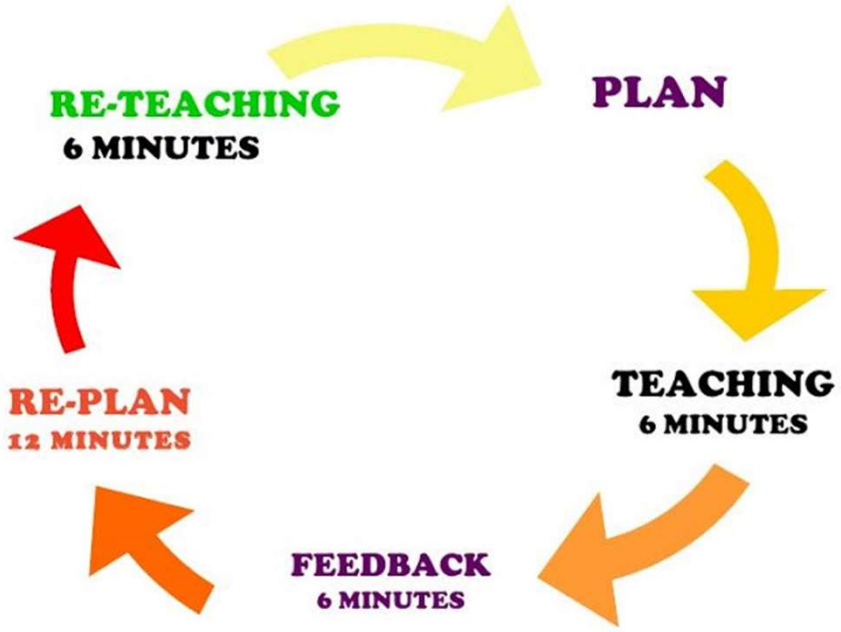
## OBJECTIVES

1. To enable teacher- trainees to learn and assimilate new teaching skills under controlled conditions
2. To enable teacher-trainees to gain confidence in teaching and to master a number of skills by dealing with a small group of pupils.

## CHARACTERISTICS

1. It is a scaled down teaching.
2. It is less com complex than regular teaching.
3. It involves lesser number of students - 5 to 10.
4. Its duration is short - about 5 to 10 minutes.

# MICROTEACHING CYCLE



## Microteaching procedure

Involves 3 phrases

**1.knowlege acquisition phase**

observe the demonstration of skill by teacher . analyze and discussion about the demonstration

**2.skill acquisition phase**

Prepare microlesson and practicing

**3.transfer phase**

Evaluating performance of trainee through feedback and transfer of skill to actual class teaching in macro sessions.

## ADVANTAGES

1. It focuses on sharpening and development of teaching skills and eliminating skills
2. It enables understanding of behavior in class room
3. Increase confidence of leaner teacher
4. It is a vehicle of continuous training for both beginners and senior teachers
5. It provides experts supervision and constructive feedback

## DISADVANTAGES

1. Skill oriented
2. Special class room setting reqrequired
3. Only few specific skills are covered
4. Time consuming
5. Many administrative problem arising while arranging microlessons

## Link practice

- Bridging gap between microteaching and macro teaching
- Integrating many skills
- 20students ,20 minutes

# TEACHING SKILLS IN SCIENCE

- Teaching skills are set of related overt behavior of teacher which are observable, measurable, demonstrable and refinable through practice.
- Teacher uses Teaching skills in pre instructional, instructional and post instructional stages

  for achieving predetermined specific objectives.

B.K.passi has given following list of 13 teaching skills

1. writing instructional objectives.
2. introducing
3. Fluency in questioning.
4. probing questioning.
5. Explaing.
6. illustrating with examples.
7. stimulus variation
8. reinfircement
9. silence and non- verbal cues.
10. increasing pupil participation.
11. recognising attending behaviour.
12. using blackboard.
13. achieving closure.

8 CORE SKILL+ 5COMLEMENTARY SKILL

# 8 CORE TEACHING SKILL

- Skills are extensively used in routine teaching by all teachers.

1.skill of introducing a lesson
2 .skill of stimulus variation
3 .skill of explaining
4.skill of illustrating with examples
5.skill of using black board
6.skill of probing questions
7.skill of questioning
8.skill 0f reinforcement

## Skill of introducing a lesson

- Introduction must be interesting so as to absorb the student attention into lesson inspiteof individual difference.
- Two main functions namely refreshing and ensuring the prerequisite and motivating the pupils to learn the new lesson.

## Components of the skill

Desirable Behaviors

1.use of previous knowledge

2.use of appropriate devices

Undesirable Behaviors

1.lack of continuity

2.uttering irrelevant statements and question's

## Skill of stimulus variation

- Master skill
- Most important skill used to hold the attention of the class, it is the use of various attention catching behaviors in order to sustain interest and attention of students.
- 7 component skills

**1.Teacher gestures**

Gestures are the movements of parts of body used for expressing emotions, size, shape, direction etc and also for directing attention.

**2.Teacher movements**

Meaningful, purposeful movements with a pedagogical function.

**3.change in speech pattern( voice modulation)**

The intensity and pitch of voice and speed of speech can be modulated to express different types of feelings and emotions by bringing appropriate variation or change in the tone volume, pitch etc.

**5.change interaction style ( physical involvement)**

Teacher - class interaction

Teacher- pupil interaction

Pupil - pupil interaction ( peer group interaction)

6.**Focussing**

It refers to the behaviors that help in focusing pupils attention on a particular object, word, idea etc.

**7.pausing**

Deliberate use of silence during talk.

A pause of approximately 3 second regarded as quit effective in securing and sustaining pupil attention. Sustaining people attention.

Pause when focusing on important factors after which voice modulation is required.

**8.oral visual switching**

Change in the sense channels or perception channels.

Eg. *oral to visual *visual to visual

*Visual to oral* oral to oral

## SKILL OF EXPLAINING

- Factors contribute to effectiveness of skill of explanation are
    1. Continuity : in actions, verbal, behaviors and writing.
    2. Fluency : depends upon the mastery of the subject matter
    3. Simplicity
    4. Explicitness (clarity/ openness)

One indication about the vagueness of explanation is the unnecessary use phrases such as " you know that" ," of course "," well known" etc.

## Components of skill

Desirable Behaviors

1.use of beginning statements

Purpose is to prepare the minds of
To receive the new idea and giving them
Some clues of explanation.

2.use of explaining links.

Words or phrases which increase effectiveness of explanation. They bring continuity in statements.

3.use of Mediators

Use of various teaching aids to make explanation effective and meaningful.

Eg .charts, diagrams, anecdotes etc.

4.use of concluding statements

At end of explanation to summarize and conclude and gives a consolidated picture of what has been explained.

5 .questions to test pupils understanding

In the course of explanation, frequently ask some questions which will help the teacher get immediate feedback from students.

6.covering essential points

ensure that all essential points included I lesson plan conveyed in class room.

## Undesirable Behaviors

1.use of irrelevant statements
2.lack of fluency
3.lack of continuity
4.using inappropriate vocabulary
5.use of vague word and phrases
6.deviating from the main points

# Skill of illustrating with examples

Skill for timely use of examples for the purpose of making an idea, concept or principle lucid .

A good illustrative example will also engage the pupils attention.

**Components of skill**

**1.formulating simple examples**

Eg familiar to pupils and hence helpful for easy assimilation.

**2.formulating relevant examples**

Relevant to item being taught

**3.formulating interesting examples**

Can arouse curiosity and interest

**4.use of appropriate media for examples**

Verbal and non verbal media

May be storytelling, poems, songs, analogy, objects ,maps ,pictures models, experimental demonstration, dissection.

**5.use of inductive and deductive approach for examples.**

Rules are formulated from specific examples and then pupil cited examples for the rule.

## SKILL OF USING BLACKBOARD

- Most widely used visual aid
- One of the quickest and easiest means of illustrating an important point.
- Matter once written on the black board can be erased easily and new materials added as lesson progresses.

# Components of skill

## 1.Legibility of handwriting

Maximum ease in reading what is written on the black board even for students sitting on the back bench should be ensured.

### Subcomponents

a. distinct difference between letters
b. adequate spacing between letters
c. adequate spacing between words
d. slant of the letter nearly vertical
e. all small letters of the same size

f. all capital letters of same size
g. size of the letters large enough to be read
h. thickness of the line

2.Neatness in black board work

a. adequate spacing between lines
b. lines parallel to the base of the board.
c.no overwriting
d. focusing the relevant matter

3.Organisation of black board work

a. systematic planning space
b. spacing to exhibit the sequence of the items being presented
c. adjustment of space for presenting related items totality

4.appropriateness of back board work

a) continuity in points
b) points brief
c) appropriate presentation of illustrations and diagrams.
d) proper use of colur chalk.
e) underlining only the important points to be stressed

# Skill of fluency in questions

Components of skill

**1.structure**

a. grammatical correctness and lucidity

b. conciseness

Question should be direct,avoiding unnecessary words

c. relevance

relevant to content and context

d .specificity

## 2.process

- speed

  Should not be unnecessarily slow speed or too fast

- voice

  Audible and clear

- pause

  Pause After questions help students to understand and think and formulate answer

- style.

  Should be asked in properly modulated and pleasant tone and in a friendly manner so that the pupils would not become nervous and hesitant

## 3.product

# Skill of probing questions

Skill required in applying the technique of effectively dealing with students responses for going deep into their knowledge.

## Components of skill

### 1.prompting

Use of cues or hints provided by teachers under conditions like no response, incorrect response, partial response or incomplete response

### 2.seeking further information

technique of getting additional information from pupil to bring completely correct response level

**3.refocussing**

when Pupil give correct response, the teacher relates their responses with something already taught.

**4.increasing critical awareness**

Teacher asks ' why ' and 'how' of a correct Response

**5.redirection**

Asking same question to another pupil for increasing pupil participation

## SKILL OF REINFORCEMENT

- Belongs to area of psychology
- Appropriate use of reinforcement enhances the positive behavior in classroom.
- Positive reinforcement

  a stimulus which strengthens a behavior
- Negative reinforcement

  it is a stimulus whose withdrawal strengthens a behavior

## Component skills

1. Use of positive verbal reinforcement
2. Repeating, rephrasing and summarizing pupil responses.
3. Use of positive extra verbal reinforcement
4. Use of positive non verbal cues
5. Use of gestures and other body language like patting, looking into eyes, turning ears, moving towards the responding pupil.

# MEANING OF MODELS OF TEACHING

- **JOYCE and WELL (1972:2):** Teaching models are just instructional designs. They describe the process of specifying and producing particular environmental situations which cause the student to interact in such a way that specific change occurs in his behavior
- The definition considers models as instructional design
- Suggest the ways and techniques of creating a favorable environmental condition for carrying out the teaching process
- They help in achieving desirable teacher-pupil interaction during teaching and form favourable changes in pupils behaviour
- **JAYCE and WELL (1972:3)**: Teaching model is a “pattern or plan” which can be used to shape a curriculum or course, to select instructional materials and to guide a teachers action.
- Patterns or plans prepared in advance for the successful construction of curriculum, selection of instructional material and utilisation of appropriate teaching techniques
- **PAUL D. EGGEN, ET AL. (1979:12)**: Models are prescriptive teaching strategies designed to accomplish particular instructional goals.
- This definition views models in terms of some specific teaching strategies aimed at the realisation of the set objectives.

# CHARACTERISTICS OF MODELS OF TEACHING

- Models of teaching are some sort of pattern or plans prepared in advance for the success of the teaching learning process.
- They differ from general teaching techniques and strategies in the sense that they are designed to meet specific objectives or goals.
- Models of teaching specify in definite terms the environmental conditions under which a students response should be observed.
- Gives specific instructional design for particular type of instruction in specified teaching-learning situation.
- Provide systematic procedure and organized efforts for the desirable modification of the behavior of the learners.
- They first specify the teaching or learning outcomes in behavioral terms and then lay down a step by step procedure for the attainment of these outcomes.
- Models of teaching specify the criteria of acceptable performance expected from the students
- Save the energy, time and efforts of the teacher and the learners besides providing economy to the best utilization of the other teaching learning resources.

# FUNCTIONS OF MODELS OF TEACHING

- Designing of curriculum or course of study
- Development and selection of instructional materials
- Guiding the teachers activities in the teaching learning situation
- Bringing desired outcomes or behavioural changes in the learner
- Creating proper environment for teaching and learning

# FAMILIES OF MODELS OF TEACHING

- Joys and Wells(1980) classified 24 models into 4 families

1. Information processing family
2. Personal development family
3. Social interaction family
4. Behaviour modification family

## Information Processing Family

- These model share an orientation towards the information and processing capability of the learners and the ways they can improve their ability to master information
- The teaching models in this family emphasize peoples' desires to make sense of the world by gathering and organizing data, determining problems, and finding solutions
- Helps the learner to seek and master information, organize them and build and test hypothesis

# INFORMATION PROCESSING MODELS

| MODELS | EXPONENT | GOALS/MISSIONS |
|---|---|---|
| Concept Attainment Model | Jerome S. Bruner | Designed to develop inductive reasoning and concept development and analysis |
| Inductive Thinking Model | Hilda Taba | Designed primarly for the development of inductive mental process and academic reasoning or theory building |
| Inquiry training Model | Richard Suchman | Training in systematic inquiry |
| Advance Organizer Model David | David Ausubel | Designed to increase the efficiency of information processing capability of the learner |
| Biological Science Inquiry Model | Joseph. J. Schwab | Designed to teach the research system of discipline |
| Cognitive Development Model | Jean Piaget , Kohl Berg, Siegal | Designed to increase general intellectual development and logical reasoning |
| Memory Model | Henry Lorayne | Designed to increase the capacity of memorisation |

## Personal Development Family

- Members of this family share an orientation towards the development of self hood and so is more concerned with human feelings and emotions
- The models placed in this family guide students toward greater mental and emotional health by improving students' awareness of self and raising their self-confidence
- In the Personal development Family, there is a belief that education should stem from the needs of the student.

| MODEL | EXPONENT | GOAL/MISSION |
|---|---|---|
| Non directive Teaching Model | Carl Rogers | Designed for personal development in terms of self-awareness self understanding, and self concept autonomy |
| Synectics Model | Bill Gorden | Creativity and creative problem solving |
| Awareness Training Model | Fritz Pearls | To develop ones self awareness and self-exploration |
| Classroom Meeting Model | William Glasser | Development of self understanding and responsibility to ones' self, ones' in social group. |

## Social Interaction Family

- Deals with relationships of the individual with the society.
- Interaction with others is a key element.
- They stress the development of social skills which help the Individual to engage In democratic processes and to work productively in the society

| MODEL | EXPON | GOAL/MISSION |
|---|---|---|
| Group Investigation | John Dewey and Herbert Thelen | Designed for the development of social skills, ie., skill for parti-cipation in social democratic process. |
| Role-playing Model | Frannie Shaftel | To help the students to inquire about personal and social values. |
| Jurisprudential Inquiry Model | Donald Oliver and James P. Shaver | Designed to teach the Jurisprudential frame of reference as a way of thinking about and resolving social issues. |
| Laboratory Method Model of National Training Laboratory | Bethel, Maine | Designed for the development of interpersonal and socialgroup skills. |
| Social simulation Model | Sarene Borock, Harold Guitzknow | Designed to motivate the students to examine their own reactions towards various social issues |
| Social-inquiry Model | Byron Massials and Benjamin Cox | Designed for the development of social problem solving skills |

- Behaviour Modification Family: The emphasis is on changing the visible behaviour of the learner rather than the underlying psychological structure and unobservable behaviour

| MODELS | EXPONENT | GOALS/MISSIONS |
|---|---|---|
| Relaxation Model | Rimm and Master | Designed for the reduction of stress. |
| Anxiety Reduction Model | Rimm and Masters | Designed for the substitution of anxiety in social situations. |
| Assertive Training Model | Lazarus, Wolpe, Salter | Designed for the development of direct and spontaneous expression of feelings in social situations. |
| Direct Training Model | Gagne, Smith and Smith | Designed for the development of behaviour and social skill among the learners. |
| Managing Behaviour Model | B.F. Skinner | Designed for the development of social behavioural skill. |
| Self Control Model | B.F. Skinner | Social behavioral and skills. |
| Desensitization Model | Wolpe | Designed for the removal of the fear response of a phobia and substitute a relaxation response ae to the conditional stimulus gradually using counter conditioning. |

# ELEMENTS OF A MODEL

- **Focus**: Focus is simply the goal or objective of teaching. The teaching activities/ teaching-learrmlg process are oriented to achieve some goals. It descnbes the aspects of the environment which are most important in the life of the student.
- **Syntax**: It is described in terms of sequences of activities which are called phases. Each model has a distinct flow of phases.
- **Social system**:The social system provides a description of the student and teacher roles and relationship and the kind of norms that are encouraged. The leadership role of teacher varies greatly from model to model. The models are varied from one another on the basis of its social system such as highly structured, moderately/semi structured and unstructured.
- **Principles of Reaction**: Principles of reaction guide the teachers response to the learner, they tell the teacher how to regard the learner and respond to what he does. In some models the teacher overtly tries to shape the behaviour of the students by warding certain students activities and maintaimng a neutral stance towards others. Principles of reaction provide the teacher with rules of the thumb by which to “tune in” to the student and select an appropriate response to what students does.
- **Support system**: This refers to additional reguirements beyond the usual human Skills of capacities and technical facilities necessary to impliment a model
- **Instructional and Nurturant Effects**: The descriptions of the effects of a model are categorised as the direct or instructional effects. The indirect or nurturant effects. come from experiencing the environment created by the model.

# CONCEPT ATTAINMENT MODEL

- **Concept** : A mental representation / mental picture of some object or experience.
  The elements of a concept are :

  1)**Name or label** : Word that describes a concept for communication

  2)**Attribute (Essential & Non essential)**: They are features or characteristics on the basis of which a number of items could be categorised into a particular group or class that represents the concept. A few of these will be essential and others not so( non essential)

  3)**Attribute value**: Each attribute have it's value range

  4)**Exemplars (Positive & Negative)**: Exemplars are instances (or items) that could be observed and studied in the process of categorisation. These may include items that are positive examples that obey all the essential cues used for categorisation leading to the concept as well as negative items that do not satisfy all the cues of a positive example but are needed for making the grouping meaningful and definite rule or definition

## Continuation..

- Jerome S Bruner is the exponent of this model.
- This model belongs to information processing family of models, designed primarily to develop inductive reasoning but also for concept development analysis.
- Concept attainment is “the search for and listing of attributes that can be used to distinguish exemplars from non exemplars of various categories.”(Bruner,Goodnow, and Austin).
- Concept attainment requires a student to figure out the attributes of a category that is already formed in another person’s mind by comparing and contrasting examples that contain the characteristic of the concept with examples that do not contain those attributes. To create such lessons teacher needs to have their category clearly in mind.
- In Concept attainment the first step is categorisation through observation, atttribute analysis and hypothesis formation and verification is done by the learner with the help of somebody who can guide him properly.
- Concept formation  is the basis of the inductive model and requires the students to decide the basis on which they will build categories.
- In concept formation the tasks are done by the individual on his own and hence often a learner makes as many classes as he could imagine from among a pool of items. Then each group is defined in terms of cues or attributes with the help of the teacher.

## Focus

- The main objective of this model is to develop students' inductive reasoning.
- To provide students the knowledge about the nature of concepts so they can gain the efficiency to categorize the objects on the basis of their qualities and their characteristics.
- To make students able so that right concepts can be developed in them
- To develop specific concepts in students.
- To develop strategies related to thinking in students.

## Syntax

Phase 1 : Presentation of data and identification of concept

- Teacher presents labeled examples
- Students compare attributes in positive and negative examples
- Students generate and test hypotheses
- Students state a definition according to the essential attributes

Phase 2 : Testing attainment of the concept

- Students identify additional unlabelled examples as yes or no
- Teacher confirms hypotheses, names concept, and the restates deiinitions according to essential attributes
- Students generate examples

Phase 3 : Analysis of thinking strategies

- Students describe thoughts Students discuss role of hypotheses and attributes
- Students discuss type and no. of hypotheses

## Social System

- Prior to teaching with the concept attainment model the teacher chooses the concept, selects and organizes the material into positive and negative examples and sequences the examples.
- When using the concept attainment model, the teacher acts as a recorder, keeping track of the hypotheses as they are mentioned and of the attributes.
- The teacher also supplies additional examples as needed.
- The three major functions of the teacher during concept attainment activity are to record, prompt, and present additional data.

## Principles of Reaction

- During the flow of the lesson, the teacher needs to be supportive of the students hypotheses emphasizing, however, that they are hypothetical in nature and to create a dialogue in which students test their hypotheses against each other.
- The teacher acts as a guide, motivator, facilitator
- He supports the pupil's hypotheses and creates an atmosphere of meaningful dialogue.
- Again becomes supportive at the final phase. Encourages different strategies.

## Support System

- Concept attainment lessons require that positive and negative examplars to be presented to the students. When students are presented with an example, they describe its characteristics which can be recorded.
- The success of a lesson for concept attainment depends up on presentation of appropriate examples/non examples.

## Instructional effects:

- Getting clear notions about nature of concepts.
- Developing skills in using appropriate concept-building strategies.
- Attaining the specific concepts.
- Develops skills in inductive reasoning.

## Nurturant effects:

- Sensitivity to logical reasoning
- Tolerance of ambiguity and initial errors
- A sense of using alternative perspectives

# INQUIRY TRAINING MODEL

- This model was designed by Richard Suchman to teach students to engage in casual reasoning and to become more fluent and precise in asking questions, building concepts and hypotheses, and testing them.
- Inquiry learning provides opportunities for students to experience and acquire processes through which they can gather information about the world.
- This requires a high level of interaction among the learner, the teacher, area of study, available resources, and the learning environment, students become actively involved in the learning process as they:

1. Act upon their curiosity and interests
2. Develop questions
3. Think their way through controversies or dilemmas
4. Look at problems analytically
5. Inquire into their preconceptions and what they already know
6. Develop, clarify and test hypotheses
7. Draw inferences and generate possible solutions.

## ASSUMPTIONS OF THE MODEL

- All knowledge is tentative
- Most of the problems are amenable to several equally plausible explanations. There is no one particular answer to a problem
- Inquiry is natural. All of us often inquire when confronted with a problematic situation or puzzle
- An individual can be made amenable to the process of inquiry. He can be made to learn to analyse his thinking strategies
- In addition to what is already known to an individual, he may be taught the new strategies to enquire and explore things
- The inquiry process is a co-operative effort. It is always facilitated by the ‘give and take’ of ideas.

## Focus

- The inquiry training model has following goals.
- To enhance the thinking ability of the student.
- To enable them to form conclusions based on facts.
- To enable them to have fluency in their thinking and speaking.
- More specialty to impart training of inquiry skills.

## Syntax

Phase 1 : Encounter with the Problem

- Teacher explains Inquiry Procedures
- Teacher presents Discrepant Event

Phase 2 :Data Gathering

- Learners verify the nature of objects and conditions
- Learners verify the occurence of the problem situation

Phase 3 : Data Gathering: Experimentation

- Learners with the help of the teacher search for related data and Isolate relevant ones with a view to find out relations
- Learners hypothesize (and test) causal relationships

Phase 4: Formation of Expectation

- Learners formulate rules or explanations as solution to the descripant event

Phase 5 : Analysis of the Inquiry Process

- Analyse Inquiry strategy and develop more effective ones

## Social System

- The success of this model depends on mutual cooperation between teacher and the student
- Teacher and students, however participate as equals where exchange of ideas is concerned

In this model, the teacher has a large number of tasks to perform. These are

- Acts as refree in the inquiry
- Responds to students inquiry
- Probes with necessary information
  Helps beginners to focus on the inquiry process
- Acts as a recorder, keeps track of inquiry by recording theories and types of questions on the black board
- Helps students to arrive at explanations.
  Inquiry Training Model emphasises group activity
- This model requires an open classroom climate where the teacher acts an instructional manager and monitor.

## Principles of Reaction:

- Ensuring that questions are phrased so that they can be answered in ‘Yes’ or ‘No’
- Asking students to rephrase invalid questions
- Neither approving nor rejecting student theories (hypotheses)
- Pressing students for clearer statements of theories and more support for generalizations
- Encouraging interaction among students.

## Support System

- A set of confronting materials or discrepant events and resource materials bearing on the problem for inquiry are needed.
- Also the teacher should be knowledgeable about the Inquiry process

## Instructional Effects

- Scientific process skills
- Strategies for creative inquiry

## Nurturant effects

- Spirit of creativity
- Autonomy in learning
- Tolerance of ambiguity
- Tentative nature of of knowledge

# Advance Organizer Model

- David Ausubel is the originator of Advance organizer teacher model.
- This model is based on verbal learning and information processing. Some key concepts are are as follows

## Students existing cognitive structure

- At a given time and with respect to a given subject matter cognitive structure refers to a student's knowledge of that matter with special reference to how much he knows, how well he knows and how effectively the knowledge is structured.

## Meaningful learning set

- This Is a condition in which connections could easily be established between the new material to be learnt and the related materials that already exist in the cognitive structure. Such a mental set makes the learner ready to receive the new knowledge.

## Structure of concepts

- Each discipline has a structure of concepts, hierarchically organised. Normally certain broad abstract concepts are at the top and these will include more concrete concepts at the lower stages of organisation.

## Advance Organiser

- These ensure meaningful reception and effective retention These are materials presented in advance as introduction to the new materials to be presented.

- There are two types of advance organiser.
- **Expository organisers** are provide basic concept at highest level of abstraction and perhaps some lesser concepts. These represents Intellectual Scaffold ( platform for execution of criminals) on which student will hang new information as it is encountered.
- **Comparative organisers** are used for familiar material, they are designed to discriminate between new and old concepts in order to prevent confusion caused by their similarity.

## Subsumer

- The advance organiser acts as a subsumer, that is a structure which can 'subsume' (contain or include) all the new material presented. Subsumption and acting as a firm anchor are the two main functions served by the advance organizer.

**Principle of Progressive Differentiation**- means most general ideas of disciplines are presented first and followed by gradual increase in detail and specificity.

**Principle of Integrative Reconciliation**(satisfying opposing facts) – means new ideas should be consciously related to previously learned content.

## Focus

1. To make aware of the concepts and facts.
2. To establish relations in knowledge.
3. To create interesting and meaningful text.

## Syntax

Phase 1: Presentation of advance organizer.

(a) The objective of the lesson are specified.

(b) The presentation of the organizer is done. For this:

- Definitions of the variables are marked.
- (Examples are offered.
- References are presented and are repeated if needed.

Phase 2 : Presentation of Learning Material/Learning Task—
Organizer is fully clarified.
Logical order of learning content is interpreted, so that there should not be any doubt.
Taking care by concentration and to maintain concentration.
To present learning material.

Phase 3: To Strengthen Cognitive Organizer—
(a) Use of integrative reconciliation principles.
(b) To make students active to gain information.
(c) To clarify text of complex approach and to make it simple and easy.

## Social System

- Teacher have more important role in it.
- The first two phases are highly structured but during the third flphase more free interactions takes place
- Principles of reaction The teacher reacts to pupils reactions by way of giving clarifications, differentiating or by helping them to reconciliate with existing knowledge.

## Support system

- Well organised learning material that includes the advance organiser and the new items to be successively differentiated forms the most important support.
- Instructional materials can be prepared in advance.

## Instructional Effects

- Formation of conceptual structures and meaningful assimilation of information and ideas are

## Nurturant effects

- Interest in inquiry and habits of precise thinking.

# 2 Mark questions

- Write significance of link practice in pre service training course
- List out components of skill of questioning
- Do you think that speech pattern of teachers helps in teaching learning process.justify
- Do you think link practices are necessary. Justify
- Draw a flow chart depicting different families of models of teaching
- List out the basic elements of models of teaching
- List out the effects of Concept Attainment ModelWhat is advance organiser
- How concept attainment model is significant in the teaching of a concept

# 4 Mark short essays

- Relevance of microteaching as a teacher training programme
- Short note on  microteaching cycle
- Explain any 3 core teaching skill
- Examine the relevance of Concept Attainment Method in learning biological science
- Describe the Syntax of Advance organiser model

# 10 Mark essays

- Prepare a lesson plan on constructivist format for any topic of your choice from standard 9
- Describe the basic elements of Inquiry training model

# EDU.05.11. THEORETICAL BASES OF TEACHING NATURAL SCIENCE

## UNIT 3

## APPROCHES, METHODS AND TECHNIQUES OF TEACHING SCIENCE

NUSAIBATH. C. V
RAGI BABU
RIFA. T

- The role of the teacher is considered main in the classroom. He is responsible for creating such an ambience as gives rise to maximum learning activities and various experiences may be achieved. But, practically, it is not as convenient as it looks. However talented, scholarly and able a teacher may be, he would be considered unsuccessful if he or she is unable to transfer learning to students.
- Teaching is an art which encompasses the following:
- Mastery over subject
- Scientific knowledge of teaching style for transfer of knowledge to pupils

# MAXIMS OF TEACHING

- 1. From to known to unknown
- 2. From simple to complex
- 3. From concrete to abstract
- 4. From particular to general
- 5. From actual to representation
- 6. From whole to part
- 7. From analysis to synthesis

## 1. From to known to unknown

A good teacher should always plan his teaching on the principle of proceeding from known to known. Teacher should first activate pupil's previous knowledge and present new knowledge on the basis of that activated previous knowledge of pupil. In other words, whatever the pupils know, the new knowledge of the unknown should be given on that basis.

## 2. From simple to complex

Teacher should start his teaching with the simpler things and the complex contents should be taught afterwards. This creates interest in the pupil and also motivates him to aspire more. The teacher should decide what is easy and what is difficult keeping in view the interest, attitude, ability, potentiality and needs of the pupils. After that the teacher should divide the subject matter in such a way that simple aspects should come first and these should be followed by the complex one in an order.

## 3. From concrete to abstract

Mental development of pupils begins with the concrete and afterwards he gains micro-words for them. Therefore a good teaching should lead from concrete to abstract. The concrete material is to be shown and the pupils should be opportunities for acquiring direct experience in order to make them able to learn the abstract concepts at the later stage.

## 4. **From particular to general**

Generalized facts, principles, concepts and phenomenon are quite abstract in nature and therefore should not be presented in the beginning of the teaching. Specific examples should be presented before the pupils first and then the general laws or principles should be derived from those specific examples.

## 5. **From actual to representation**

A good teacher should always try to give first knowledge about actual things and then lead is students to artificial representation. Pupils should be made aware of those things first which exist before them and then those things should be presented which don't exist before them. This facilitates the necessary knowledge concerning non-perceptual things or unseen things. From this point of view, first of all knowledge of present should be imparted to the pupil and then regarding past and future.

## 6. **From whole to part**

According to Gestalt Psychology, we first perceive the object as a whole and then its parts. Whole is not only greater then the parts but also more understandable, motivating and effective. For example – when we see some trees our attention goes on the entire tree, then on its stem, branches and leaves etc. Therefore, beginning should always be made with the whole and then step by step its various parts should be presented before the students.

## 7. From analysis to synthesis

- When we divide a thing into easy parts or separate elements in order to understand it easily is called analysis. It is the process which helps in understanding the hidden elements of a thing or the cause of some incident or behavior. For instance, in order to tell about the structure or functions of heart, the parts of the heart are shown separately and knowledge of every part is given. After it the students are made to understand the structure or system of working of the heart. In this way, even a very difficult thing can be easily understood. Synthesis is just opposite of analysis. All parts are shown as a whole. The process of analysis is easier than synthesis for understanding a thing. This process develops the analytical power of the students. It is the best method of starting the teaching process.
- For example while teaching digestive system, we should first analyse the different parts of digestive system one by one and then gives the synthetic view of it. Hence a good teacher always proceeds from analysis to synthesis.

# Approaches to teaching

- An approach is defined as way of dealing with a situation or problem.
- An approach to teaching is a description of how you go about teaching your students.
- A good approach may include choosing the right teaching methods.
- An approach is a combination of techniques, methods and strategies to result in better teaching.
- Different popular approaches adopted to teaching are :inductive, deductive, enquiry and discovery approaches.

# Enquiry approach

- Focuses on students investigation and hands on learning.
- Teachers primary role is that of a facilitator.
- Students play an active and participatory role in their own learning process.
- The enquiry requires students to draw on existing knowledge.
- Curiosity in the students encourages them to explore and seek out new evidences.
- Analyzing and presenting the findings is the responsibility of the students.

Enquiry components

- problem statement
- data collection
- analysis
- implication/conclusion

Enquiry procedure

1. formulation of questions
2. Investigating the topic
3. Connection with new learning with prior learning.

## Facilitator role

- Allow students to direct their own learning.
- A co- learner with students.
- Provoke additional inquiry of questions presented by the students.

## Learners role

- View themselves as learners in the process of learning.
- Accept in “invitation to learn” and willingly engage in an exploration process
- Raise question, propose explanations, and use observations
- Plan and carry out learning activities.
- Communicate using a variety of methods.
- Critique their learning practices.
- Direct their own learning within the parameters set by the facilitator.
- Work in groups and learn from each other.

## Advantages of enquiry learning

- It nurture passion and talent It increases motivation and engagement
- Develop research skills Solve the problems of tomorrow in the classroom of today

# Discovery learning

- Discovery learning is a technique of inquiry - based learning and is considered a constructivist based approach to education.

Advantages of discovery learning

- Active engagement
- Promotes motivation
- Promotes ownership of learning
- The development of creativity and problem solving skills
- A tailored learning experience

Examples of discovery learning

- Learning with and through narratives
- Case-based learning
- Guided discovery
- Problem based learning
- Simulation -based learning
- Incidental learning

Critisms of discovery learning

- Too much information
- Often requires vast resources
- Lack of teacher control
- Potential misconceptions

# GUIDED DISCOVERY APPROCH

- An approach to instruction through which students interact with their environment
- By exploring and manipulating objects, wrestling with questions and controversies, or performing experiments
- Students discover knowledge, developing their own understanding.

# Inductive approach

- Inductive approach is advocated by Pestalaozzi and Francis Bacon
- Inductive approach is based on the process of induction.
- In this we first take a few examples and greater than generalize.
- It is a method of constructing a formula with the help of a sufficient number of concrete examples. Induction means to provide a universal truth by showing, that if it is true for a particular case. It is true for all such cases. Inductive approach is psychological in nature.
- The children follow the subject matter with great interest and understanding. This method is more useful in arithmetic teaching and learning.

## Steps of inductive method

Following steps are used while teaching by this method:-

***(a) Presentation of Examples***

In this step teacher presents many examples of same type and solutions of those specific examples are obtained with the help of the student.

***(b) Observation***

After getting the solution, the students observe these and try to reach to some conclusion.

***(c) Generalization***

After observation the examples presented, the teacher and children decide some common formulae, principle or law by logical mutual discussion.

***(d) Testing and verification***

After deciding some common formula, principle or law, children test and verify the law with the help of other examples. In this way children logically attain the knowledge of inductive method by following above given steps.

## *MERITS*

- It enhances self confident
- It is a psychological method.
- It is a meaningful learning
- It is a scientific method
- It develops scientific attitude.
- It develops the habit of intelligent hard work.
- It helps in understanding because the student knows how a particular formula has been framed.
- It is a natural method of making discoveries, majority of discoveries have been made inductively.
- It does not burden the mind. Formula becomes easy to remember.
- This method is found to be suitable in the beginning stages.

## *DEMERITS*

- Certain complex and complicated formula cannot be generated so this method is limited in range and not suitable for all topics.
- It is time consuming and laborious method
- It is length.
- It's application is limited to very few topics
- It is not suitable for higher class
- Inductive reasoning is not absolutely conclusive because the generalization made with the help of a few specific examples may not hold good in all cases

# Deductive method

- Deductive method is based on deduction. In this approach we proceed from general to particular and from abstract and concrete. At first the rules are given and then students are asked to apply these rules to solve more problems.
- Deductive approach proceeds form
  - General rule to specific instances
  - Unknown to know
  - Abstract rule to concrete instance
  - Complex to simple

## Steps in deductive approach

- Deductive approach of teaching follows the steps given below for effective teaching
  - Clear recognition of the problem
  - Search for a tentative hypothesis
  - Formulating of a tentative hypothesis
  - Verification

## *MERITS*

- It is short and time saving method.
- It is suitable for all topics.
- This method is useful for revision and drill work
- There is use of learner's memory
- It is very simple method
- It helps all types of learners
- The speed and efficiency increase by the use of this method.
- Probability in induction gets converted into certainty by this method.

## *DEMERITS*

- It is not a psychological method.
- It is not easy to understand
- It taxes the pupil's mind.
- It does not impart any training is scientific method
- It is not suitable for beginners.
- It encourages cramming.
- It puts more emphasis on memory.
- Students are only passive listeners.
- It is not found quite suitable for the development of thinking, reasoning, and discovery.

# Deductive and Inductive method

**Deductive method**

1. General to particular

2. Method of verification

3. Very quick method asgeneralization are accepted.

4. Encourage dependence on accepted principles

5. Learner gets ready made knowledge.

6. Downward movement

7 .Conclusions are developed from specific observations in the sample.

8.start with a theory. Theory is used to develop a hypothesis.

9. Start with the a priori acceptance of truth

**Inductive method**

1. Particular to general

2. Method of discovery

3. very slow method as a new generalization has to be discovered

4. Principle are independently generated

5. Learner gets first hand information

6. Upward movement.

7 Conclusions are developed from specific observations.

8.No a prior acceptance of truth.

# METHODS OF INSTRUCTION

## 1. LECTURE METHOD

It is the oldest and teacher centered teaching method. It involves one way communication. According to James Michael Lee “A lecture is a pedagogical method whereby the teacher formally delivers a carefully planned expository address on some particular topic.”

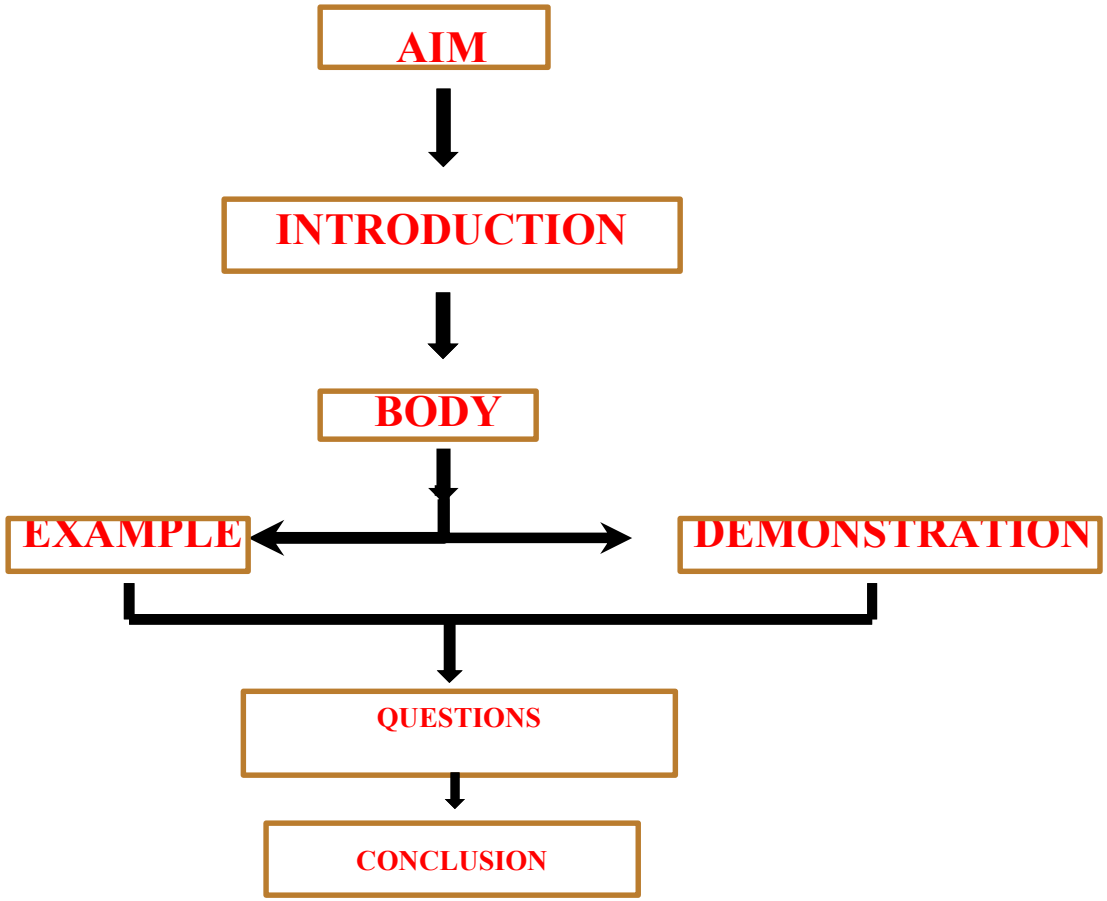
### 1.1 Psychological principles leading to effective lecturing

i. The delivering of lecture should be in an active mode.
ii. A lecturer should think from the point of view of the students. It should not be exposition of his subject mastery.
iii. The lecturer should present the subject matter in a systematic way. All the concepts should be sequentially arranged and clearly explained.
iv. The lecture should use the language which is easily understandable to each student.
v. The lecture should be interspersed with interesting examples, anecdotes etc. and through stimulus variation.

## 1.2 How to prepare and deliver more effective lectures

i. Don’t be so rigid with the plan of the talk. Changes should be made according to the nature of the learners.
ii. It is probably better to outline the lecture notes than to write everything in full.
iii. Distribute among the audience appropriate reading materials prior to the presentation.
iv. There should be a good beginning and make use of stimulating audio visual demonstrations and provocating questions.
v. Use a variety of ‘mediators’, with a view to make unfamiliar ideas familiar.
vi. The appropriate use of humour is a wonderful means of stimulating attention and imagination.

## 1.3 ORGANISING A LECTURE



## 1.4 Advantages of lecture method

- It is easy for the teacher to prepare and execute.
- Large number of students can be handled at the same time.
- It economizes time and effort.
- The teacher can express his ideas very effectively by his tone, gestures and facial expressions.
- It provides better opportunities for clarification of important things.
- It can be organized in accordance with the principles of educational psychology.
- This method is more helpful in introducing a new topic.
- It provides opportunities of correlating events and subjects.

## 1.5 Disadvantages of lecture method

- Lengthy lectures can be easily lead to boredom.
- It does not encourage pupil activity unless the lecturer is extremely competent.
- In it the students are generally passive recipients.
- The average student may not be able to fix up his attention to a lecture of say 45 minutes . During this span of attention may be diverted.
- In this method more content may be covered by a teacher, but less learning may take place.
- A lecture may become monotonous to the pupils. Whether they are attentive and are understanding the lesson is rather difficult to know.

## 2. LECTURE-CUM-DEMONSTRATION METHOD

A good demonstration are good communication media. A lecturer can combine demonstration with his lectures, so that the students through the observation of the demonstration , along with the explanation given in the beginning can comprehend the theme of the lecture more effectively. This strategy of using both demonstration and lectures at the same time is known as the lecture-cum-demonstration method.

### 2.1 Merits of Lecturer cum demonstration method

- Multi-sensory approach is followed in this method.
- It is economical when compared to individual laboratory work.
- The important maxims of teaching such as proceed from known to unknown, simple to complex, concrete to abstract and analysis to synthesis are followed in this method.
- It improves rational thinking and observation power of students

**2.2 Demerits of Lecture cum demonstration method**

- ❑ Pupil do not participate actively.
- ❑ No scope for learning by doing.
- ❑ The desirable practical skills are not developed.
- ❑ It is impossible to demonstrate certain theoretical topics.
- ❑ It does not impart training in scientific method.

## 3. HEURISTIC METHOD

Advocated by Prof. Armstrong in 1884 by which the pupil was made to find the answer to his problem by his own unaided efforts. Here the pupils are led to ‘discover’ the facts for themselves with the help of experiments, apparatus or books. This method emphasises the process of the growth of mind by one’s own effort rather than the provision of cooked material into empty vessel. The main aim of the Heuristic method is not to teach so much of facts in science, but to teach how facts are collected, systematised and applied. In short process is more important than product. Heuristic spirit is called as spirit of discovery.

### 3.1 Role of teacher

The teacher should be a good guide. The teacher should be capable enough to plan and devise problems for investigation by pupils. If problems od not arise in the mind of pupils from the materials supplied, the teacher  should direct their attention to problem rendering situations. Teacher should see that the problems are graded according to age, ability, interest and background knowledge.

## 3.2 Merits of Heuristic method

- Child is given prominent place
- Helps in developing scientific attitude, and spirit of enquiry and discovery.
- Develops manipulating skills and mastery of laboratory techniques.
- Develops research skills.
- Individual practical work encourages self reliance, self confidence and self discipline.
- Individual differences can be catered to.
- Learning becomes lasting and permanent.

## 4. PROJECT METHOD

It is the direct outcome of John Dewey's philosophy. In this method of teaching the curriculum and its transaction are considered from the student's point of view. 'Learning by doing ' and ' Learning by living' are the two cardinal principles of this method.
This method bringing out what is in the child and at allowing him to develop himself. It gives an opportunity for self expression. This method takes children out of the classroom atmosphere to the realities of actual life – ie. from academic to practical.

### 4.1 Definition

- Dr. Kilpatric – "A whole hearted, purposeful activity proceeding in a social environment."
- Stevenson – "A project is a problematic act carried to completion in its natural setting".
- Professor Ballard – "A bit of real life that has been imparted into the school."

## 4.2 Principles of the project method

I. **Purpose** : The project should be purposeful. Every project chosen should be useful and practicable to the daily life of the pupil.
II. **Activity** : The project should cater to the natural tendency of young boys and girls to engage in activity. The teacher should allow them to think and plan independently. Students should be made active both physically and mentally.
III. **Utility** : The experience gained from the project should be useful.
IV. **Freedom** : There should be full freedom of the students to work on their own accord.
V. **Economical** : The project should be economical and the purpose of the project should be achieved without any waste of money, time and effort.
VI. **Challenging** : The project should be challenging. Psychologists have proved that students would prefer to do a task which requires reasonable amount of effort.
VII. **Feasibility** : The project should be feasible.

### 4.3 Steps involved in the project method

I. **Providing a situation** : The teacher should always be on the look out for curricular or co-curricular situation that would provide ‘problematic act’ that could be carried to completion in a natural setting.

I. **Choosing and purposing** : The aim of the project method is to develop among students the ability to think, make proper choice, fix up feasible goals or purpose, plan and to execute it in a natural social setting.

I. **Planning** : planning too should be done by the students themselves under the guidance of the teacher.

IV. **Executing the project** : The teacher should help the students in dividing the project selected by them into proper parts and to distribute the tasks among them appropriately. Execution is the longest step. Here series of activities are undertaken by the students. They may be busy in collecting information, visiting places and people, gathering inputs, preparing tables and charts, engaging in manual activities involved etc.

IV. **Evaluating the project** : The students must review their work and try to see what mistakes they have committed in planning or in its execution. Thus at this stage a sort of self criticism is done by the students.

IV. **Recording** : It is necessary that students are encouraged to maintain a complete record of all activities connected with the project. This ‘project book’ should contain everything relating to the project starting from the choice of the project to the self-appraisal made.

## 4.4 Role of the teacher in the project method

i. He should provide occasions for every student to come forward and contribute something towards the success of the project.
ii. He should learn with the students and should not claim to know everything.
iii. He should create and maintain a democratic atmosphere so that the students can express themselves freely without any fear or hesitation.
iv. He should be alert all the time to see that the project is running on its right track.
v. He should thoroughly study the abilities, interests, aptitudes etc. of each individual student so as to allot them suitable works relating to the project.
vi. He should have initiative, tact, sincerity, leadership qualities, etc. that would infuse dynamism and active participation of all.
vii. He should always bear in mind that he is neither a dictator nor a commander, but a friend, guide and working partner.

## 4.5 Types of projects

i. **The producer type** : In this type of projects, the emphasis is laid down on the actual construction of a material, object or article.

i. **The consumer type** : In this type of projects the main objective is to obtain either direct or vicarious experience.

i. **The problem type** : In this type of projects the chief purpose is to solve a problem that would necessitate intellectual participation, spirit of enquiry and reflection on the part of the learners.

i. **The drill type**: In such a project the objective is to attain mastery of a skill.

## 4.6 Merits of the project method

i. It is original.
ii. It provides a good deal of independence to the pupils.
iii. It has practical value. Pupils themselves are given opportunity to solve their problems.
iv. This method follows psychological principles.
v. There is no place for the application of rote memory.
vi. The different subjects of study can be meaningfully correlated and integrated.
vii. It is very useful for creating a democratic out look and for developing the skills required for group work.
viii. Being able to work in a realistic and natural settings, it gives training for successful living.
ix. Project method is motivating to the backward children as it could provide them opportunity to participate actively and meaningfully in a purposive venture.

## 4.7 Demerits of the project method

i. It is too expensive. It requires lot of money for equipments.
ii. Many topics of the curriculum will not yield themselves to project work.
iii. In this system, very little time is given for strengthening the experiences. It is so because there is no time for practice.
iv. There is a good deal of wastage of time.
v. It is very difficult to complete the prescribed curriculum in time.
vi. It is very difficult to have evaluation of the achievement of the pupils.
vii. It upsets the routing work of the school.
viii. It will be rather difficult to achieve mastery over most of the content of the subject of study under this method.

# 5. PROBLEM SOLVING METHOD

## 5.1 Meaning

A problem is a challenge that warrants additional effort on the part of the learner to arrive at feasible solution which in turn will help in realising many of the deep level educational objectives.

## 5.2 Definition

- "Problem solving is a planned attack on difficulty for finding out satisfactory solution." – M. N. Singh and S. B. Maheswary.
- "A problem exists for an individual when he has a definite goal, which he cannot reach by the behaviour pattern which he already has available".

Gates

## 5.3 Characteristics of problem in a learning situation

i. Clear and definite.
ii. Challenging and hence interest generating.
iii. Suitable to the age, needs, and mental and physical capability of pupils.
iv. Related to actual life situations.
v. Understandable to the learners who face it.
vi. Thought provoking.
vii. Correlated to the existing knowledge of the learners.
viii. Worthwhile and of practical value.
ix. Workable with the resources available.
x. Feasible within the time available.

## 5.4 Teacher's role in problem solving

i. Maintain the spirit of discovery among students.
ii. Give proper guidance to the students from the beginning till the solution is reached.
iii. Extend optimum help to each student in case difficulties are experienced.
iv. Supply only extra information regarding the problem.
v. Establish rapport with students, for the smooth completion of the work.

## 5.5 Steps in the problem solving method

I. **Sensing the problem:** The teacher presents a challenging situation in which the students feel the presence of the problem and need for solve it.
II. **Interpreting, defining and delimiting the problem:** The problem having been raised the teacher helps the pupils through heuristic questions to interpret and identify the exact problem involved.

III. **Collecting the relevant data:** To collect the data the pupils may be asked to read books from library, search on internet, and to study charts, graphs and other relevant materials.

IV. **Organising and evaluating the data:** The data collected are then properly organised and evaluated.

V. **Formulating tentative solution:** The pupils go on formulating hypothesis on feasible solutions. Tentative inferences are made.

VI. **Arriving at the final solution:** This is the most important step. Discussions and argument by students with intervention of the teacher are necessary. Everyone should be allowed to express his views freely. it requires much patience from the part of teacher. Finally the stuednts arrive at a conclusion collectively.

## 5.6 Distinction between Project and Problem solving method

| The project method | The problem solving method |
|---|---|
| i. More stress on physical activities leading to concrete product | i. Physical activities resulting in a material product is rather absent. |
| ii. Less important to mental activities | ii. More importance to mental activities. |
| iii. Students get practical experience | iii. Less possibility for practical experience |

## 5.7 Merits of Problem solving method

i. Children get training in the art of problem solving in actual life situations.
ii. It develops habits of planning, thinking and reasoning power of the pupil.
iii. It develops the power if critical judgment as pupils have to think a lot, for arriving at correct solution of the problem through practice.
iv. Pupil gets training in co-operation and fellow feeling.
v. It inculcates the habit of open-mindedness and tolerance.
vi. The pupil gets valuable social experiences.
vii. The teacher-taught relationships are strengthened. Teacher is a friend, philosopher and guide.
viii. It is also helpful in making the students resourceful an self-reliant.

## 5.8 Demerits of Problem solving method

i. It is difficult on the part of the teacher to organize the content of science according to needs of the pupils.
ii. It is a time consuming process.
iii. Text books and written materials on these lines are not easily available.
iv. This method is not proper for immature pupils because they cannot follow the relevant material of science properly.
v. There is dearth of trained and competent teachers who can put this method into practice.

# Dalton plan
# (Contract Plan)

*Dalton plan is the result of an experimental programme conducted around 1920.
*With a view to provide education /instruction to suit the ability, needs and interests of learners.
*Strategy was developed by “Helen Parkhurst “at the Dalton High school in Massachusetts, USA.
(Hence named as Dalton plan).
*In this, learning activities are organized by providing monthly assignments to pupils.
* Assignments are given for each of the subjects of study have to be completed within the period.

- There is no rigidity as to which assignment in which subject has to be learnt during a specific time.
- The student is free to organize the schedule for working and to adopt the learning strategy  of one's own choice.
- At same time they have to complete the whole assignment within the time alloted, by working on them independently.
- The results are properly recorded .
- Along with intividual work, group activities and conferences also are organized by  teachers. Academic help essentially required also maybe given.
- The progress of each student is recorded in a separate card meant for them.
- This card is called ‘Job Card ‘.

- The spirit of Dalton plan is even now acceptable and advisable in order to cater to the needs and interests of individual learners.
- When the assignments for a month are completed, further monthly assignments are given.
- The children of various levels will be working in the subject room, where each of them gets materials for his work.
- Here, classroom teaching is abolished to a great extent.
- Dalton Plan is not a particular method of teaching any particular subject, but a method of organizing the work of the school to promote purposive self activity.
- It's aim to solve the problem of differing rates of progress which are observable among all groups of children even when ability grouping is made.
- The individual is accepted as the unit that receives instruction.
- Here, the traditional curriculum is preserved but the time table is discarded.

# Principles of the Dalton Plan

**1.The principle of freedom** :Miss Helen gives freedom to a prominent place in her plan.

*Freedom to study what a pupil would like to.

*At a given time.

*They are free to move from one subject room to another to consult one another and to work in any particular subject

**2. The Principle of individual work**:The Dalton plan is based on one of the soundest principles of pedagogy that each individual works at his own rate.

*There should be no time restrictions for doing piece of work.

*Pupils are permitted to regulate their own speed.

**3. Principle of self effort** :The responsibility of education rests upon the pupils.

*Learning is expected to most effective when it is the result of self effort and self activity.

**4.The Principle of group interaction** :Constant interaction among the members of the group is made possible when children varying in age and ability work together in the same subject room.

## Features /Requisite of the Dalton Plan

1. **Subject Laboratories** :Instead of classrooms, there will be subject Laboratories with specialist teacher in attendance.

   *Each laboratory is equipped with books on the subject, apparatus, excellent reference materials, maps, charts, models etc.

   * The pupils can use laboratory as classroom, work room, library etc.

2. **Subject teachers or Specialized teachers** :Instead of class teachers there should be subject teachers specialized in the subject concerned.

   *The teacher give intividual guidance to solve problems and offer suggestions.

   * Teachers are expected to take up the role of a advisor, helper, stimulator , instead of engaging in mere teaching .

**3. Assignments or Contracts** :The work of each unit or sub unit of the academic subject is laid out into a series of related tasks, usually known as contracts, hence the name Contract Plan.

**4 . Records** :The progress of the pupils in each subject is recorded by means of graphs and diagrams.

* There are three records - two are maintained by the pupils showing their own progress in each part and the contracta as a whole. The third record is kept by the teacher.

**5. Conferences** :Teacher may sometimes hold conferences to discuss common difficulties or to introduce something new.

# Advantages and disadvantages

Advantages

1.Teaching is individualized.

2. Continuity of work is assured.

3.Self effort brings confidence.

4 Develops initiatives and resource fulness.

5 Problem of indiscipline is solved.

6.Solving the problem of home task.

7 Better pupil teacher relationships.

8.Development of desirable study habits.

9 Purposeful learning.

10 Development of sense of responsibility

Disadvantages

1.It may result in damages of apparatus.

2.It limits opportunities for group work.

3.It is impracticable in ordinary schools.

4.It is difficult to prepare assignments.

5.Not suitable for the average child and shriker.

7. Lack of well equipped libraries and reading rooms.

8 Unsuitable for junior classes.

9 very costly

10.Time consuming

11. Does not give sufficient opportunity for the practice of appreciation and inspiratio

12. Difficult topics are cannot be covered.

# Individual Laboratory Method

- As like Dalton Plan, it is also a suitable method of teaching science.
- It is a childcentered method.
- This method provides hands-on experience to students.
- Aquire the skills in handling scientific apparatus, reading scales, drawing diagrams, interpretating graphs, drawing conclusions and in taking precautions.
- Also develops process skills like observation, experimenting, hypothesing, predicting etc.
- The method represents the true nature of science as it involves reaching conclusions through investigations.

Laboratory approaches can be classified into the following types :

1. Verification laboratory :The of this approach is to illustrate concepts, principles and laws.
2. Inductive laboratory :It provides students with the opportunity to form concepts, principles and laws through first hand experiences,followed in projects, allows them to form concepts for themselves and to explore ideas and pursue them.
3. Science process oriented :All laboratory work stresses the science process skills.
4. Technical skills oriented :enables students to aquare. manipulative skills that involve the development of hand - eye coordination.
5. Exploratory :Allow students to explore an idea, concept or principles without structural procedures, are given freedom to explore and specific learning outcomes are left to the students to determine and achieve.

## Role of the teacher

- The supervison by the teacher counts much in the success of the individual Laboratory Method.
- Teacher should give intividual attention and note the progress of each student.
- He should give guidance and brief instructions.
- He should clear  doubts and help in setting up of apparatus.
- Teacher should check the observations for errors and omission of entries.

# Advantages and disadvantages of laboratory method

Advantages

1.This method is childcentered.

2 Provides a chance of learning by doing.

3 Develops science process skills.

4 Develops self confidence.

5.Helps to participate in scientific investigations.

6 Enable the students to apply the facts in everyday life.

7 Provides opportunity to participate in the methods of science.

8.It encourages the habits of neatness and discipline.

9.It gives facilities for developing the laboratory techniques and manipulative skills.

Disadvantages

1.It is very expensive

2. There is wastage of time and energy of the teacher who has to give intividual attention to each student.

3 Laboratory management may pose some problem to the new science teacher.

4.The dull students are often tempted to copy down the results of the brilliant one.

5. Not suitable for all topics.

# Activity Based Learning (ABL)

- Activity Based Learning started sometime in 1944 around World War II When a British man David Horsburgh came to India.
- He opened a school, NeelBagh in Kolar district in Karnataka.
- Neel Bagh was based an innovative idea of Horsburgh and known for its creative methods in teaching with well planned learning materials.
- The initiative of Horsburgh was one of the milestones in ABL.
- The ABL in its contemporary form was first undertaken by the Chennai Corporation in 13 schools on a trial basis in 2003.
- First designed and tested by the Rishivalley school in Andra pradesh in the 1990's.
- The ABL has been successfully implemented in several Indian states.
- ABL describes a range of pedagogical approaches to teaching.

- It's core premises include the requirement that learning should be based on doing some handson experiments and activities.
- The idea of ABL is rooted in the common notion that children are active learners rather than passive recipients of information.
- If child is provided the opportunity to explore by their own and provided an optimum learning environment then the learning becomes joyful and long lasting.
- ABL methodology is based on the pedagogical principles of learning through activities.

Characteristics :

- It uses child friendly educational aids to foster self learning and allows a child to study according to their aptitude and skill.
- Child centered, child friendly education, which is the mandate of the Right of children to Free and Compulsory Education Act(RTE) in India.
- Here, the curriculum is divided into small units, each a group of Self Learning Materials comprising attractively designed study cards for English, Tamil, Maths, science and social science.

- Where child finishes a group of cards, he complete one “milestone”
- Activities in each milestone include games, rhymes, drawing and songs to teach a letter or a word, form a sentence, do completing all the milestone in a subject.
- On a common chart the milestones are arranged in the form of a ladder and the child knows exactly which milestone he completed in the last season.

- Each milestone has different steps of the learning processes represented by logos having six types of activities :viz
  1.Introduction
  2 Practice
  3. Reinforcement
  4.Self assessment
  5.Evaluation
  6. Remedial and enrichment activities.
- This is a child friendly way to evaluate and reinforce learning.
- If a child is absent one day, they continue from where they left unlike in the old system where the children had to learn on their own what they missed out on.

# Advantages and disadvantages of Activity Based Learning

Advantages

1.It is a childcentered approach.

2.Devolops self learning skills among the learners.

3 Allows a child to study according to his skills and aptitude.

4 Provides optimum opportunities to learn.

5.Gets motivation and become active learners.

6.Provide fearless and freedom to express environment.

7 Learning becomes joyful and long lasting.

Disadvantages

1.This method requires long term planning with minute details whole process.

2.It cannot be used on a regular and daily basis as it involves a lengthy procedure.

3. The objective of the method can only be fulfilled if the planning of the lesson flawless.

(if there is slightest flaw in planning, this method do more harn than good)

4.The method is more suitable for the branches of experimenta science and less useful for subjects of social science.

# Techniques And Strategies of Teaching

- In literature, teaching generally makes no distinction between methods of teaching and techniques of teaching.
- Writing on educational theory and practice describe different classroom procedures as either methods of teaching or techniques of teaching.
- But these two terms have different meaning and scopes :though both are integrated in any instructional

In brief, it could be said that :

1.Method of teaching :refers to the arrangement of ways and procedures through which learning is achieved.

2.Technique of teaching :refers to the special skill employed by the teacher in the course of teaching, it is a certain particular way to accomplish the task or objective.

3.Strategy:is a proper and systematic plan which aims to achieve the objective. In education, it means selection of suitable pedagogical process by means of using appropriate techniques, such that all of these lie in the realm of the approach, the teacher chooses to follow.

Strategies can be changed or modified depending upon teaching learning situation.

The he major techniques and strategies that could be effectively applied in the teaching of science are discussed below :

# Questioning Techniques

- Questioning plays a critical role in teaching.
- Teachers must be knowledgeable in the process of framing and posing questions, so that they can guide student thought process in the most skillful,meaningful manner.
- Questioning tend to be universal strategy.
- Through systematic questioning, teacher may determine students entry skill and knowledge levels for specific content areas.
- This technique encourage the widest spectrum of student participation.
- Questioning should act to invite and encourage higher levels of critical thinking in students.
- The minds of the learner and the teacher can be brought into close touch and the learners can be led to creative effort through questioning.

- Second most widely used teaching strategy.
- Some teachers used as many as 150 questions per hour
- Average was 395 questions a day, where
- 71% were Factual
- 29% required thought

Purpose of questioning

1. For exposing difficulties.
2. For promoting thinking, searching out new ideas.
3. For developing appreciation.
4. For directing learning to deeper and broader understanding.
5. For preparing pupils mind to receive new materials.
6. For revising work covered earlier.
7. For laying emphasis on something.
8. For preventing misbehavior and inattention.
   (in attentiveness remedied by unexpected questions)

Questioning strategies

There are four distinct questioning strategies :

1. Convergent questioning
2. Divergent questioning
3. Evaluate questioning
4. Reflective  questioning

Convergent questioning

- This strategy focuses on a narrow objective, encourages student responses to converge or focus on a central theme.
- It elicit short responses from students and focus on the lower levels of thinking (knowledge or comprehension levels).
- This does not mean that using this strategy is bad, the appropriateness of any questioning strategy must be judged solely on the basis of its ability to fulfill your predetermined objectives.
- It is appropriate when teacher uses Inductive teaching style, build technical vocabulary, uses short response questions as rapid - fire warm up exercises.
- It is an ideal application in teacher directed instruction.

Divergent questioning

- Divergent questions are the opposite of convergent questions.
- Rather seeking a single focus, the goal in using this strategy evoke a wide range of student responses.
- It elicit longer student response and several responses.
- It encouraging creative responses to questions and novel solutions to problem is the goal.
- It allow free responses by students.
- The teacher should allow all students to present their responses without teacher's interference.

Evaluate Questions

- Evaluation level
- Questions that ask for judgment
- No right or wrong answers

Reflective questioning

- Elicit wide range of student responses.
- Also have an evaluative element.
- It develop higher order thinking.

*Open ended and close ended questions are another category of questioning technique,former enable pupils to respond in variety of different ways and later have a single right answer and respond more directly.
*Higher order questions for promote reasoning and encourage pupil to apply knowledge in to new situations.
*Lower order questions involve factual recall

Questioning Procedure

- Ask
- Pause(3 to 5 seconds)
- Call on someone
- Listen to response
- Emphasize correct answer

# Advantages and disadvantages of questioning technique

Advantages

- While asking questions teacher keep inmind the abilities and interest of the learner.
- Achieving cognitive objective and bringing knowledge at concious level.
- Classroom verbal interaction is encouraged.

Disadvantages

- It is difficult to make good questions
- Whole content is cannot taught by this strategy
- There is no freedom of imaginative answer s.

# DISCUSSION

- Discussion is a strategy in which student learn by sharing experiences and opinions with each other.
- The teacher has to carefully plans the lesson to reach desired learning And guide the discussion through questioning and summarizing.
- The group interactsin response to questions.
- The flow of communication can be smoothened among all the learners. .

# Stages involved in the organization of discussion:

1.Introduction

It should be initiated by the teacher. The topic for discussion and the key areas are to be developed.

2.Devolopment:

In this stage teacher can use lead points and follow up interactions.

3 Transition :

In this stage, the key points may be viewed and participation of all learners may be ensured.

4.Summerisation:

At this stage teacher may provide additional support materials to ensure the achievement of the objectives.

# Advantages and disadvantages of Discussion method

Advantages

- Increase student learning.
- Motivate students.
- Support teachers in understanding and assessing student thinking.
- Shift the mathematical authority from teacher (or textbook) to community.

Disadvantages

- discussion method is not appropriate for all the topics
- It can be used only to students who have some basic knowledge in the topic.
- some of the students may feel shy or reluctant to take part while others may try to domonate.

# BRAIN STORMING

- Brain Storming is basically an activity designed to promote creativity.
- It is a form of discussion which enables the group to do collective creative thinking.
- The emphasis in brain Storming is on eliciting from the students as many different ideas as possible for more careful consideration at later time.
- Under brain Storming, the mind is stimulated to think without any inhibition whatsoever.
- The ideas are just accepted as they are.
- They are never rejected during the process of brain Storming, how much inappropriate or even irrelevant they might appear to be.
- The time for a person to express his ideas is limited to 3-5 minutes.
- The suggestions are taken for comment and elaborate the ideas suggested by others.
- Brain Storming in the class situation invariably leads to new ideas and approaches related to the topic studied.

- This technique is very useful in science, because students get immense opportunity to participate and involve in the instructional process and thus to make substantial contribution.
- Topics like group farming, environmental pollution etc, can be subjected to thorough discussion by this technique.
- When a creative suggestion needs, it is the good technique because we know that wantering brains bring back with wonderful ideas.

# Advantages and disadvantages of Brain Storming

- The advantage of brainstorming in a group is mutual stimulation of all participants.
- The disadvantage is that the group will focus too quickly on a certain area. *After collecting ideas through brainstorming, you have to sort the risks into further steps and roughly evaluate them.

# ROLE PLAYING

- Role playing is a teaching technique in which students assume an identity other than their own to cope up with real or hypothetical situations in life with a view to internalize ideas and relations realistically.
- While playing such a roles, participants exhibit behavior patterns they believe are characteristics of those roles in specific social situations.
- For example, two students might enact an interview,one taking the role of a scientist and the other that of curator.
- Through role playing the students get a various experience.

# Types of Role-playing

There are two types of Role-playing. They are :

1. Structured role playing
   - Here the teacher selectes the situation to be enacted in advance
   - And specifies the goals of activity.
   - Proper planning is required for this.
   - In some cases written material which describes the role and situations also is presented in advance.
2. Spontaneous role playing
   - It is arises in the midst of a discussion in a natural way.
   - Spontaneously happened with respect to the teaching situation.

# Advantages and disadvantages of Role playing

Advantages

- Develops communication skills
- Develops language skills
- Allows children to act out and make sense of real life situations.
- Allows children to explore, investigate and experiment.
- Develops social skills as children collaborate with others.

Disadvantages

- It requires expert guidance and leadership.
- Some times participants may feel threatened.
- Strongly depends on students imagination
- Limited by the teachers ingenuity and realistic use.
- Time consuming

# SIMULATION

- It is relatively new approach introduced in the field of education.
- It has been defined as role playing, strongly in which learner performs the role in an artificiay created environment
- Simulation is the process of presenting a situation, Event or task in an artificiay created environment similar to that of the real one.
- The presentation is made as similar as possible to the real situation or event.

example :

*Mini working model of an aeroplane being used in training pilots

*Various computer programms.

*Microteaching used in teacher training.

*Models of heart, kidney, digestive system etc.

# Advantages and disadvantages of simulation

Advantages

* helps in developing self-confidence among them.

*helps in linking theory with practice of teaching.

*Simulated training provides feedback to student teachers to modify their behavior.

*It helps in developing efficiency in student-teachers.

*As a result of role-playing, it helps in the development of critical-thinking in student-teacher

*There is self monitoring in stimulated training.

*Allows testing of every possible fault.

Disadvantages

*In simulation role-playing is done in artificial situations which are un-psychological and impracticable.

* Simulation is like socio-drama or sort of gaming, which reduces seriousness of learning.

*No emphasis is given on teaching skills or content.

*Portray the real situation in a simple way, which in general ar very complex and difficult.

*Time consuming and expensive.

# SEMINAR

- Seminar is a controlled type of discussion.
- It is a method of teaching where the students ability to solve problems is increased by way of rational thinking
  and reasoning.

- Seminar is one of the techniques of discussion for small groups, a small group is one in which face to face relationship among participants is there.

- Seminar are simply a group of people coming together for the discussion & learning of specific techniques & topics.
- Usually there are several keynote speakers within each seminar&
  these speakers are usually experts in their own field or topics.

- The seminar may be arranged on some particular topic or it can be on various problems.
- A working paper is prepared before hand which is presented before participants.
- The seminar may be held on new techniques of teaching, teaching learning process, teaching of special children, improvement of science curriculum, science practical of different classes etc
- Seminars widen the professional outlook of science teachers.
- Science teachers can attend seminar in science and other subjects.
- Date, time  topic  etc are discussed earlier in this technique.

# Advantages and disadvantages of seminar

Advantages

- It provides situation for free expression of ideas.
- Develops communication skills.
- Develops creative abilities.
- Develops leadership qualities and cooperation in the learners

Disadvantages

- Lot of preparation is needed from the part of learners.
- Only a competent and experienced teacher can conduct a seminar successfully.

# DEBATE

- Debate is a creative And collective process of eliciting all related facts of a topic.
- It t also enables the participants to enrich their  knowledge through healthy dialogue.
- The skills of critical thinking, positive interactions etc of students can be developed through this method.

The following stages are involved in the organization of a debate :

1.Topic selection
The topic should be relevant and having potential for different viewpoints
2.Selection of panels
At least two panels of students may be selected to argue for and against the topic
3.Selection of a moderator
A student representative should be selected to moderate the session. In the initial stage teacher may act as a moderator.

4. Collection of information

The panel of student should be guided by the teacher to collect as enough information from various sources.

5. Conducting the debate

The teacher acts as overall guide and moderator will facilitate the debate. Both the pannels can arise thier views and arguments on the topic.

6. Conclusion

Moderator should conclude the debate by expressing his final version based on the views evolved from the debate. The teacher can make his observation, comments and suggestions.

# Advantages and disadvantages of Debate

Advantages

1. Gaining broad, multi-faceted knowledge cutting across several disciplines outside the learner's normal academic subjects.
2.Increasing learners' confidence, poise, and self-esteem.
3.Providing an engaging, active, learner-centered activity.

Disdvantages

1.Debates Can Be Hurtful.
2 Assigning Sides Sways Opinions.
3 Repetition Shapes Views.
4 Confirmation Bias Can Occur.

# PANEL DISCUSSION

- Panel Discussion technique was originated by Harry A. Overstreet in 1929.
- This technique is a discussion in which few persons (the panel) carry-on conversation in front of the audience.
- At the end of the discussion, the audience will also participate.
- The audience put important questions and the experts answer them and clarify the points.
- In other words, Panel Discussion is a specific format used in a meeting, conference or convention.
- It is a live or virtual discussion about a specific topic amongst a selected group of panelists who share differing perspectives in front of a large audience.

Purpose of panel Discussion

- To provide information &new facts.
- To analyse the current problem from different angles.
- To identify the values.
- Town organize for mental recreation.
- To influence the audience to an open - minded attitude &respect for other's

Types of panel Discussion

1.public Panel Discussion

2 Educational Panel Discussion

Public Panel Discussion

- This type of panel discussion is organized for the common -man problems.
- Generally, the public panel discussion is organized through television programmes.
- The main objectives achieved by this type are :
  To provide factual information regarding current problem.
  To determine social values.
  To recreate the common man.

## Educational Panel Discussion

- Educational Panel Discussion is used in educational institutions to provide factual and conceptual knowledge and clarification of certain theories and principles.
- Some times these are organized to find out the solutions of certain problems.

- Objectives of educational panel discussions are :
  * To provide factual information and conceptual knowledge.
  * To give awareness of theories and principles.
  * To provide solution of certain problem.

Guidelines for conducting panel discussion

- Identity an issue or topic
- Select panelists. 3-5 panelists.
- Select a leader or chairperson/moderator of the panel.
- Decide on the format of the panel discussion.

# Advantages and disadvantages of Panel Discussion

Advantages of panel Discussion

● Different points of views on the subject are presented by expert.

● The quick exchange of facts, openion etc helps develop critical attitude and better judgment.

Disadvantages of panel Discussion

● It requires more time for planning and organising

● The effectiveness of the method depends op on:

-The compitency and presentation of the panel members.

-The compitency and leading ability of the chairperson.

-Planning, organizing, conducting the panel discussion.

# 2 mark questions

- List any four maxims of teaching?
- What are the advantages of role-play method?
- Select two topics from high school biology suitable for debate as a teaching method?
- Name any two types of projects?
- Name any two registers to be maintained in the biology laboratory?
- Write any three major features of Dalton plan?
- What is heuristic method?
- What are the merits of using enquiry approach of teaching?
- What is project method?
- Mention any two techniques of managing group learning?
- Explain the demerits of lecture method?

# 4 mark questions

- Diffentiate between Inductive and deductive approaches?
- Explain the steps in problem solving method?
- Brain Storming is one of the effective techniques for developing concepts of social relevance, explain?
- Compare reception learning and discovery learning?
- Explain different steps in brain Storming technique?
- Differentiate between simulation and role play?
- Briefly explain the essential features of heuristic method?
- Suggest ways to modify the lecture method, so as to involve the pupils learning?
- Explain Inductive VS deductive approaches of teaching biology, compare the relative merits and demerits of each?
- How will you conduct Brain Storming session in the class room by selecting a suitable topic of your choice?
- What is brain Storming? How it different from buzz session?
- Explain Dalton Plan, what are the merits of this method.
- Explain the demerits of lecture method.
- What is project method? What are the steps involved in a project?

# 10 Mark questions

- What are the requisites of a good demonstration? Explain about demonstration method?
- What is problem solving method? What are the steps involved in this method? Discuss the relevance of this method in the present scenario of Biology classroom teaching?

B.Ed SEM-1-EDU-05.11-THEORETICAL BASIS OF TEACHING NATURAL SCIENCE

Unit 4

# LEARNING AS A GENERATIVE PROCESS

**Ruby Mumthaz P**

**Rohini Krishna P T**

# CONSTRUCTIVISM

- Approach to learning activity construct their own knowledge by testing ideas approaches based on their prior knowledge and experiences.
- Learning is active reconstruction and reinterpretation of experiences.
- Principle of constructivism : Learner build new knowledge upon the foundation of previous knowledge.
- Learner autonomy and initiative is accepted and encouraged in constructivism.
- Against the 'Banking concept of education.'
- In classroom situation students work primary in groups and learning and knowledge are interactive and dynamic.
- Greater emphasis on social and communication skills as well as collaboration and exchange of ideas.
- Learner construct knowledge through individual and social activities.
- Individual difference play a greater role in construction of knowledge.

# THEORETICAL UNDERPINNINGS OF CONSTRUCTIVSISM

## 1.Genetic Epistemology by Jean Piaget

- Epistemology - Study of knowledge . Genetics - Development
- Genetic epistemology means study of developmental changes in the process of knowing and in the organization of knowledge.
- Cyclic steps in assimilation of new instance to be a part of cognition.

A. Disequilibrium - While facing challenging and unfamiliar situation learner experience a disequilibrium which promote him for learning it.

B. Concept of schema - Schema are the cognitive structure or mental images linking the new situation with already familiar schemas present in the cognitive structure of the learner through the process of reversibility. Schema is the potential to do some action like remembering.

C. Assimilation - It is the process by which individual uses the existing schema to deals with some problems in the environment.
D. Accommodation - The process of tolerating the unfamiliar situation is called accommodation. It involves the rearrangement of existing schema to adapt to new experience.
E. Equilibrium - It is the balance between cognitive structure and environmental experiences.

- Essential for the cognitive stability of the individual.

- Balancing is achieved through changing existing schema.

## 2. Bruner's discovery learning

- Inquiry based instruction.
- Learning should understand the structure of the body of knowledge rather than memorize as isolated fragments (dates names place etc.)
- By understanding the structure of the knowledge gives the idea about the basic relation with one another.
- Conceptions arises by the learner are more meaningful than proposed by others.
- Children should be made to confront problem instead of giving predesigned learning environment.
- Develop problem solving skill and acquire confidence in their on learning ability.
- Discovery learning – Approach of education.
- Intellectual development occurs through three phases they are enactive, iconic and symbolic

A. Enactive - Representation of things through physical activities (unable to use languages.)
B. Iconic - Representation of things through sensory images or mental pictures.
C. Symbolic - Advanced phase characterized by translation experiences into languages.

## 3. Vygotsky and social constructivism

- Social interaction play a fundamental role in the development of cognition.
- Cognitive activities takes shape in in a matrix of society.
- Concept of ZPD zone of proximal development.
- Vygotsky suggest three zone of development.

A. Zone of actual development ./
B. Zone of proximal development .
C. Zone of potential development.

- ZPD relate the gap between what the child can learn unaided and what he can learn with the help of adult.
- ZPD implies child development is determined by the social interaction and collaborative problem solving.
- Scaffolding - The helping hand provided to cross the zone of proximal development and to reach the zone of potential development.

## 4. Multiple Intelligence by Howard  Gardner

- Gartner suggest each person has a unique cognitive profile.
- Gardner's theory argues that students will be better served by a broader vision of education were in teachers uses different methodologies experiences and activities to reach all students.
- ‘Intelligence is the ability to find and solve problems and create product of value in one's own culture’ Howard Gardner.

1. Linguistic intelligence - It is the capacity to use words effectively whether orally or in writing.
2. Logical mathematical intelligence - It is the capacity to use numbers effectively to reason well.
3. Spatial intelligence - It is the ability to perceive the visual spatial world accurately and perform accordingly and to make transformations upon those perceptions.

4. Bodily kinesthetic intelligence – It is the expertise in using once on whole body to express ideas and feelings and facility in using one's hand to produce or transform things.
5. Musical intelligence – It is the capacity to perceive discriminate transform and express musical forms.
6. Interpersonal intelligence - It is the ability to perceive and make distinction in the mood intentions motivation and facing of other people.
7. Intrapersonal intelligence – It is the ability to sense oneself.
8. Naturalistic intelligence - It is the ability to understand the natural world including plants animals and scientific studies to recognize and classify individuals species and ecological relations to interact effectively with living creations.

# COGNITIVE CONSTRUCTIVISM AND SOCIAL CONSTRUCTIVISM

## Cognitive constructivism

- Jean Piaget's work is basis of cognitive constructivism.
- Individually constructed approach.
- In this learner actively construct knowledge by trying to organize structure and restructure the information and experiences in the light of exciting schemata of thought and gradually modifiers and expand these schema.
- This is biological mechanism found in the individual learner.
- This approach emphasize individual meaning making or individual derives meaning.
- Teacher work as a facilitator to change the cognitive structure in students by bringing some difficulties through task and form dilemmas.
- Cognitive constructivism assumes that knowledge is a result of accurate internalisation and reconstruction of external reality by the learner.

## Social Constructivism

- Social constructivism accepted that two parts of knowledge they are individual knowledge and social knowledge and they are interdependent.
- Social constructivism put forward two approaches of cognition they are situated cognition and social cultural cognition.
- Both of these forms highlights the importance of meaningful integrated learning in the context of environment.

A. Situated cognition - Individual transform knowledge in the context of social environment both the individual and environment chang as a result of the interaction.

B. Socio cultural forms of constructivism focus on meaningful integrated learning. This approach advocate the development of meaningful tasks in which a variety of subject areas are incorporated and uses.

# BEHAVIORIST APPROACH VERSUS CONSTRUCTIVIST APPROACH

## Behaviouristic Approach

- Teacher centered model of interaction.
- According to behavioral perspective learning can be defined as the observable change in behavior.
- Drill and practice method - Learning is simply remembering and restating what is said.
- Learning considered as a incidental event as a result of stimulus - Response establishment.
- Behaviorism explains behavior by observable experiences and not by the mental processes.

## Constructivist Approach

- Learner centered education.
- Learner must construct what they learn. Teacher facilitate learning.
- Learner's active participation.
- Rote memorization is antagonistic to constructivism.
- Learner can construct and use memorization strategies on their own.
- Foundation of constructivism is that learner bring with the prior knowledge and briefs.
- The approach requires concrete experiences rather than abstract presentations.
- Learner and teacher learn from each other.

| Behaviourism | Constructivism |
|---|---|
| 1. Teacher-centred education | Learner-centred education |
| 2. Content oriented | Process oriented |
| 3. Emphasises teaching | Emphasises learning |
| 4. Learner as a receiver of knowledge | Learner constructs knowledge |
| 5. Extrinsic motivation leads to learning | Intrinsic motivation leads to learning |
| 6. Learner viewed as empty vessels | Learner with unique abilities |
| 7. Learning as a mechanical process | Learning as a natural process |
| 8. Learning is stimulus - response relationship | Learning is active mental processes |
| 9. Same approach for all age groups | Changed approach based on developmental stages |
| 10. Rewards, punishments, reinforcement make learning effective | Problem solving through experiences makes learning effective |
| 11. Learning is behavior modification | Learning is conceptual change and addition |
| 12. Does not consider learner's mental models | Considers learner's mental model |
| 13. Importance to product of learning | Importance to process of learning |
| 14. Foundation of behaviorist theories of learning | Foundation of cognitive theories of learning |
| 15. Teacher's role as a trainer | Teacher's role as a facilitator |

# COLLABORATIVE LEARNING

Collaborative learning Involves the development of collaborative communities, where groups or pairs of learners interact to learn and solve authentic problems, foster constructive learning.

- It is an educational approach to teaching and learning jn which students team together to explore a significant question or create a meaningful project.

## Characteristics

1. A common task /activity
   Small group learning
   Co-operative behaviour
   Interdependence
   Individual  responsibility  and accountability

# Principles

- Working together results in a greater understanding than would likely have occurred if one had worked independent
- Spoken and written interactions contribute for better understanding
- Opportunity exists to become aware, through class room experience, of relationships between social interactions and increased understanding
- Some elements of this increased understanding are unpredictable
- Setting mutual goals
- Develop thinking and language skills
- Participation is voluntary
- Interact constructively with their peers.

STEPS

1. Identity the issue or Concept
2. Formation of groups
3. Exchange of ideas, discussion
4. Teacher facilitate their Interactions.
5. Feedback

## Ways of applying

- Brain storming
- Task group
- Inquiry group
- Jigsaw
- Simulation, etc.

## ADVANTAGES

- Engage in subject specific  discussions with peers.
- Learn how to work cooperatively and support each other
- Develop effective team work and communication skills
- Foster individual accountability to the team
- It helps to increase subject matter comprehension, efficiency and productivity

## LIMITATIONS

- A few shy students may not participate actively in the group
- It may be difficult to check and recheck the work of all groups working at one time for an inexperienced teacher
- Teachers dominance is reduced.
- Careful planning is required for meaningful learning to take place.
- If the work of the groups is not properly monitored, misconception and native concept may develop in learners.

# JIGSAW LEARNING

- Whole content is cut into pieces
- When put together form the whole
- A portion is assigned to a group of 4-6 students
- Each group is responsibility to find out the task assigned
- When each group complete the task, returned to their original position
- Jigsaw learning promotes cooperation than competition.

# MANAGING GROUP LEARNING

- Class room management techniques are determined by teacher –student – situation factors.
- The attitudes of students develop in the classroom settings are influenced by the teacher‘s classroom management skills.
- The most successful teacherare those who make deliberate decisions based on sound educational principles.
- To be an effective class room manager, the tracher must learn to exercise the least amount of power necessary to accomplish the desired result.

## Elements of Managing Group Learning

- Planning
- Establishing usable rules.
- Getting off to a good start.
- Providing clear directions.
- Monitoring the classroom environment.
- Keeping records of student responses..
- Creating strategies for managing interruption

## Tips for Managing Group Learning

- Plan discussion group in advance.
- Organize activities in advance.
- Have the necessary materials in the classroom.
- Reserve special room/space for the activity.
- Give clear and concise instructions.
- Give clear assignments.
- Be sure about pre-requisite skills.
- Systematic routine for procedural activities.
- Motivate students for group work.

# LEARNING AS A GENERATIVE PROCESS-

## ROLE OF TEACHER

- Teacher is a mediator and facilitator.
- Teacher prompts students to formulate their own questions. (Inquiry ).
- Teacher allow multiple interpretation and expression of learning (multiple intelligence ).
- Teacher encourages group work and the use of peers as resources (collaborative learning )
- Teacher is a co-learner and democratic leader.
- Becoming a cognitive guide for learner, providing or scaffolding, helping to extend the learners zone of proximal development.

## ROLE OF A LEARNER

- Active participant in the learning process.
- Formulate concepts of his own.
- Engaging in group activities.
- Share information /knowledge.
- Share responsibilities.
- Take leadership.
- Co-participant.
- Interpret and draw inferences.

# CRITICAL PEDAGOGY

- **Paulo Regius Nerves Freire** is known as father of critical pedagogy perspective of education
- Critical pedagogy is concerned with teaching learning practices that are de designed to raise learners critical awareness regarding oppressive social conditions
- It is against the banking concept of education.
    - Banking concept :Children's are empty vessel teacher deposit knowledge.

## DEFINITION

Critical pedagogic educator, **Ira Shor** defines;

“Habits of thought, reading, writing, and speaking which go beneath surface meaning, first impressions, dominant myths, official pronouncements, traditional cliches, received wisdoms, and mere opinions, to understand the deep meaning, root causes, social context, ideology, and personal consequences of any action, event, object, process, organization, experience, text, subject matter, policy, mass media, or discourse. ”

(Empowering Education, 129)

## CHARACTERISTICS OF CRITICAL PEDAGOGY

- It provides the learner with tools to better themselves
- Its approach is issue based or problem based
- It transforms the learner from objects to subject
- It is focused on dialogue instead of a one-way transmission of knowledge
- It transforms the learner role of passive listener to active participants
- It aims to create more egalitarian and just society
- It argues for an approach to education that is rooted in the experiences of marginalized people
- It envisages a transformed world  i.e., a more democratic, more just and more egalitarian world.

# FEATURES OF CRITICAL PEDAGOGY

- Education for liberation
- Education for conscientization
- Dialogue as pedagogic tool
- Problem posing education
- Egalitarian teacher –student relation
- Co-construction of knowledge
- Praxis  as synthesis of theory and practice in learning process
- Transformative social Justice learning

## ROLE OF TEACHER

- The role of teacher is to provide a safe space for children to express themselves, and simultaneously to build in certain form of interactions.
- Teachers need to step out of the role of ‘moral authority ‘and learn to listen with empathy and without judgment, and enable children to listen to each other.
- While consolidating and constructively stretching the limits of children’s understanding, they need to be conscious of how differences are expressed
- Make the classroom as an atmosphere of trust

# ISSUE BASED LEARNING

- Issue- Based learning (IBL) or Event-Centred Learning (ECL) or Problem Posing Approach societal issues ( such as public health, waste management, genetic engineering, farming, over fishing, water management, urbanisation, industrialisation, endemic disease, pollution, etc.) become central organizer for science curriculum and instruction .
- Issues form the building block of the curriculum and encourage explorations that are socially relevant and personally compelling.
- IBL provides opportunities to enrich the experiences of students, sponsors creativity and imagination about alternatives and provides power and freedom to examine and question societal issues related to science.

# ISSUE DOMAINS

- Based on the theory of problem posing education KCF adopted issue based education as it's core and identified eight major issues.

1. Lack of cohesive vision on universal humanhood
2. Lack of human resource development
3. Inability to consider agriculture as part of culture
4. Lack of cultural consciousness and its independent development
5. Lack of consideration towards marginalised sections
6. Lack of eco-friendly industrialisation and urbanization
7. Lack of scientific vision on health and public health
8. Lack of scientific land water management.

# ISSUE BASED CURRICULUM

The aim of education is the welfare and development of all. The needs of society should be reflected in the curriculum.

- Issue based curriculum should ignite the thoughts and attitudes among learners .
- It will help the learners to link life with social problems and opens up avenues to solve them.
- Education will become life centred, meaningful, and enriching.
- Learning focuses not only on scientific concepts, but also on critical thinking and decision making skills.
- Issue based education connects scientific evident to social and political perspectives.
- It promotes scientific literary and higher order thinking level.
- Learners must be sensitized on social issues, at the global level, national level, regional level or local specific.
- Thus education become more fruitful than ever before.

# REVIEW OF THE LATEST HAPPENINGS IN THE SCHOOLING PROCEDURE

## Features of the Curriculum

The curriculum

- Is learner-centred, process- oriented, activity - basic and value oriented.
- gives stress to the learning outcomes that a learner imbibes at the cognitive, social and emotional levels.
- lays stress on the skills to be attained by the learner in values and attitude.
- Is based on the philosophy of constructivism.
- Is flexible to implement various teaching.
- Ensures Free and universal education to all learners.

- Ensures a Continuous and Comprehensive Evaluation(CCE)focused on learning outcomes.
- Stresses Health and Physical Education, Art Education and Work Education.
- Lays stress on the code of professional ethics for school teachers.
- Ensures equity and equality among the learners.

## Features of Curriculum Transaction Approach

- Activity-based
- Process –related
- Ensure learning
- Focus to attain learning outcomes
- Environment –friendly
- Highlights development areas
- Suitable for the nature of the learner
- Integrates learning and assessment

## 2 mark

1. What is collaberative learning?
2. Define critical pedagogy?
3. Briefly explain the role of collaborative learning in social constructivimsm.
4. Distinguish between Behaviourism and Constructivism
5. What is social Constructivism? Who proposed the theory?
6. What is jigsaw technique in teaching? Write any two merits of it.

## 4 mark

1. Explain about Lev. Vygotsky's view of learning.
2. Give a brief account about the elements of collaborative learning.
3. What are the educational implications of social constructivism.
4. Compare constructivist approach to behavioral approach in the teaching of biology.
5. Mention the implications of Piaget's theory in biology teaching.
6. What is jig saw learning? Narrate a topic of your choice for adopting jigsaw learning.
7. Compare and contrast Behaviourism and Constructivism.
8. What is cognitive Constructivism? Explain the theory of Generic epistemology proposed by Jean Piaget.

## 10 mark

1. What is multiple intelligence? How can a biology teacher apply this in his teaching. Discuss.

EDU-05.11-THEORETICAL BASIS OF TEACHING NATURAL SCIENCE

# Unit 5
# Science Education

Shahna Sharin T
Rushda E P
Suneera Chukkan

# Science and society

- It is important to know the students about the inter connectivity of science and society
- The responsibility of science teachers are not only teach facts principles and processes, but also to discharge the social responsibilities and preserve democracy as well
- Students need to understand and participate in the use of science

  a) for the benefit of society

  b) To visualize the future of our nation

  c) And to become responsible citizen
- Science enhanced the quality of our life
- Science is changed over time. The need of society have important role in development of science(in current scenario the need of society is corona vaccine and the science is going with that)
- We see that science and society influenced each other. Educational aims are framed in accordance with our socio-economic and socio –cultural needs

## Science as a social Endeavour

- Science is a never lasting spirit of enquiry.it is the cumulative achievement of human kind. It is the effort all science people from the beginning of mankind and never ending process. because of that science is known as social endeavor.
- This means application of science to figuring out –how the world works /exists/originated etc.
- Another dimension of this is to solve various problems ,satisfy various needs, and sustainable development of society with the help of science knowledge
- The study of science has a social endeavor has a prominent place in curriculum .
- Development of scientific literacy is considered to be the major aim of this.

## Influence of science on society

- We feel the influence of science in everywhere (change in our means of communication, our housing ,clothing, methods of transportation etc.)

- Organized research and development, which are increasingly international in character have greatly influenced the production of new knowledge

- Science influenced society more or less in a positive way. It is also true that it have negative effect also. However science cannot be blamed for its abusive uses. Man is responsible for that

## Positive effects:

**1. Industry**

- Without science we cannot produce enough for the growing population in the world
- Science has helped man to increase production in various ways.
- Textile industry, fertilizer industry etc.

**2. Agriculture**

- Ever increasing demand for food due to the rapidly growing population couldn't have been possible pin the absents of science extensive and intensive agriculture have been made with its help.
- Improved means of irrigation, new machines like tractor, chemical fertilizer, disease resistant verities of seeds are some of its contribution to agriculture

**3. Government**

- Focus on the development of innovative solutions which provides better public services like military defense, health and safety etc.

**4. Medicine**

- Discovery of various Surgical, Anesthetic and Antisepsis, Antibiotics and Antiviral birth control pill, Heart surgery and Cardiac care, Radiologic imaging, Organ transplantation etc.

**5. Education**

- Influence of Science and Technology on education is called learning technology. It facilitate learning by creating, using and managing appropriate technological process and resources.
- It includes software, hardware as well as internet applications and activities.

## Negative effects:

**1.Isolation**

- It is due to lack of contact with other people in normal day living
- Listening to iPods and mobile phones is the reason

**2. Lack of social skills**

- It is because of the use of social media.

**3. Obesity**

- Spending less time being active or exercising leading to obesity

**4. Depression**

- Lack of human contact, over eating and lack of exercise leads to depression

**5. Pollution**

- The level of toxicity in our air and land is increasing
- Air pollution, land pollution, sound pollution.

**6. Shortened attention span**

- Attention span shortened from 12 to 5 minutes (due to increase use of social medias.)

**7. Higher energy consumption**

- People don’t turn their devices off, they keep computer, television plugged in on

**8.Other health issues**

- Neurosis (Mental and emotional disturbances)
- Loss of hearing and eye sight
- Developmental issues in children

**9.Use chemical fertilizer and mechanized farming in agriculture**

**10. Satellites are widely used for espionage purposes**

**11. Nuclear weapons, Bio weapons**

# Scientific literacy

Scientific Literacy : Meaning

- Scientific literacy means :

I. a firm understanding of the nature and key concepts of science

II. The interrelationship between science, technology and society.

III. Being familiar with natural world.

IV. Having capacity for scientific way of thinking

V. Using scientific knowledge for individual and special purpose

- The term scientific literacy was pointing 1991 (De Boer)
- While discussing on scientific literacy Miller (1983) has suggested three dimensions

1. An understanding of key scientific terms and concepts

2. An understanding of norms and methods of science

3. Understanding of impact of science and technology on society

## Definition

- Scientific literacy is defined as “the capacity to use scientific knowledge, to identify questions and to draw evidence – based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity ”

  - Programme for International Student Assessment

## Types of Scientific Literacy

Shen (1975) has identified three types of scientific literacy, such as:

i. **Practical scientific literacy** :- it includes knowledge of science that can be used to solve practical problems. Example – Conservation of water, energy

ii. **Civic scientific literacy** :- awareness of science and science related issues and making opinion about them. Example – protection of environment

iii. **Cultural scientific literacy** :- it includes knowing about the achievements of science as a human enterprises

Example – development of life saving medicines, television as a source of learning and entertainment

## Need and importance of scientific literacy

- A scientifically literate person

I. Can easily understand his immediate environment, influence of science and technology, contemporary problem like pollution global warming etc.

II. Is capable of understanding scientific name technological issues in the contest of economic, environmental, ethical and social consideration.

III. Have increased understanding about nature of science and scientific enquiry.

IV. Undergo moral improvement

V. Responsible for Judicious self direction

## Characteristics of scientifically literate students

- Know and understand the scientific concepts and processes required for participation in society
- Ask, find, or determine answers to questions derived from curiosity about their world
- Describe, explain, and predict natural phenomena
- Read with understanding science articles in the popular press and engage in social conversation about the validity of the conclusions
- Evaluate the quality of scientific information on the basis of its source and the methods used to generate it

# Role of the Science Teacher in Promoting Scientific  Literacy

- Have mastery over his/ her subjects
- Have a good understanding of the nature of sciences
- Be up-to-date
- Be willing to provide suitable situations encouraging students to develop scientific inquiry skills
- Help develop value judgements regarding science – based issues in our daily life

# Misconceptions in science

- Learning is a process in which learner uses existing knowledge as a basis to interpret and construct new ideas
- Hence children's misconceptions, errors or confusions resulting learning blocks

Difference between Pre-concept & mis-concept

- **Pre-concept** :- by seeing & hearing we get superficial ideas about many things and form a mental representation prior to getting actual knowledge or experience

- **Mis-concep**t :- even after exposed to adequate learning experiences, some learners may not comprehend the actual picture. There may be lapses and lacunae in the mental representation of the concept

## Where do Misconception Come From?

1. **Personal experience in the world**
    - Children invent ideas based upon their interpretations of sensory impressions that influence their way of thinking
    - For example, children learn rhymes (twinkle twinkle little star …. Like a diamond in the sky) and perceive stars as diamonds
2. **Informal learning**
    - Casual conversations among friends and peers result in serious misconceptions
    - For example, many of the advertisements are not scientifically true and lead to misconcepts

## 3. Experiences in school

- Figures and diagrams given in textbooks serve the purpose of explaining the present content portion. But the same figure may not be quite suitable for explaining the other aspects

- Foe example, textbook figures of molecules or ions in solution

## 3. Language usage

- in the common language words have one meaning and in the technical sense they have another

- A student knowing only the first meaning and unknowingly using it in the technical sense in a case of misconception

## Some common misconceptions

- Things float if they are light and sink if they are heavy
- Clouds contain water that leaks out as rain
- Trees are only considered plants when they are small
- Air has no weight or mass
- In osmosis one solution diffuses to another
- Light travel further at night than in day time
- Respiration in fishes-oxygen of water molecules used for respiration

## Role of teacher in Overcoming students Misconceptions

The process of replacing a misconception with the scientifically accepted concept is called conceptual change.

- Teacher should aware of misconceptions
- Inquiry oriented investigations can engage students in discussion of scientific ideas in cooperative group work
- Individuals who are asked to predict the results of their experiments are more willing to change their thinking than those who function as passive observers
- Teachers also need to ensure that connections are made in a relevantly between the concepts learned in a classroom and student's everyday life, asking students to describe or represent their own concepts, discussing and evaluating concepts

- Teachers must help students identify and correct their misconceptions
- Teachers must make an effort to determine what “old” misconceptions are present and what “new” ones are being created
- Simply telling students that their present concept is wrong or telling the wrong concept plainly does not help much
- To help students correct their misconceptions you must provide opportunities for them to test their concept

# SCIENCE TEACHER AND SOCIETY

- Science teachers have the greatest part to playing the society.
- Science teachers are the mirror of the society.
- Science teacher should be a good specimen of our culture.
- They are the backbone for the development of the nation.

There are certain roles which have been played by the teachers, they are

- Science teachers in a society impart knowledge on day to day facts and reason out things which are observed.
- They provide the students the power to question and interpret them knowledge and suggestion.
- They are therefore a source of motivation for students to think independently.
- Science helps the student to acknowledge the factsbased on experiments, observation and inferences which is a judgement based on evidence
- They thus enable students to discover new ideas and apply them to the world we live.
- They can inculcate scientific attitudes, temper and habits in the students.

## Role of Science Teachers in Modern Society

- Teachers place in a society is of vital importance.
- A modern is a helping teacher.
- It is the teacher who through the classroom imbibes the feelings of 'Share and Tell', 'Give and Take', 'Think and Do' in the students which is later on generated in the society.
- They should be flexible in his approach.
- Teachers should encourage new trends in the field of education.
- He should be ready to make experiments to make teaching learning process effective by keeping in view new trends, new waves in modern society.

- A teacher is a good counselor.
- People look up to him as a person who really give a good piece of advice.
- Teacher act as a transmitter of values. He is the one who carries higher values, virtues within him so as tobecome a role model of the society and strengtheningthe moral aspect of be society.
- Teachens ghould be epitome of knowledge, enthusiastic,inspire and ignite minds to realisetheir potential tounderstand and innovate the new technology.
- Teachers ane highly thoughtful thinkers always striving to inculate the good values and viruses in eachand every student.
- A teacher should be anenvironmentalist, social worker to give awareness to the peoplearound him.
- The positive attitude towards the naturewill help todevelop the national development and encourage socialwelfare.

# SCIENCE CURRICULUM

## Concept of Curriculum

- The term curriculum is derived from latin word currere which means path.
- In this sense curriculum is the path through which the student has to go forward inorder to reach the goal envisaged by education.
- Usually the term curriculum is understood as a group of students prescribed for study in a particular course.
- Curriculum should be considered as a broad based term encompassing every aspect concerning a course of study.

## Definition of Curriculum

- Curriculum embodies all the experiences which are utilised by the school to attain the aims of education.

  - Munroe

- Curriculum is that which the pupil is taught. It involves more than the act of learning and quiet study. It involves occupation, production, achievement, exercise and activities.

  -H.H.Horne

- Curriculum is the means of achieving the goals of education.
- Includes all these experiments activities and environmental influences which the students receiving during the educational career.

## Curriculum and Syllabus

### Syllabus

- It is verbal, book oriented and theoretical.
- Much more specific.
- Speaking of the details of study.
- The hierarchical order of presenting the content.
- Places more stress on the specific learning materials to be internalised.

### Curriculum

- Much broader and deeper.
- Comprehands every aspects of the educants life.
- Seeks to satisfy all his requirments and aspire to develop every aspect of his personality.

# Type of Curriculum

1. **Transitional or Subject Oriented Curriculum**
   - Emphasis a knowledge including facts, concepts, principles, process and skills in the subject.
   - All stress was on the cognitive attainment of the learners rather than on their personal and social development.
2. **Activity Centered Curriculum**
   - Whatever has to be learnt must be learnt by doing.
   - Subject matters is translated in terms of activities and knowledge is gained as an outcome and product of those activities.
   - Activity is used as a medium for imparting knowledge and developmental status.

## 3. Hidden Curriculum

- Coined by Philip Jackson in 1958.
- It is the process that involves the transmission of normals and values as well as a body of socially approved knowledge.
- Basic concept is that pupil learn things that are not actually taught in the formal curriculum.
- Refers to unwritten, unofficial and often unintended lessons, values and perspectives that students learn in school.
- ‘Hidden’ because it is usually unacknowledged or unexamined by the students, teachers and the wider community.

# Principles of Curriculum Construction

1. **Principle of Child Centeredness**
   - Based on the child's needs, Interest, ability, aptitude, age level and circumstances.
   - Child should be central figure in any scheme of curriculum construction.
   - It meant bring about the development of the child in the desired direction, so that he is able to adjust well in the life.
2. **Principle of Community Centeredness**
   - It is the development of the child of his needs and desires must be in conformity with the need and desires of the society in which he is to live.
3. **Principle of Activity Centeredness**
   - The curriculum should center round the multivariate activities of pupils.
   - It provides well selected activities according to the general interts and development stages of children.
   - It should provide constructive, creative and project activities.

## 4. Principle of Coordination and Integration

- The activities and subjects should not be put in after tight compartments but should be inter-related and well integrated so as to develop the whole child.

## 5. Principle of Conservation

- One of the main functions of education is to preserve and transmit our cultural heritage.
- Culture consists of traditions, custom, attitude, skills, conduct, value and knowledge.
- Curriculum formers must make a suitable selection on the elements of culture keeping in view their educational values and developmental stages of pupil.

## Stages of curriculum development

1. Goal specification

   task of determining specific objectives of teaching a particular course of programme.

2. Planning

   writing outline of the syllabus.

3. Validation

   draft of the curriculum is evaluated and examined by academic experts.

4. Field testing

   approved curriculum is subjected to field testing in a smaller group to collect the feedback.

5. Quality control

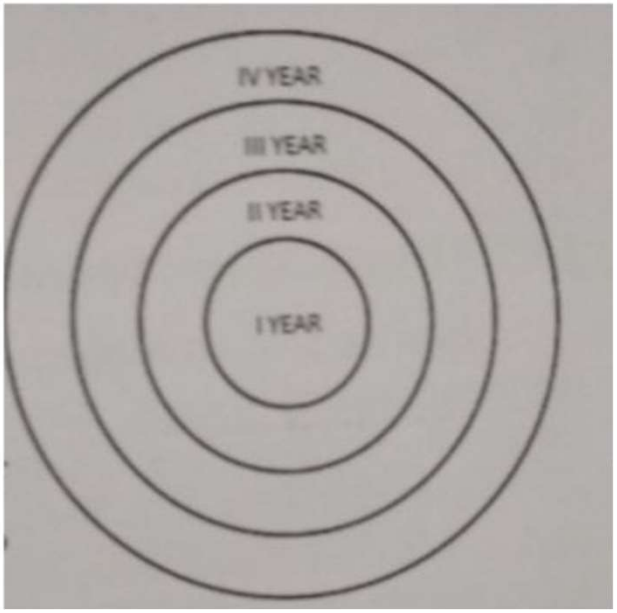
   feedbacks are incorporated into the prototype of the curriculum andis redefined to larger adoption.

# Approaches to curriculum

- Concentric approach
- Spiral approach
- Integrated approach
- Disciplinary approach
- Interdisciplinary approach

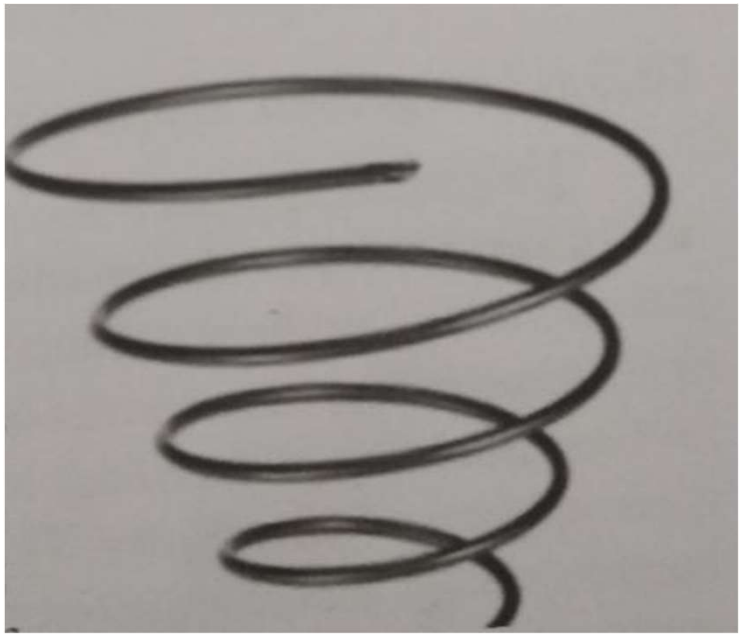
## Concentric approach

- The whole curriculum is spread over a number of years
- Topics are attempted at the beginning.
- Then developed in successive years according to mental development of pupils.
- In beginning whole aspect is given in a simplified way. More and more details are added in coming years.
- It follows maxims of teaching such as whole to part, simple to complex, easy to difficult.
- Opportunity for revising what they learned in the previous years.
- Possibility of losing freshness of subject
- Same teacher should handle the class room up to final year to keep continuity.
- It arouses interest in students.



## Spiral approach

- Contents are explained In depth in same class itself.
- Same content is not discussed in higher classes.
- The linkage between topic is taken care of.
- It is preferred to the concentric.



## Integrated approach

- Subject matter boundaries are ignored.
- Taught in relation to one another.
- Establishing numerous links between the various branches of science or knowledge.

## Disciplinary approach

- Science includes physics, chemistry, botany, zoology etc.
- So the content is treated exhaustively and is made to cover wider areas.
- Provides a sound knowledge of the fundamentals of various science and is more practicable.

# Curriculum reforms abroad

1. Biological science curriculum study (BSCS) – America
2. Nuffield foundation – England

## Biological science curriculum study (BSCS)

- Founded by William V. Mayer, University of Colarado ,USA in 1959.
- Initial goal was the production of classroom materials for average students at the secondary school level.
- Organized to improve biology education at all levels of instruction.
- Developed a wide variety of course materials that offer the teacher maximal flexibility in programming- and the students, optimal use of his talents.
- Produced three sets of course materials for high school biology course.
- Common aim was to make clear to students the nature of scientific enquiry.
- Provides a balanced presentation of biology with great stress on laboratory work.

## Instructional materials developed by BSCS

- Text books
  - * biological science an inquiry into life , yellow version
  - * biological science-molecules to man , blue version
  - * high school biology -green version.
- Teacher's guide
- Laboratory manuals
- Series of laboratory blocks
- Single topic enquiry films
- Program learning materials
- Pamphlet series
- Evaluation guides etc

## Nuffield foundation

- Initiated in U.K in 1962
- It is British charitable educational foundation.
- Production of new materials for the Biology, Physics and Chemistry at the O level for students of age group 11-16.
- Nuffield science teaching projects are following.
- Nuffield O level physics , chemistry and biology – for average and above average( age11-16)
- Nuffield secondary science – for average and below average (11-16)
- Nuffield combined science – for all (11-13)
- Nuffield junior science (7-11)
- Nuffield A level physics, chemistry and biology – pre university course (16-18)

## Objectives of Nuffield science projects

- To make science intelligible and accessible to pupils of all kinds in schools of all kinds.
- To make science a more useful tool, both intellectually and practically.
- To develop material that will help teachers to present science in a lively and exciting manner.
- To develop and encourage an attitude of curiosity and inquiry.
- To develop a program which is relevant to the world outside the classroom.
- To develop a critical approach to the subject with an emphasis on experimentation and enquiry rather than on the mere assimilation of facts.
- The aim is not only to produce a new syllabus, but a new approach to teaching.

## Study materials

- Reading materials in the form of books
- Teacher’s guide
- Films a) dealing with processes b)illustrating experiments c)showing the sequence of a technique.
- Tests made of objective based items.
- Nuffield chemistry project
- Nuffield physics project
- Nuffield biology project

# Correlation in science teaching

- It implies the reciprocal relationship among various subjects in the curriculum.
- This approach helps to obtain a coherent view of science .
- It establishes numerous links between the various branches of knowledge.
- It makes learning easier, more interesting and natural and practically significant to life.
- Types of correlation are incidental or systematic.

## Incidental correlation

- Natural correlation- makes use of usually while teaching a topic.
- This occurs by co-ordinating topics with allied materials from other subjects.
- Success depends on the knowledge and versality of teacher.
- It does not prevent repetition. So students gets bored.
- Eg: a biology teacher , while taking about eye correlates it with camera.

## Systematic correlation

- It is achieved through the careful planning of the curriculum.
- It avoids un-necessary repetition of subject matter.
- Eg: the respiration in chemistry is explained by chemistry.
- Effective when the teachers of different subjects co-operate and co-ordinate.

**Correlation or interdisciplinary approach can be explained under three headings**

1. Correlation of science subjects with one another

   * all the branches of science are inter-dependant and there are a number of facts and principles common to various science subjects.

   * physical sciences are easily correlated to biology.

   eg: teaching of eye - camera, convex lens

   transpiration - evaporation

2. Correlation of science with other subjects.

   *it will arouse interest in the pupils who associate the knowledge they have already acquired in other subjects.

   * eg : science with maths , genetics – ratio , gas laws –proportion and equations.

   * science with geography , topics like pressure, temperature , humidity and living thing is common for both subjects.

   *science with history – history of plants and animals , inventions

3. Correlation with social and physical environment

   *everything around us is directly or indirectly related to science.

## Advantages of correlation

- Motivation
- Integration of knowledge
- Practice
- Mental horizon
- Economy of effort
- Transfer of training
- Correlation with life

# 2 marks questions

1. What are the stages of curriculum development?
2. What is concentric approach of curriculum?
3. Why science is called as a social endeavor ?
4. Writ any three examples for students misconception

# 4 marks short essay questions

1. What is the correlation in science teaching?
2. What are the approaches of curriculum?
3. What is mean by scientific literacy. Mention its types
4. What is the roll of teacher in overcoming students misconception
5. What is 'Hidden Curriculum'?
6. Difference between Syllabus and Curriculum.

# 10 Mark Questions

1. Explain the curriculum reforms abroad.
2. Analyze the influence of science in society
3. What is the role of science teachers in the society?