Farook Training College Innovative Academia (FTCIA)

Online Collaborative Learning Project (OCLP)

Pre-Edited Version of Study Materials.

(Chance for minor errors)

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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

EDU 05.12   THEORETICAL BASIS OF TEACHING PHYSICAL SCIENCE

Unit 1

INTRODUCTION TO TEACHING PHYSICAL SCIENCE

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MEANING OF SCIENCE

- The word science has been derived from the Latin noun 'scientia' which means knowledge.

- From the Latin verb "scire" means to "to know"

- In the literal sense the term 'science' refers to percuit of knowledge

Definitons

"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 observation."

<div align="right">Frederick Fitzpatrick (1960)</div>

"Science is nothing but systematized and organized common sense"

<div align="right">Aldous Huxley</div>

Science is first of all a set of attitudes. It is disposition to deal with facts rather than with what someone has said about them.

B.F Skinner

"Science is a history of corrected mistakes"

Karl Popper

"Any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation."

Encyclopedia Britannica

Nature of physical science

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

Science = inquiry + Knowledge + social aspects

- Some educators and philosophers explained nature of science in three parts

1. substantive structure of science(knowledge, concepts, conceptual schemes of science)
2. syntactical structure of science (process of science such as observation, measurements, classification, prediction, experimentation)
3. Social perspectives of science (relationship of science with technology)

Scope of science

Scope of science includes:

- Science help us to understand ourselves better
- Science help us to meet our needs
- Science help us to solve so many problems that may arise in our daily lives
- Science help us to understand our responsibilities to protect our environment
- It necessitates the importance of the conservation of the natural resources
- It provide number of career opportunities

Science as a process

- The way gathering information, thinking, measuring, problem solving are called Process of science
- The basic process of science are observation, comparison, classification, communication, measurements, estimation and prediction
- The quality of knowledge acquired in science depends on the quality of process skills applied
- VARIOUS PROCESSES OF SCIENCE CLASSIFIED UNDER FIVE CATEGORIES.

  1. Collection of data

  2. Analysis of data

  3. synthesis of data

4. Evaluation of data

5. Application of generalisation to new situations

- Apart from the basic process of skills ,Integrated skills are required that are,

1. Identifying and controlling variables
2. Defining operationally
3. Forming hypothesis
4. Experimenting
5. Tabulating and graphing
6. Interpreting data
7. Testing hypothesis
8. Drawing conclusions

- Through these process of skills pupil learn to unfold the mysteries of nature
- According to Dr.D.S.Kothari "to learn science is to do science,there is no other way of learning science"

Science as a product

- Whatever information or ideas we acquire through various Process of science form the body of knowledge or product of science
- That results accumulation of huge quantum Of knowledge
- The basic components of the product of science are facts, concepts, principles, theories and laws
- However science is dynamic in nature, information constantly being rearranged and reoriented in the light of new knowledge

Values of Teaching PS

- INTELLECTUAL VALUES
- UTILITARIAN VALUES
- VOCATIONAL VALUES
- AESTHETIC VALUE
- CULTURAL VALUE
- RECREATIONAL VALUE
- MORAL VALUE
- DISCIPLINARY VALUES

Intellectual

- Science is an intellectual process. It helps us to think well and promotes reasoning capacity.
- The creative and critical thinking of individuals become developed with science
- The understanding of various concepts encourage us to analyse situations and make decisions and make decisions wisely.
- It helps us to adjust with our surroundings and effectively utilize our resources Intellectual value

Utilitarian Value

- All our activities are controlled, designed & Fashioned by Science. Science has entered in our daily activity, life rescue interventions, inventions and innovations.
- Without Science our existence would become impossible
- Improved our Standard of Living
- It is very Essential to have elementary knowledge for becoming useful, productive, responsible member of the community

Cultural Value

- Science forms an essential part of our social heritage, it is a legacy of mankind passed on from generations to generation
- It influenced our way of thinking & way of life
- Development of technologies has provide changes in the society by promoting new cultural models
- We must preserve and spread our culture
- Our invention must not spoil our culture and future generation

Disciplinary

- Science is an organized common sense it has introduced us to new way of thinking and reasoning
- It makes people to sharpen their intellect and makes them more careful & systematic reasoning
- The Science education will develop the positive attitude like open mildness, logical reasoning
- It helps in solving problems in life and to lead happy life

Aesthetic

- Knowledge of Science develops in man a passion for truth ; thus he has a passion of beauty
- Nature is store house off all beautiful things
- There is no difference between Art and Science
- Science is primarily unfolding of mysteries of nature
- Teaching of SCIENCE is essential for developing Aesthetic sense in an individual

Moral

- Knowledge of Science develops Truthfulness and Reasoning
- These qualities make the life worth living

Psychological

- Teaching of Physical science is essential for developing scientific attitude
- Science develop positive attitude such as open mindedness, critical observation, reasoning and respect others point of view
- Learning by doing & learning by observing

Vocational

- Science forms the basis of many of the individuals of a purely Vocational in nature and thus prepares for a various professions like Medicine, Engineering, Dental, Agriculture, Computer Etc

- Thus it is a Quite clear that a subject which is so closely associated with our daily life and the world which surrounds around us and it is so useful to an individual as well as to a community as a whole cannot be neglected from the school curriculum

Evolution of PS as a School Subject

A global view

- Roger Bacon- first to lay emphasis on the value of experiments & inductive enquiry (1214-1249)
- Francis Bacon- brought them to the notice of the world– advocated sense training (1561-1626)
- Galileo Galilei (1564-1642)
- William Harvey
- Audreas Vesailus
- John Amos Comenius- emphasized importance of objects and pictures in teaching (1592-1670)

- Establishment of Royal Society in 1664 is a landmank in the history of science education
- 17th century- various science academies were established
- 18th century- industrial revolution- brought science closer to common man
- Univ of London (opened in 1827)- Natural science was taught- T.A Guxley, John Tyndall, Faraday urged for science education
- First employed science teacher – William Sharp
- @ Rugby School, Britain , 1850 (1849)- Botany, Geology, Physics & Chemistry
- 1867- British Academy for the advancement of Science (BAAS) published a report to promote teaching of "pure science" and training of the "scientific habit of min

- 1870- founding of London School Board
- Initiation of courses to train teachers
- Influence of Thomas Henry Huxley (neurosurgeon) and John Tyndall (diamagnetism, IR radiation)- demarcation of science from religion
- 1890- science as a subject in schools in US
- H.E. Armstrong- Heuristic Method of teaching (close of 19th century)
- 1916- British Govt appointed Sir J.J.Thomson to enquire into the position of natural science in the educational system and presented the Thomson Report titled 'Natural Science in Education'
- 20th century- rapid progression of science education all over the world

In India- before the British

- A flourishing tradition of scientific research & technological development since 2600 years.
- Takshashila and Nalanda Universities- attracted students from all over the world
- Education focussed on I is soul not mind and body
- Tradition of original thinking, adventure of ideas and creative innovations
- Mathematics, astronomy, medicine, surgery & metallurgy
- Sushrutha- Father of Indian surgery

During the British

- Not an organic extension of the earlier tradition, but an implant by the British in an alien language.
- Only such developments were introduced that did not lead to a conflict with the interests of the colonial power.
- Only aim of education- to turn out men competent to serve the civilian administration
- Science education & research was uneven & patchy with no facilities

- 1857- Univ of Bombay, Calcutta & Madras
- Even adverse conditions produced globally competitive scientists – C V Raman, M N Saha, S N Bose, S Ramanujan, Homi Bhabha, S. Chandrashekhar…..
- Outbreak of World War I

Post Independence

- Nehru, a great visionary
- 1958- Scientific Policy Resolution
- 1964- National/Kothari Commision on Education led to NPE (1968)
- 1968- Technology Policy Resolution
- Constitutional amendment of 1976 places education, incl science & technology in the concurrent list
- 1986- national Policy was modified & updated
- 1992- Ramamurthy Committee Report
- Establishment of MHRD, UGC, AICTE by acts of parliament

Scientific Attitude

Science teaching and learning has three main groups of aims:

1. To develop scientific processes- skills,
2. To foster the acquisition of conceptual knowledge
3. To develop particular attitudes which are related to scientific knowledge, its ways of thinking, its ways of working and the impact that science has in our environment, culture.

- Achievement in science of a learner is the resultant of learning experiences of various kinds. It is a product variable and is influenced by several independent variables (Rao, 1996), which are obviously the determinants of effective science learning. The factors like scientific aptitude and scientific attitude are few among the major aspects to qualify an individual to live as an effective citizen in the present scientific society.
- An attitude is a condition of mind that brings in imagination & emotional states which are the outcome of previous experiences. It is the sum total of man's inclinations & feelings, prejudices & biases, preconceived notions, ideas, threats & convictions about any specific topic.

- Attitudes related to science in the primary school belong to two main groups:
a) scientific attitudes
b) positive attitudes towards science.
- A measure of the students' expressed preferences and feelings towards science
- They influence students' motivation and interests, and, therefore, in their behaviour.
- They also influence the transcendental decision of studying science in secondary education and can help to develop their confidence in dealing with science in terms of curiosity and systematic inquiry that may foster the development of children character.
- When children reach the post-primary school, they will have experienced six years of primary schooling and by this stage will have developed their attitudes to science.
- Some studies reveal that most of the older pupils (10-12 years) had significantly fewer positive attitudes than younger ones (7-9 years) towards science.

- Scientific attitudes are a mixture of the willingness to know and apply a scientific approach ,to face any task of problem-solving with respect for logic and critical thinking. These attitudes include curiosity, honesty in the recording and validation of data, flexibility, persistence, open-mindedness, willingness to tolerate uncertainty, and an acceptance of the provisional nature of scientific explanation, perseverance, originality, responsibility, independence of thinking, co-operation, selfcriticism. These are the features that characterise scientific thinking.
- Teachers and society should try to achieve these attitudes through school activities in teaching and learning science

Positive Attitudes Towards Science

- An early categorisation of students' affective behaviours towards science is:
  - ❖ Acceptance of scientific enquiry as a way of thought;
  - ❖ Adoption of 'scientific attitudes';
  - ❖ Enjoyment of science learning experiences;
  - ❖ Interests in science and science-related activities; and
  - ❖ Interest in pursuing a career in science or science-related work.

Indicators of Scientific Attitudes

- Attitudes are manifested through behaviour. Therefore, in designing activities to promote the development of attitudes, it is advisable to consider indicators/behaviours associated with them
- ATTITUDE: WILLINGNESS TO COLLECT AND USE EVIDENCE

  - ❖ Reporting what happened, even if this conflicted with expectations
  - ❖ Querying and checking parts of the evidence which do not fit into the pattern of other findings
  - ❖ Querying an interpretation or conclusion for which there is insufficient evidence
  - ❖ Setting out to collect further evidence before accepting a conclusion
  - ❖ Treating every conclusion as being open to challenge by further evidence

- ATTITUDE: WILLINGNESS TO CHANGE IDEAS IN THE LIGHT OF EVIDENCE
(Flexibility combined with open-mindedness)

  ❖ Being prepared to change an existing idea when there is convincing evidence against it
  ❖ Spontaneously seeking alternative ideas rather than accepting the first one which fits the evidence
  ❖ Relinquishing an existing idea after considering evidence
  ❖ Realising that it is necessary to change ideas when different ones make better sense of the evidence

- ATTITUDE: WILLINGNESS TO REVIEW PROCEDURES (Critical Reflection)

❖ Willingness to review what they have done to consider how to improve
❖ Considering alternative procedures to those used
❖ Considering the points in favour and against how an investigation was carried out
❖ Spontaneously reflecting on how the procedures might improve
❖ Considering alternative procedures at the planning stage and reviewing those chosen during an investigation, not just at the end

Characteristics

- Open mindedness
- Objectivity
- Freedom from belief in superstitions
- Belief in cause – effect relationship
- Accuracy & truthfulness in reporting observations
- Methodical way of solving problem on hand
- Up-to-dateness
- Respect for other people's opinion, though he may not agree with them
- Ability to distinguish between scientific evidence & scientific proof
- Ability to discern between fact & fiction

- How can we help children to acquire and develop attitudes?

The problem of declining interest in school science is international. Among the main factors, influencing this problem is the content-driven of the science curriculum and the ineffective methods of science teaching. To make the children's experience of science in primary school relevant, we can propose two main avenues of action:

a) Increasing the amount of practical, investigative work in science and
b) Using ICT, due to the positive effect they have in their enjoyment of science.

Both will increase pupil's interest and motivation, as well as their curiosity and desire for understanding

Some more Techniques:

- Use of wide reading
- Use of planned exercises
- Proper use of laboratory period
- Co-curricular activities in science
- The atmosphere of the class
- Field trips and visits
- The personal example of the teacher
- Science club activities,….

- The Constitution of India encourages the citizens of India to have a sense of scientific temper. According to the Fundamental Duties under Article 51 A(h):

- [It shall be the duty of every citizen of India] To develop scientific temper, humanism and the spirit of inquiry and reform.

- Scientific temper describes an attitude which involves the application of logic. Discussion, argument and analysis are vital parts of scientific temper. Elements of fairness, equality and democracy are built into it. Prime Minister of India Jawaharlal Nehru was the first to use the phrase in 1946 in India.

Scientific Aptitude

- Bingham: Aptitude refers to new qualities Characterizing persons way of behaviour Which serve to indicate how well he can learn to meet and solve certain specified kind of problems
- Freeman:Aptitude is a compination of characteristics indicative of individuals capacity to acquire some specific skills
- Scientific Aptitude is an inherent ability which helps in acquiring required Skills and proficiency in the field of science
- It cannot be created ,it exists to the individual which may perfected through the study of science

Branches of science
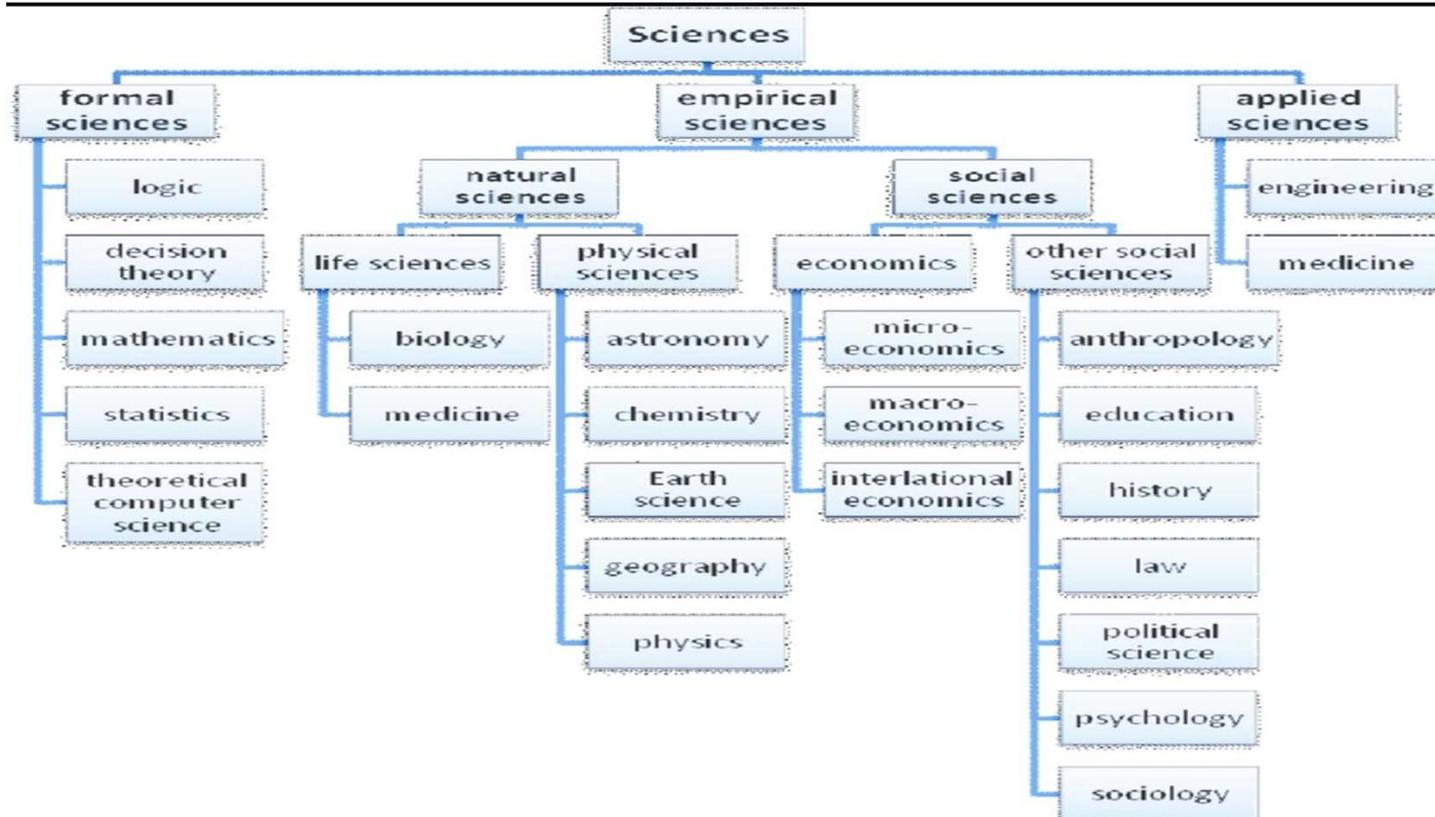
Emergence of interdisciplinary subjects

- Interdisciplinary learning in science is characterized as a perspective that integrates two or more disciplines into coherent connections to enable students to make relevant connections and generate meaningful associations
- Some of the topics studied by interdisciplinary science students include: Astrophysics. Nanotechnology, bio medical engineering

- The main aim of interdisciplinary research aim to build knowledge by hypothesizing new theories and discovering laws

2 Mark Questions

1. List any two emerging interdisciplinary branches of science
2. List four process of science
3. Using a definition bring out the process and product aspects of science
4. List any four emerging interdisciplinary subjects in the field of science

4 Mark Short Essays

1. Science is a process and product .Elaborate the concept
2. What is scientific attitude ? suggest five Strategies for promoting scientific attitude
3. Distinguish between product and process approach in teaching physical science
4. Distinguish between scientific attitude and scientific aptitude

10 Mark Essays

1. Scientific attitude and scientific aptitude are two essential outcomes of science learning. substantiate

EDU 05.12 THEORETICAL BASES OF TEACHING PHYSICAL SCIENCE

Unit 2

AIMS, OBJECTIVES AND VALUES OF TEACHING PHYSICAL SCIENCE

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Aims of Teaching Physical Science

- To acquire knowledge about the world which we live
- To understand science as a discipline
- To develop scientific temper
- To develop interest towards science
- To acquire skills in experimentation, observation, drawing, problem solving etc.
- To provide training in scientific method
- To help pupils to become good individuals in the society
- To help pupils choose careers in Science

Difference between Aims and Objectives

Aims	Objectives
Long term goals	Short term goals
General in nature	Specific in nature
Limited in number	More in number
Influenced by the school as well as society	Mainly accomplished in school

There can be three different objectives,

1. Institutional Objectives for schools and colleges

2. Instructional Objectives for each separate course of instruction

3. Specific outcome of learning or Specifications

	Breadth	Number
Institutional Objectives	Broad, General Goals	A few per school
General Instructional Objectives	More precise, but are too broad to define very precisely	Moderate in number
Specific outcome of learning or Specifications	Specific Precise Narrow observable	More in number (Many expected behaviours)

Instructional Objectives and Specification

- Instructional objectives are statements that express the expected learning outcomes of the learners at the end of instruction.
- Statements expressed in behavioral terms that identify the end product of instruction in terms of observable and measurable performance of students are specific objectives or specifications.

Example:

Objective 1 – Knowledge

The pupil acquires knowledge of terms, facts, symbols, formula in the field of Physical Sciences.

Specification:

1. Recalls facts, concepts properties etc.
2. Recognises facts, concepts, instruments, devices, substances etc.

Contd...

Objective 2 – Understanding

The pupil understands concepts, principles, definitions, equations in Physical Sciences.

Specification:

1. Illustrates a phenomenon or principle.
2. Gives experimental or theoretical proof.
3. Identifies relationship between concepts, principles .
4. Interprets charts, graphs .
5. Cites examples....etc.

Objective Based Instruction

Objective, learning experience and evaluations are interrelated. The interrelationship between objectives and evaluation is evident from the fact that evaluation is based on objectives and those objectives are selected as can be measured and evaluated. The close relationship between the three are symbolically represented in the diagram.

Objective

Learning Experience   **Evaluation**
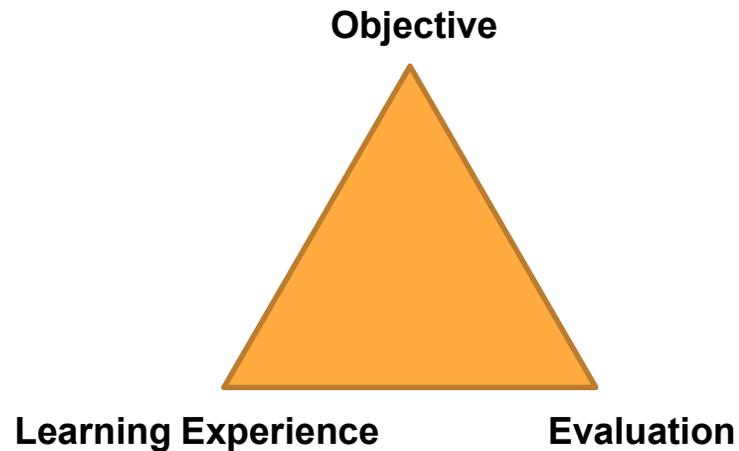
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When planning an educational session, teacher has to pay attention about how the objectives will be achieved (through appropriate teaching and learning activities), and how the learning outcomes will be assessed and once the objectives are defined,the learning is oriented towards accomplishment of the pre-set objective. Therefore teaching learning activities are planned to meet the specific instructional objectives. Thus the instruction is objective based.

Objective Based Evaluation

- Evaluation based on pre-determined objectives is called objectives based evaluation.
- "What to measure and evaluate"? Is the crucial problem in evaluation.
- There is relationship between objectives, learning experiences and evaluations.
- Any experience provided in the class room which results in learning is called learning experiences.
- Instruction aimed at the attainment of pre-determined objectives is called objective based instruction.
- The evaluation based on pre-determined objectives is called objective based evaluation.

Learning Experiences

- Desired changes in behavior is called learning. It refers to mental, emotional and physical reaction.
- Change in behavior means responses to stimuli.
- Learning Experience is the interaction of the learners and the situation provided by the teacher.
- Situation should be provided as per the objectives and tools available for evaluation.
- Learning experiences are student's activities planned with specific purpose of producing desired change.
- Activities which include an arrangement of teaching aids, questioning, explanations, observations, visits, handling of apparatus, models, charts, reading, writing etc. Leads to learn.

Contd....

There are two types of learning experiences,

1. Direct learning experiences
(eg: observing and experimenting with materials)
2. Indirectct learning experiences
(eg: observing pictures, maps and charts)

Instructional Objectives of Teaching Science

- An objective is an immediate reality which can be accomplished after a lesson, whereas the aim is a long goal often realised with the joint effort of school and the community
- Objectives are the parts of aim and they fall in the same line, one contributing to the fulfilment of the other.
- Aims are like ideals, the ultimate expectation, the realisation of which may or may not be possible to the expected extent. They need a long term planning.
- Objectives are the ways and means of achieving the aims in a realistic and definite way.

Example – My **Aim** is to make a sense of scientific temper in my student

My **Objective** today is to teach my students about surface tension

Purpose of Instructional Objective

Instructional Objectives	Announce what is expected of students after a segment of instruction.
	Directs teacher to select appropriate instructional devices, activities and procedures for teaching.
	Assists in determining the apprpriate methood of evaluation.

- Objectives are specific – It describes precisely what the learner will be able to do.
- Objectives are outcome based – It describes the output after instruction is complete
- Objectives are measurable – It describe the effects in the learners that can be seen or heard

Bloom's Taxonomy of Instructional Objectives

- Benjamin S. Bloom (1956) University of Chicago proposed the classification of educational objectives
- Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition. Ie, thinking, learning and understanding
- A goal of Bloom's Taxonomy is to motivate educators to focus on all three domains, creating a more holistic form of education

Domains of Educational Activities

According to Bloom all behavioral changes fall under three domains,

1) Cognitive Domain

2) Affective Domain

3) Psychomotor Domain
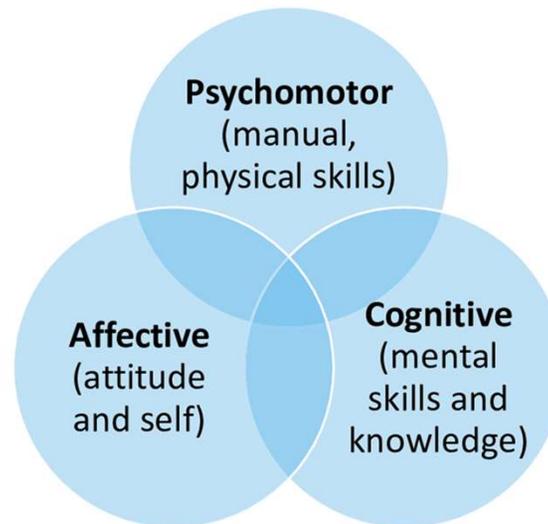
Cognitive Domain

Cognitive Domain deals with thinking and information processing and is concerned with changes in the head region
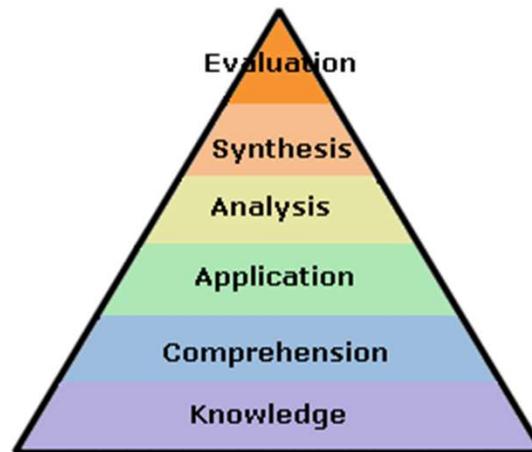
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a. Knowledge – Focuses on memorization, recognition, and recall of information.
b. Comprehension – Focuses on organization of ideas, interpretation of information, and translation.
c. Application – Focuses on problem solving, use of particulars, and principles.
d. Analysis – Focuses on finding the underlying organization, and the division of a whole into components.
e. Synthesis – Focuses on a combination of ideas to form something new, creating something unique whether verbal or physical.
f. Evaluation – Focuses on making judgements, resolving disparities or disagreements .

Affective Domain

Affective Domain is related with attitudes; emotions and values. It deals with changes in the heart. There are five levels in the affective domain.
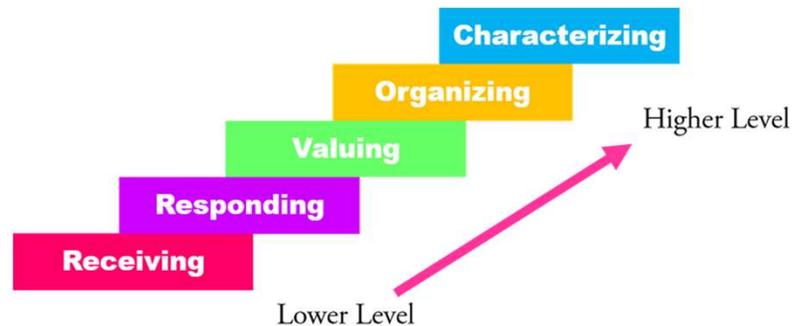
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a. Receiving – Passive attention of learner thar results in memorizing and recall
b. Responding – Active attention by learner which further reinforces learning
c. Valuing – Learner attaches value to the knowledge gained, be it a piece of information or a phenomenon
d. Organizing – Learner gains the ability to present information in a meaningful manner, by organizing, comparing and relating
e. Characterizing – Learner Develops a belief or attaches a value to something, which his or her work behavior

Psychomotor Domain

Psychomotor domain indicate motor changes in the individual. The level of the coordination includes speed, accuracy and grace of body movements. Dave's classification of psychomotor domain is as follows,

a. Imitation – Learns by watching and imitating actions
b. Manipulation – Actions performed through memorization or following directions.
c. Precision – Performance becomes more exact and action are more precise.
d. Articulation – Several skills can performed together in a harmonious way.
e. Naturalization – High level performance achieved with actions becoming second nature

Revised Bloom's Taxonomy

- Bloom's taxonomy is a model of classification of thinking in to multilevel in increasing order of complexities.
- The original Bloom's taxonomy was revised in 2001 by Anderson and krathwohl.
- The revised Bloom's taxonomy provides the measurement tool for thinking.
- The changes in RBT occur in three broad categories:

  1. Terminologies

  2. Structure

  3. Emphasis

1956

2001

Evaluation → Create

Synthesis → Evaluate

Analysis ← Analyze

Application ← Apply

Comprehension ← Understand

Knowledge ← Remember
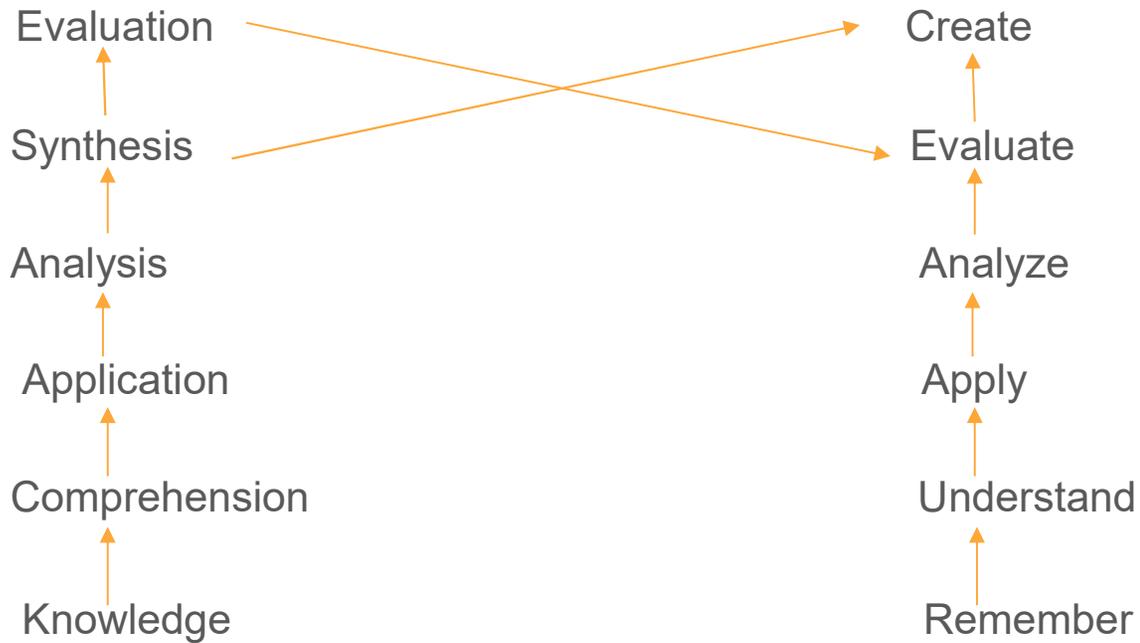
Changes in terms

- The names of six major categories were changed from noun to verb forms.
- Taxonomy reflects different forms of thinking and thinking is an active process, hence verbs are more accurate.
- The knowledge category was renamed. Knowledge is a product of thinking and was inappropriate to describe a category of thinking and was replaced with word remembering instead.
- Comprehension became understanding and synthesis renamed creating in order to better reflect the nature of the thinking described by each category.

Remembering (Knowledge)

- The learner is able to recall, restate and remember information.
- Key words for remembering

 Recognizing

 Retrieving

 Choosing

 Describing

 Defining

 Identifying

 Labelling

 Listing……

Understanding (Comprehension)

- The learner grasps the meaning of information by interpreting and extrapolating what has been learned.
- Key words for understanding
  Comparing
  Contrasting
  Demonstrating
  Interpreting
  Explaining
  Extending
  Giving examples……..

Applying

- The learner make use of the acquired knowledge, facts, techniques and rules in a different way.
- Key Words For Applying
  - Applying
  - Solving
  - Using
  - Constructing
  - Experimenting
  - Developing
  - Carrying
  - Computing
  - Implementing......

Analyzing

- The learner breaks learned information in to its parts determining how the parts relate or interrelate to one another or to an overall structure or purpose through differentiating, organizing, and attributing.
- Key words for Analyzing
    Analyzing
    Comparing
    Contrasting
    Discovering
    Differentiating
    Attributing
    Detecting
    Examining……

Evaluating

- The learner makes decisions based on in depth reflection, criticism and assessment through checking.
- Key words for evaluating
   Judging
   Evaluating
   Appraising
   Defending
   Criticizing
   Assessing
   Justifying……

Creating

- The learner creates new ideas and information using what have been previously learned.
- Key words for creating
    Designing
    Constructing
    Planning
    Producing
    Inventing
    Devising
    Making…..

Structural Changes

- Bloom's original cognitive taxonomy was a one – dimensional form consisting of Factual, Conceptual and Procedural - but these were never fully understood of used by teachers because most of what educators were given in training consisted of a simple chart with the listing of levels and related accompanying verbs.
- The Revised Bloom's Taxonomy takes the form of Two dimensional table.

  1. The knowledge dimension or the kind of knowledge to be learned

  2. Cognitive process dimension or the process used to learn.

The Knowledge Domain

- FACTUAL KNOWLEDGE – refers to the essential facts, terminology, details or elements student must know or be familiar with in order to solve a problem in it.
- CONCEPTUAL KNOWLEDGE – is knowledge of classification, principles, generalizations, theories, models or structure pertinent to a particular disciplinary area.
- PROCEDURAL KONWLEDGE – refers to information or knowledge that helps students to do something specific to a discipline subject, area of study. It also refers to methods of inquiry, very specific or finite skills, algorithms, techniques and particulars.
- META-COGNITIVE KNOWLEDGE – is a strategic or reflective knowledge about solving problems, cognitive tasks to include contextual and conditional knowledge and knowledge of self.

Change in emphasis

- Emphasis is the third and final category of changes.
- It is placed upon its use as a more " authentic tool for curriculum planning, instructional delivery and assessment'.
- Easily applied to all levels of schooling.

Taxonomy Of Mc Cormack & Yager

- Mc Cormack and Yager (1989) developed a new " Taxonomy for science Education" that broadens the view of science education beyond the two domains of content and processes.
- The domains which come under this taxonomy are

Domain 1- Knowing and understanding (conceptual domain)

The concepts which the learner acquires and understands through relating them with the previous knowledge gets integrated in to his conceptual domain.

The knowing and understanding domains includes :

1. Facts
2. Concepts
3. Laws
4. Principles
5. Existing hypothesis and theories

Domain 2- Exploring and Discovering (Process Domain)

- It focuses on the use of the processes of science to learn how scientists think and work.
- Its includes 13 process skills identified by American Association for the Advancement of science as follows
1. Observing
2. Classifying and organizing
3. Measuring
4. Communicating
5. Using number and relations
6. Predicting
7. Using number relations
8. Hypothesizing
9. Inferring

10. Identifying and controlling variables
11. Making operational definitions
12. Interpreting data
13. Experimenting

Domain 3 – Using And Applying (Application Domain)

- Students applying the scientific concepts and process skills to solve a problem in their real life situation
- This can be done by correlating science and technology with current social problems.
- Dimensions of this domain includes
  1. Critical Thinking
  2. Seeing instances of scientific concepts in every day life experiences
  3. Applying learned science concepts and skills to everyday technological problems
  4. Integrating science with other subjects
  5. Using scientific processes in solving problems that occur in everyday life
  6. Understanding and evaluating media reports on scientific developments.

Domain 4 – Feeling and valuing(Attitude Domain)

Attitudes

Attitudes towards science   Scientific Attitudes

- The confidence of the students can be increased by developing a positive attitude towards the problems and subjects.
- Personality is also influenced by inculcating a positive attitude in students mind.
- This domains includes
- 1. Developing positive attitudes towards science in general.
- 2. Developing positive attitudes towards oneself.
- 3. Exploring human emotions.
- 4. Making decisions about social and environmental issues.

Domain 5 – Imagine and Creating (Creativity Domain)

- This provides a little formal attention towards the science programes to the development of student's imagination and creative thinking.
- Some of the human abilities are important in this domain:
  1. Visualizing – producing mental images
  2. Combining objects and ideas in new ways
  3. Producing alternate or unusual uses for objects
  4. Solving problems and puzzles
  5. Divergent thinking
  6. Using open ended questions
  7. Imagination
  8. Designing devices and machines
  9. Producing unusual ideas .

Domain 6 – Nature of science domain

- The nature of science domain calls for experience in;
  1. Farming of questions for scientific research
  2. The methodology used in scientific research
  3. The ways in which teams cooperate in scientific research
  4. The competitive side of scientific research
  5. The interactions among science, technology, economy, politics, history, psychology and philosophy.
  6. The history of science idea.

Bloom's Digital Taxonomy

- In 2007 Andrew Churches further developed and refined Bloom's Taxonomy to Bloom's Digital Taxonomy.
- Its an attempt to supplement the original structure with more action verbs associated with digital approaches and tools.
- Its helps to have a list of verbs to know what actions define each stage of the taxonomy
- The verbs are applicable to facilitating technology use in the modern class room.

Bloom's Digital Taxonomy

Higher Order Thinking Skills

Key Terms

Creating — Verbs → **Designing, constructing, planning, producing, inventing, devising, making,** programming, filming, animating, blogging video blogging, mixing, re-mixing, wiki-ing, publishing, videocasting, podcasting, directing, broadcasting

Evaluating — Verbs → **Checking, hypothesising, critiquing, Experimenting, judging, testing, Detecting, Monitoring,** blog commenting, reviewing, posting, moderating, collaborating, networking, refactoring, testing.

Analysing — Verbs → **Comparing, organising, deconstructing Attributing, outlining, finding, structuring, integrating,** mashing, linking, validating, reverse engineering, cracking, media clipping

Applying — Verbs → **Implementing, carrying out, using, executing,** running, loading, playing operating, hacking, uploading, sharing, editing

Understanding — Verbs → **Interpreting, Summarising, inferring, paraphrasing, classifying, comparing, explaining, exemplifying,** advanced searches, Boolean searches, blog journaling, twittering, catergorising, tagging, commenting, annotating subscribing.

Remembering — Verbs → **Recognising, Listing, Describing, Identifying, Retrieving, Naming, Locating, Finding,** bullet pointing, highlighting bookmarking, social networking, social bookmarking, favouriting/local bookmarking, searching, googling.

LOTS
Lower Order Thinking Skills

COMMUNICATION SPECTRUM

Collaborating

Moderating

Negotiating

Debating

Commenting

Net meeting
Skyping
video conferencing

Reviewing

Questioning

Replying

Posting & Blogging

Networking

Contributing

Chatting

e-mailing

Twittering/Microblogging

Instant messaging

Texting

1. Remembering : Retrieving, recalling or recognizing knowledge from memory.

The digital additions and their justification are as follows:

Bullet pointing

Highlighting

Book marking or favouriting

Social networking

Social book marking

Searching or googling

2. **Understanding:** Constructing meaning from different types of function be they written or graphic.

The digital additions and their justification are as follow

Advanced and Boolean searching

Blog journaling

Twittering

Categorizing

Commenting and annotating

Subscribing

3. APPLYING: Carrying out or using a procedure through executing or implementing.
   The digital additions and their justifications as follows :
      Running and operating
      Playing
      Uploading and sharing
      Hacking
      Editing

4. ANALYSING : Breaking materials or concepts into parts, determining how the parts relate or interrelate to an overall structure or purpose.
The digital additions are as follows;
      Mashing
      Linking
      Reverse engineering
      Cracking
      Validating
      Tagging

5. EVALUATING : Making judgments based on criteria and standards through checking and critiquing.
   The digital additions are as follows;
      Blog or Vlog commenting and reflecting
      Posting
      Moderating
      Collaborating and networking
      Testing

6. CREATING : Putting the elements together to form a coherent or functional whole; recognizing elements into a new pattern or structure through generating, planning, or producing.
The digital additions are as follows;
      Programming
      Filming, animating, videocasting, podcasting and remixing
      Directing and Producing
      Publishing.

Process Skills In Science

- Science process skills can be defined as a set of broadly transferable abilities, appropriate to many disciplines and reflective behavior of scientists.
- Simply science process skills are the processes which are being used by various scientists while doing science.
- The 13 process skills are approved by UNESCO
  1. Observing
  2. Classifying
  3. Measuring
  4. Communicating
  5. using number relations

6. Using Space time relationship
7. Inferring
8. Predicting
9. Making Operational definitions
10. Formulating Hypothesis
11. Interpreting
12. Controlling Variables
13. Experimenting

1. Observing
- Through observation the learner acquires knowledge through his sense organs. Observation should be objective and meaningful. Thus observations become an integral part of the method of science.

2. Classifying
- Classification means recognizing more and more properties (collected information) and ordering them. The skill of classification varies with age, standard, and mental growth of the learners.

3. Measuring
- Measuring is a part of scientific investigation process. The skill of measuring can easily be practiced along with other skills rather than in isolation.

4. Communicating
- Acquisition of knowledge becomes fruitful only when the gathered knowledge is communicated to others.
- Different ways for communication - oral, written, etc.
- More effective, when it is done through the most scientific way and with supporting material.

5. Using number relations
- This process skill refers to the ability to illustrate the available data using mathematical language. See, such a learning activity.

6. Using space time relationship
- Ability to find out the relationships, between size, shape, distance, movement, speed, directions, time etc.
- When we make garden, what are the factors related with the above process skill.

7. Inferring
- Ability of drawing conclusions by analyzing the data properly.
- It is more than mere observation or data collection.
- When we analyze a table of data what are the inferences that we can make?

8. Predicting
- Ability to forecast what would happen in future
- It is based on data obtained so far
- In science, prediction is valid only with the support of scientific evidences.
- The students of science should develop skill of prediction based on the science concepts acquired by them so far.

9. Making operational definitions
- Define a scientific concept operationally
- The definitions, he makes may reflect his experiences also.
- Whenever he wants to apply these concepts in a real life situation, this operational definition may help him.

10. Formulating hypothesis
- Hypothesis can be referred to as a temporary intellectual, tentative solution for a problem.
- The process of problem solving proceeds on the basis of the hypothesis formulated
- Let us see an example The vital capacity of cigarette smokers is lower than that of others. Is it true? Formulate a tentative guess i.e., smokers have low vital capacity
- The scientific inquiry on the problem starts with this hypothesis.

11. Interpreting data
- Information becomes more meaningful.
- when they throw light on new knowledge.
- Skill of interpreting data is important to be developed among learners of science.

12. Controlling Variables
- when we plan an experiment, variables are to be controlled.
- An example: Experiments of Charles, Joules & Boyles laws where Temperature, pressure & volume are controlled.

13. Experimenting
- Experimenting is the integrated form of process skill, which includes skills like observing
- measuring, controlling variables, interpreting data etc.

- It is essential to formulate a hypothesis to prove whether CO2 is needed far photosynthesis.
- In high school classes we should provide opportunities for doing experiments.
- By doing experiments, the learner could acquire many process skills.

- As mentioned earlier, the process skill domain of science is very significant.
- The teachers while planning learning activities, should focus on the development of the process skills.

2 Mark Questions

1. Give two specific objectives for each

    a. Understanding

    b. Application

2. Pictorially represent the interdependence of objectives, learning experience and evaluation
3. Mention two taxonomies helpful for a science teacher
4. Give the contribution of the following personalities to education
    a) Mc Cormack and Yager

4 Mark Short Essays

1. Describe general aims of teaching physical science.

2. What is objective based instruction?

3. What is the importance of learning experience in teaching? Suggest any four modes of providing learning experience.

4. Explaining the domain proposed by Mc Cormack and Yager for developing higher order thinking

5. Give the revised bloom's taxonomy of Anderson and krathwohl. How is it different from bloom's original taxonomy

10 Mark Essays

1. What is objective based instruction? Explain.

2. Discuss in detail Bloom's taxonomy of educational objectives with specific examples from physics/Chemistry and express your views on revised Bloom's taxonomy.

3. What are the important teaching skills for secondary science teacher. Explain.

EDU 05.12 THEORITICAL BASIS OF TEACHING PHYSICAL SCIENCE

UNIT 3

TEACHER BEHAVIOUR AND MICRO TEACHING

Group Members

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Teaching - Introduction

- Teaching is an important part of the process of education.
- Its special function is to impart knowledge, develop understanding and skill.

Teaching - Definition

- The art of assisting another by providing information and appropriate situations, conditions or activities designed to facilitate learning.
- The process by which one person helps other to achieve knowledge, skill and aptitude

"Teaching is an intimate contact between a more mature personality and less mature one which is designed to further the education of the later"

- H. C. MORRISON

"Teaching is aform of interpersonal influence aimed at the changing the behaviour potential of another person"

- N. L. GAGE

"Teaching refers to activities that are designed and performed to produce changes in Student behaviour"

- CLARKE

Characteristics of teaching

- It is a complex social process

- Its nature both artistic and scientific

- Communication plays a vital role in teaching

- It is an interactive process

- It can be executed in various forms and styles

- Its execution requires the use of various teaching skill.

- It is a professional activity

Principles of Teaching

Principle 1: Encourage contact between students and faculty.

Building rapport with students is very important. The contact between students and teachers are vital to the students' success. One of the main reasons students leave school is the feeling of isolation that they experience. The concern shown will help students get through difficult times and keep working. Faculty have many avenues to follow to open up the lines of communication.

- Know your students by name.
- Help students with problems in their extracurricular activities.
- Advice students regarding academic courses and career opportunities.
- Encourage students to present their views and participate in class discussions.

- **Principle 2: Develop reciprocity and cooperation among students.**
  When students are encouraged to work as a team, more learning takes place. Characteristics of good learning are collaborative and social, not competitive and isolated. Working together improves thinking and understanding.

- Use cooperative learning groups
- Encourage students to join at least one organization on campus.
- Assign group projects and presentations
- Encourage students to participate in groups when preparing for exams and working on assignments.

- **Principle 3: Encourage active learning.**

  Learning is an active process. Students are not able to learn much by only sitting in classes listening to teachers, memorizing pre-packaged assignments, and churning out answers. They must be able to talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives.

- **For the regular classroom:**
- Ask students to relate what they are learning to something in real life.
- Give students concrete, real-life situations to analyze.
- Ask students to present their work to the class.
- Encourage students to challenge your ideas, the ideas of other students, or those ideas presented in readings or other course materials in a respectful matter.

- **Principle 4: Respect diverse talents and ways of learning.**

  There are many different ways to learn and no two people learn the same way. Students bring different talents and learning styles to the classroom. Students need the opportunity to show their talents and learn in ways that work for them. Then, they can be guided into new ways of learning that are not as easy for them.

- Encourage students to speak up when they do not understand.
- Use diverse teaching activities and techniques to address a broad range of students.
- Provide extra material or activities for students who lack essential background knowledge or skills.

Functions of Teaching

In teaching process, the active or functional part is played by the independent and dependent variable. Mainly following three types of functions are performed by these variables:

1. Diagnostic functions
2. Prescriptive functions
3. Evaluative functions

I, Diagnostic functions

The goal is to bring desirable changes in the behavior of students. The initial task needs a proper diagnosis for the prescription of appropriate treatment (the actual attempts) for bringing desirable behavioral changes in the students. Accordingly, a teacher has to perform the following diagnostic functions:

- He has to diagnose the entering behavior of the student. The initial potential of the student in terms of cognitive, cognitive and affective abilities should be properly diagnosed with the help of some diagnostic tests.
- He has to diagnose and formulate specific educational objectives, the type and amount of behavioral changes he wants to introduce in the student in the light of the entering behavior and environmental conditions.
- He has to analyze the content, instructional material and environmental facilities available for carrying out his task.
- He has to diagnose his own potential and capabilities and bring desirable improvement in his own behavior for the success of his own mission<br

II, Prescriptive functions

On the basis of diagnosis, the teacher takes decision about the needed prescription for achieving the stipulated objectives. Accomplishment of objectives needs an appropriate interaction between the teacher and the student which, in turn, needs proper management of the intervening variables by the teacher. Accordingly, he has to perform the following functions

- Selecting appropriate contents and organizing them into proper sequence.
- Selecting proper teaching techniques, strategies and feedback devices in view of the individual difference among the students.
- Seeking essential cooperation from the students for a purposeful interaction.

III. Evaluative functions

- Evaluative function concerned with the tasks of evaluating the progress and outcomes of the prescriptive functions that may be decided in the form of realization of the stipulated objectives. The failure in the realization of the objectives is essentially a failure in the prescriptive functions either due to improper diagnosis or some serious mistakes in prescribing or carrying out the treatment (actual teaching) task
- Various evaluation devices in the form of tests, observations, interviews, rating scales, inventories and unstructured projective techniques are help in exercising evaluative functions.
- In contrast to diagnostic or prescriptive functions, the student remains more active in the evaluative functions. He has to respond and evaluate his own progress in terms of the abilities acquired and behavior changes occurred

Phases of Teaching

- PRE ACTIVE PHASE (Planning phase)
- INTER ACTIVE PHASE (Execution stage)
- POST-ACTIVE PHASE (Evaluation cum feedback)

1.Preactive phase

- Selection of the content to be taught
- Organization of the content
- Justification of the principles and maxims of teaching to be used
- Selection of the appropriate methods of teaching
- Decision about the preparation and usage of evaluation tools

2.Interactive phase

- Teacher gives students the learning experiences through some suitable modes in actual classroom.
- In this phase, teachers give learners a pre-determined environment. The teacher interacts with students so that desired changes can be brought in the learner.

- So learning is directed in pre-determined directions to achieve pre-determined goals. In this process, the teacher provides learners with verbal stimulation.
  This stimulation can be of various kinds. Few examples are:-
- asking questions
- listening to student's response
- providing guidance
- making explanations etc.

3.Post active phase

- Evaluation of Results
- Understanding the problems in teaching
- Selecting appropriate testing devises & techniques
- Changing the strategies in terms of evidences gathered.

Maxims of Teaching

- Maxims are short statements like a dictum that are treated as general rule of conduct
- Universal facts found out by teachers after years of experience
- They are culture free and universal in nature
- They are tried and tested principles
- They accelerate momentum of teaching-learning process and help in achieving success in a classroom

1. Known to Unknown
2. Simple to Complex
3. Concrete to Abstract
4. Analysis to Synthesis
5. Particular to General
6. Empirical to Rational
7. Induction to Deduction
8. Psychological to Logical
9. Actual to Representative
10. Whole to Parts
11. Definite to Indefinite

1.From known to unknown

- Knowledge must be given by linking it to previous knowledge
- To enable the teaching-learning process and classroom progress
- The basic and primary of all the maxims
- While introducing the class with the topic, initial teaching phase
- Minimal piece of knowledge which students are already aware about

2.From simple to complex

- Simple concepts are taught first and complex ideas and concept later
- Easy concepts and teaching points are introduced first and difficulty level to be increased gradually
- This maxim helps in keeping the attention of students in the class

3.From concrete to abstract

- From actual tangible objects that can be visualized and be verified by five senses (sight, sound, smell, touch and taste) to more intangible abstract ideas that needs intuitive interpretation and can't be seen or touched directly
- Based on cognitive development of the students
- Water Bodies (Concrete) Ocean Currents (Abstract)
- Counting with Abacus (Concrete) BODMAS (Abstract)

4.From particular to general

- From particular statement, specific concept or subject matter to more generalized principles
- Experiment (Particular) Implications (General)

5.From whole to part

- The student should be acquainted with complete lesson, chapter, concept, theory or idea first and then breakdown different elements for discussion
- Introduction to the complete topic then deal each topic in detail

6.From psychological to logical

- Basic principles of psychology like students interest, aptitude, memory, creativity, attitudes, developmental needs and levels, aspirations etc. to be kept in consideration for selection of subject matter and sequential arrangement of the content and then later to the logical arrangement of the content.
- Student- centred maxim and most effective among child learner
- Incorporation of subject matter of students interest (Psychological) Completing the lesson with assigned evaluation work (Logical)

7.From Induction to deduction

- Inductive reasoning is supplying some evidence or argument to conclude to the truth. Broad generalizations are made from definite observation.
- Deductive Reasoning is when every possibilities are examined to reach to a valid conclusion.

8.From empirical to rational

- Empirical Knowledge is based on verifiable observable experiences. It is based on results and observations.
- Rational Knowledge is based on reasons and logic. Only reasoning and reflections can be used as evidence to prove
- Rules and Norms (Empirical)Values and Ethics (Rational)
- Environmental Pollution (Empirical) Future implications of Pollution (Rational)

9.From analysis to synthesis

- • Analysis is process of breaking down an idea, concept or phenomenon into its constituent element • Synthesis is compounding of various ideas, concept or phenomenon to form a theory or system
- • Evaporation, Condensation, Precipitation (Analysis) Water Cycle (Synthesis)

Teaching skills

Teaching skill is a set of related overt behaviours of the teacher (verbal and non verbal) which are observable, definable measurable, demonstratable and refinable through practice. The teacher uses teaching skills for pré-instructional, instructional and post instructional stages for achieving predetermined specific objectives.

- B.K. Passi has given the following list of Teaching skills.

1. Writing instructional objectives
2. Introducing a lesson
3. Fluency in questioning
4. Probing questioning
5. Explaining
6. Illustrating with examples
7. Stimulus variation
8. Reinforcement
9. Silence and non-verbal cues
10. Increasing pupil participation
11. Recognizing attending behaviour
12. Using Black board
13. Achieving closure

Core teaching skills

- Some of the teaching skills are extensively used in routine teaching by all teachers. These skills are known as Core teaching skills. Many experts in this field have listed the following skills as Core teaching skills.
- Skill of Introducing a lesson.
- Skill of Stimulus Variation.
- Skill of Explaining.
- Skill of Illustrating with Examples.
- Skill of using Blackboard.
- Skill of Probing questions.
- Skill of Questioning.
- Skill of Reinforcement.

1. SKILL OF INTRODUCING A LESSON

When a teacher introduces a lesson , he gives a brief introduction about the lesson in order to pre-dispose the pupil's minds to it. This has to serve two main functions, namely refreshing and ensuring the pre requisites and motivating the pupils to learn the new lesson.

COMPONENTS OF THE SKILL

Desirable behaviors

a) Use of previous knowledge/pre-requisites

To satisfy the maxim of teaching from known to unknown , the teacher has to judiciously decide upon the pre-requisites that will be essential for properly presenting the new learning material.

b) Use of Appropriate devices

Many devises such as lecturing, describing, narrating, illustrating, storytelling, role playing analogy, demonstration, audio-visual materials, experimentation/demonstrations, etc. are used for motivating pupils and to gradually lead them to the new learning material.

Undesirable behavior

a) Lack of continuity.

b) Uttering irrelevant statements and questions.

2. SKILL OF STIMULUS VARIATION

It involves deliberate change of stimuli presented by the teacher for the purpose of drawing, stimulating and maintaining the attention of the learners throughout the class.

COMPONENTS OF THE SKILL

a) Teacher movements
   Meaningful, purposeful movements with pedagogical function.
b) Teacher gestures
   Gestures are movements of the parts of the body, used   for expressing emotions, size, shape, direction etc. and also for   directing attention.
c) Change in Speech pattern
   Change in volume, tone or speed of verbal communication for   attracting attention.

d) Change in interaction style

Teacher-class interaction, teacher-pupil interaction and   pupil-pupil interaction should be there.

 e) Focusing

Drawing attention to specific aspects to be stressed, by   verbal or gestural focusing,

f) Pausing

Deliberate use of silence during talk.

g) Oral-Visual Switching

Change of sensory channel from verbal to visual and vice   versa.

3. SKILL OF EXPLAINING

Explaining is the skill by which teacher can clearly bring out the exact meaning of a concept or an idea and also can arrive at relationships among various concepts.

COMPONENTS OF THE SKILL

Desirable behaviors

a) Use of beginning statements

For drawing and maintaining attention and making the students mentally ready for learning give them some clues of explanation.

b) Use of Explaining links

Words and phrases which increase the effectiveness of explanation should be used. For eg. As a result of, Therefore, In order to, Because, Due to etc.

c) Use of mediators

Presentation of various mediators in the form of examples, diagrams etc. should be used to make explanation lucid and meaningful to the pupils.

d) Use of concluding statements-

    The purpose of it is to present a consolidated picture of what has been explained.

e) Questions to test pupil's understanding-

    In the course of explanation, frequently questions should be asked which will help the teacher get immediate feedback from the pupils.

Undesirable behavior

    a) Use of irrelevant statements.

    b) Lack of continuity.

    c) Lack of fluency.

    d) Using inappropriate vocabulary.

    e) Use of vague words and phrases

    f) Deviating from the main points.

4. SILL OF ILLUSTRATING WITH EXAMPLES

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

COMPONENTS OF THE SKILL

a) Formulating simple examples.

b) Formulating relevant examples.

c) Formulating Interesting examples.

d) Use of appropriate media for examples.

e) Use of Inductive-deductive approach for examples.

5. SKILL OF USING BLACKBOARD

Blackboard is the most widely used of all visual aids.It is one of the quickest and easiest means of illustrating an important point.

COMPONENTS OF THE SKILL

a) Legibility of handwriting

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

- ❖ Distinct difference between letters.
- ❖ Adequate spacing between letters.
- ❖ Adequate spacing between words.
- ❖ Slant of letters nearly vertical.
- ❖ All small letters of the same size.
- ❖ All capital letters of the same size.
- ❖ Size of the letters large enough to be read.
- ❖ Thickness of the line uniform.

b) Neatness in blackboard work.
- ❖ Adequate spacing between lines.
- ❖ Lines parallel to the base of the board.
- ❖ No overwriting.
- ❖ Focusing the relevant matter.

c) Organization of blackboard work.
- ❖ Systematic planning of the space.
- ❖ Spacing to exhibit the sequence of the items being presented.
- ❖ Adjustment of the space for presenting related items in totality.

d) Appropriateness of blackboard work.
- ❖ Continuity in points.
- ❖ Points brief(Brevity).
- ❖ Appropriate presentation of illustrations and diagrams.
- ❖ Proper use of color chalk.
- ❖ Underlining the important points to be stressed.

6. SKILL OF FLUENCY IN QUESTIONING

Successful teaching is highly dependent on questioning. The rate of meaningful questions put per unit time by the teacher is called fluency of questioning.

COMPONENTS OF THE SKILL

a) Structure

Structure of the question is the technique of formulation of questions. The following aspects have to be taken care of while framing questions.

❖ Grammatical correctness
❖ Conciseness
❖ Relevance
❖ Specificity

b)Process

The process of asking questions involves more than one aspect

❖ Speed

❖ Voice

❖ Pause

❖ Style

c)Product

Product is the answer expected of the question.

7. SKILL OF PROBING QUESTIONS

This is the skill required in applying the technique of effectively dealing with student responses for going deep into their knowledge.

COMPONENTS OF THE SKILL

a) Prompting

When there is no response or incorrect response teacher gives hints or clues for leading the pupil to the desired correct response.

b) Seeking further information

teacher should ask subsidiary questions in order to seek further information.

c) Refocusing

When the pupil give correct response, the teacher relates their responses with something already taught.

d) Increasing critical awareness

Teacher asks why and how of a correct response for increasing critical awareness in pupils.

e) Re-direction

Asking the same question to another pupil for increasing pupil participation.

8. SKILL OF REINFORCING

Reinforcement is the major condition for effective learning. Hence the teacher has to master the skill for adopting appropriate strategies for reinforcing the learners.

COMPONENTS OF THE SKILL

DESIRABLE BEHAVIOR

a) Positive verbal reinforcement

Students can be motivated through verbal expressions like Good, Right, Fine, Well done, Excellent, Carry on, Go ahead etc.

b) Positive Non-verbal reinforcement

Nodding the head, Smiling, Patting, friendly look etc.

c) Negative verbal reinforcement

Words like wrong, incorrect, No etc.

d) Negative non-verbal reinforcement

Staring, looking angrily, shaking the head etc

UNDESIRABLE BEHAVIOUR

a) Denial of Reinforcement

b) Inappropriate use of reinforcement

MICRO TEACHING – MEANING, DEFINITION, PHASES, MICRO TEACHING CYCLE, LINK PRACTICE AND PREPARATION OF MICRO TEACHING LESSON PLAN

- Micro teaching technique was first adopted at Stanford University, USA in 1961 by D.W. Allen and his co-workers and is now followed in many countries with modified and improved techniques. It is a training procedure for teacher preparation aimed at simplifying the complexities of the regular teaching process.

Micro teaching 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 minutes. Such a situation offers a helpful setting for a teacher to acquire new teaching skills and to refine old ones. Micro teaching is a new design for teacher training , which provides trainees with feedback about their performance immediately after completion of lessons.

- **DEFINITIONS OF MICRO TEACHING**

"Micro-teaching is a scaled down teaching encounter in class size and class time" – Allen (1966)

STEPS OF MICRO TEACHING

❖ Defining the skill in terms of specific teaching behavior.

❖ Demonstration of the skill by the teacher educator.

❖ Preparation of the lesson plan by the teacher trainee.

❖ Teaching of the lesson plan by the teacher trainee.

❖ Providing immediate feedback.

❖ Arranging re-planning, re-teaching and re-feedback sessions.

❖ Repetition of plan, teach, feedback, re-plan, re-teach and re-feedback cycle till the skill is acquired.

PHASES OF MICRO TEACHING

❖ Knowledge Acquisition Phase

a) Observing demonstration of the skill.

b) Analyzing it and discussing about the demonstration.

❖ Skill Acquisition Phase

a) Preparing micro lesson involving the skill.

b) Practicing teaching skill while teaching.

❖ Transfer Phase

Evaluating performance through feedback, re-plan, re-teach and   transfer of skill to actual class teachings in macro sessions.

MICRO TEACHING CYCLE
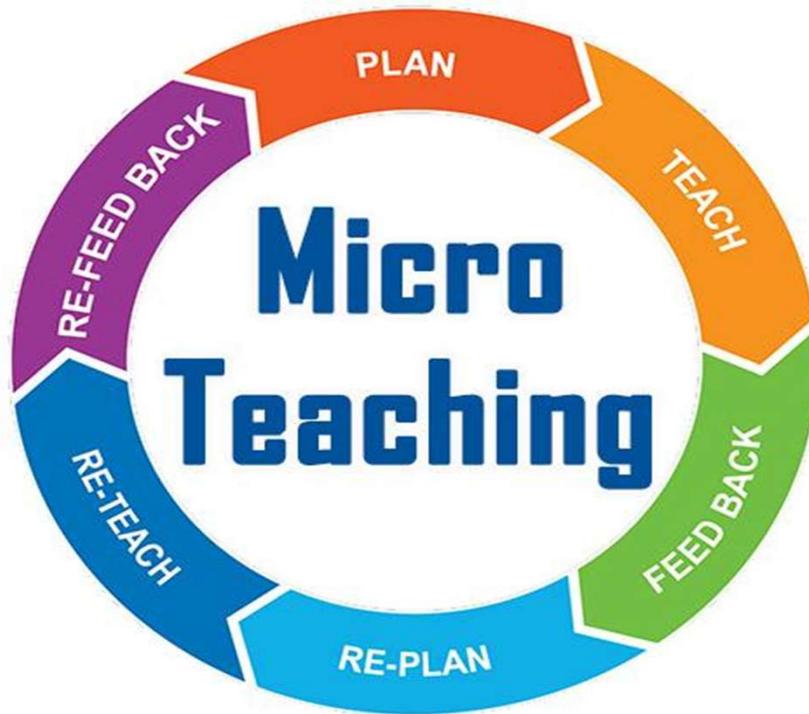
i. Planning

- Selection of a particular skill
- Presentation of a model demonstration lesson- a particular skill
- Observation of the model lesson
- Criticism of the model lesson
- Preparation of the micro lesson plan

ii. Teaching

OBSERVATION OF TEACHING SKILL

- Peer/college Supervisors

- Ratings based on frequencies

- Can be recorded in a tape recorder or on a videotape

iii. Feedback

- Individual feedback to student teachers.
- Include the tallies and ratings on observation schedule
- Interpretation about the performance.

LINK PRACTICE

- **Link practice** involves the integration of skills.
- The main objectives of integration of teaching skills are to help in the transition from **microteaching** situation to real teaching situation where the trainee teacher is allowed to teach all the skills together learnt in **microteaching** sessions.
- A deliberate programme of integration of sub skill is called Link Practice or Link Lessons.
- After practicing three subskills separately, the trainee may combine all the three sub skills in a lesson of 15 minutes.

2 Mark Questions

1. Mention for maxims of teaching.
2. What are the phases of microteaching?
3. What are the micro elements of microteaching?
4. Give for teacher behaviour that comes under the skill of explanation.

4 Mark Short Essays

1. What is link practice?
2. What are maxims of teaching ? briefly explain any six maxims.
3. Suggest and explain a technique to develop among pre-service teachers

10 Mark Essays

1. Practicing a single skills before the peers give confidence for real class teaching. Explain a process for teaching skill acquisition among student teachers

2. What are the important teaching skills for secondary school science teacher and explain.

THEORETICAL BASES OF TEACHING PHYSICAL SCIENCE

Unit 4

PHYSICAL SCIENCE CURRICULUM

Group Members

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2. Jasmin

CURRICULUM

<u>MEANING</u>

- The term curriculum is derived from Latin word currere which means Path
- In the sense curriculum is the path through which the student has to go forward in order to reach the goal envisaged by education.
- Curriculum should in no way be considered as synonymous with courses of study.
- Curriculum should be considered as a board- based term encompassing every aspect concerning a course of study
- Curriculum for a course of study may be conceived as the totality of experience a pupil is exposed to within the boundaries of the school and outside while undergoing that course, with a view to achieve the anticipated educational goals

DEFINITION

1. **Munroe:** Curriculum embodies all the experience which are utilized by the school to attain the aims of education

2. **Arthur Cunningham**: Curriculum is a tool in the hands of an artist (teacher) to mould his materials (pupils) according to his ideals (objectives) in his studio (School)

3. **H.L Laswell**: Curriculum is made up of everything that surrounds the learner in all his working hours.

4. **H.H.Horne**: Curriculum is that which the pupil is taught. It involves more than the act of learning and quiet study. It involves occupations, productions, achievement, exercise and activity

CURRICULUM AND SYLLABUS

- Curriculum is not merely syllabus
- Syllabus is only verbal, book oriented and theoretical, while the former is not.
- Syllabus is much more specific, speaking of the details of the study, the hierarical order of presenting the concept, etc.
- It forms the basis for writing text books, preparing teacher's guide and planning lessons.
- On the other hand the scope of curriculum is much broader and deeper

- Syllabus of any subject for a particular course of study can be considered as an important aspect of the related curriculum which states what materials are to be taught and in which order.
- Because of this limited scope of a syllabus the two terms should not be treated as synonymous.
- The curriculum encompasses various kinds of curricular and co-curricular activities as well as the various aspects of the social, natural and educational environment with reference to which the experience are transacted.

FOUNDATION OF CURRICULUM DEVELOPMENT

- Philosophical Foundation

  ➢ It is the philosophy of a society that determines the ultimate aims of its education .

  ➢ Social structure and its economic organization are also based on the philosophical foundations

  ➢ Philosophy considers such fundamental and profound issues such as man's place in the universe , the aims of nature, the society, and so on.

- **Sociological Foundation**

  - The sociological foundation of education demands that we should bear in mind the needs, requirement and aspirations of the community for which an educational system is designed

  - Sociolological approach considers not only the needs of the society, but also the need of the learner

  - For serving these functions the cultural heritage of the society also should be reflected by the curriculum

- **Psychological Foundations**
  - The most important basis of curriculum formation is psychological considerations
  - It has become an independent branch of study
  - The result of these research studies have great impact on the shaping of curriculam

PRINCIPLES OF CURRICULUM

❖ The Principles of Child-centredness

- Curriculum should be child-centered
- It must be based on the present needs, requirements and circumstances of the child
- The child needs more experience than instruction
- True education can be acquired only through activity and experience

❖ The Principle of Community-centredness

- Besides treating each child as an individual we should also view him as member of the community to which he belong
- The child cannot be educated in a vacuum. He is to be educated in school established by the society and by interacting with other members of the society
- The goals formulated by the school which depend upon the purpose of the society determine the nature of the curriculum
- Any curriculum has to prepare the learners to face this challenge posed by the community, with effectively

❖The Principle of Activity-Centredness

- Action is sign of life. Man is an active being.

- The curriculum should provide for a variety of activities both physical and mental in which children are naturally interested.

- Emphasis should be given to 'learning by doing' through the activity of hand, head and heart.

- Play activities at the pre-primary stage

- Project activities at the primary stage

- Constructive and creative activities at the secondary stage

❖ **The Principles of Integration**

- By integration we do not merely mean integration of subjects.

- Required is the integration of the child's needs on the one hand and needs on the one hand and the needs of the democratic society on the other

- Integration warrants that activities carried on in a school and the experiences thus gained should not be treated in watertight compartments

- Designed as to lead the child to establish a functional unity with the environment

- Such a curriculum will safeguard the general, liberal and vocational aspects of education

- **Conservative Principle**

    - **The curriculum should preserve** and transmit the traditions and culture of human race

    - It should embrace such subject, topic or activities by which students should cultivate a sence of respect for their traditions and culture

    - Selection of such items should, however be made with great care, according to the mental development of children

❖ **Creative Principle**

- God has created the universe and men have created other things in it

- By nature man is creative. Therefore, education should be so molded as to enable one develop one's creativity

- The curriculum should consist such items that enable children to exercise their creative powers so that creativity is fostered which in turn will enable them to modify their environment according to need of time

❖ **The principle of Preparation for Life**

    ○ The school curriculum should include such elements that would prepare children for their life

    ○ They should be able to earn their livelihood sufficiently and adjust themselves with the society efficiently

❖ **Principles of Elasticity and Flexibility**

    ○ Since the need of individual and society go on changing, a rigid and static curriculum cannot meet the requirements of child or of the society

    ○ Moreover, experience to be presented have to be modified to suit the enviorment, societal conditions, learning atmosphere

    ○ The curriculum by its elasticity can cater to all such requirements posed by environment and individual differences

❖ **Principles of Balance**

- ○ Curriculum should maintain proper balance between direct and indirect experiences, liberal and professional education, individual and social aims compulsory and optional subjects etc.

❖ **Principle of Utility**

- ○ Curriculum should be of practical use to the pupil and hence should maintain vocational and technical bias

- ○ Due emphasis should be given to work experience

STAGES OF CURRICULUM DEVELOPMENT

- Goal Specification

  - The curriculum development process begins with task of determining the specific objectives of teaching a particular course of the programme

  - It guides in the selection of particular course of study and expected learning outcome

  - This makes decision about content selection, time allocation, assignments of credits etc.

- Planning

  - The planning consists of writing outline of the syllabus.

  - Appropriate teaching learning strategies are indicated with respect to the nature of the content.

  - This appended with a list of reading and reference material

- **Validation**

  - The draft of the curriculum is evaluated by academic experts and is carefully examined by authorized   academic bodies such as board of studies in the university
- **Field testing**

  - The approved curriculum is subjected to field testing in a smaller group to collect the feed back
- **Quality control**

  - The feed backs are incorporated into the prototype of the curriculum and is refined for large adoption

B. SCIENCE TEXT BOOKS

- Printed materials they being an essential part of science curricula play a vital role in teaching and learning
- Text books are the most widely used of all instructional materials.
- A textbook should really designed for the pupils rather than the teacher
- The textbook should stimulate reflective thinking and cultivate in students, the scientific attitude

Characteristics of Good Science Text Book

➤ Authorship

   ○ Only such person who have experience who have experience of teaching the subject should be allowed to become authors of School Science text books. Such authors can understand actual learning situations

   ○ Certain qualification may also be prescribed for the authors

➤ Mechanical features of the textbook

   ○ The paper, the binding, the print and type of letters should be attractive

   ○ The quantity and quality of illustration need consideration. Science text books should be carefully drawn accurate and attractive

   ○ Photographs should be clearly reproduced

➢ **The subject matter- Its nature and organization**

  ○ The subject matter should cover the whole syllubus

  ○ Subject matter should be developed in psychological sequence

  ○ There should be consistency of subject matter

  ○ There should be central theme correlating the content of the text book as a whole

  ○ The textbook has to be organized into units which are based on student interest and probability of use

  ○ Inductive approach is to be used wherever possible in introducing new topic

PHYSICAL SCIENCE STUDY COMMITTEE PROJECT (PSSC)

- The **Physical Science Study Committee**, usually abbreviated as **PSSC**, was inaugurated at a 1956 conference at MIT to review introductory physics education and to design, implement, and monitor improvements
- National Science Foundation greatly increased funding, to radically improve the teaching of science in the country's response to Cold War rivalries.
- PSSC was meant to improve Physical teaching at school level
- PSSC encourage the spirit of enquiry through laboratory experimentation
- Emphasis is given to improvisation of gadgets by pupils themselves
- PSSC course has been offered as an alternative to traditional Physics cource because more emphasize is placed on modern physics

Objectives(PSSC)

- To present Physics as a unified but ever changing subject
- To demonstrate the interplay between experiment and theory in the development of Physics
- To develop the skills to observe nature closely and to interrogate it, thus learning not only the laws and principles of physics but the evidence on which they are based
- To extent the capacity of students to read critically
- To provide foundation for those who will go for further study in science and technology

Materials Developed For PSSC Course

1. Text Books
2. Teachers guide
3. Laboratory Experiments
4. Supplementary text materials
5. Simplified Low cost apparatus
6. Films or documentaries
7. Achievement Tests

Course Consist of four Parts:

- Part I- Fundamentals concept of time, space and matter
- Part II- Optics and Waves
- Part III- Mechanics
- Part IV Electricity and Physics of atom

2. Chemical Education Material Study (CHEM-study)

3. Chemical Bond Approach Project (CBA Project) in Chemistry

- There are two parallel course in chemistry the two course differ in approach only

- CHEM- study employs inductive approach in which practical work proceeds theory

- CBA theory precedes practical work i.e, it is deductive in approach

- The CHEM – study originated in 1960. J.A. Campell was mainly responsible for its developments

- The course stresses productive learning and thinking rather than rote learning and mechanical habits of thought

Objectives:

- To update chemistry in the light of latest developments
- To give students a good understanding of subject
- To organize content in unedifying concept and principles
- To provide opportunities for laboratory work

CHEM study materials comprise the following:

- Textbook
- Laboratory Manual
- Teacher's Guide
- Films
- Tests
- Programmed instructional materials
- Supplementary experiments

- The CBA course was originated in 1959
- Laurence Strong was the founder
- The concept of bonding form the central theme
- The whole course is planned in such a manner that experiments suggest the idea to be tested suggest the experiments to be setup

- **CORRELATION IN SCIENCE TEACHING**

- Correlation means the relationship between different subjects of the curriculum. It can be direct or reciprocal. Through learning of science, problem solving ability of mind is developed.

- **Correlation is of three kinds**

1. correlation within the subject.

2. correlation with other subjects.
   (a) Incidental correlation.
   (b) Systematic correlation.

3. correlation with daily life.

1. Correlation of Physical science within the subject

All the branches of science are inter-dependent on each other and there are a number of facts and principles which are common to various science subjects. As a result of this, new subjects like, Physical chemistry, Quantum chemistry, Nuclear chemistry, Spectroscopy etc. are introduced.

Physics provides instruments for the study of almost all other science subjects, thus correlating many principles of physics with other science subjects.

2. Correlation of Physical science with other subjects

A. **Incidental correlation**

- > It is the natural correlation, which the teacher secures by coordinating each topic with allied materials from other subjects. Here the teacher plays a prominent role. It is not a planned or pre decided one.

- > The success of incidental correlation depends on the wide knowledge and reading of the teacher.
  For instance, A chemistry teacher while teaching about Oxygen says about haemoglobin i.e. carrier of oxygen, and mountaineers use oxygen carriers

B. Systematic correlation

- Systematic correlation with other subjects is achieved by a careful organization of the curriculum in different subjects avoiding unnecessary duplication of the subject matter and at the same time developing related topics from different subjects.

- > Here the teacher makes deliberate attempt to teach a particular topic in such a way that he may go on explaining other things as well along with it.

- For instance, while teaching about adsorption, teacher says about the purpose of using charcoal as a purifier in wells.

- **Correlation of Physical science with other subjects**

Correlation With Mathematics.

Correlation With Geography.

Correlation With History.

Correlation With Art.

Correlation With Craft.

Correlation With Music.

Correlation With Language.

a) CORRELATION WITH MATHEMATICS

Mathematics is considered to be sole language of science because of which real understanding of science is considered to be impossible. Some of the useful mathematical tools which are generally used in the physical science teaching are Algebraic equations, Geometrical formulas, Graphs etc.

b) CORRELATION WITH GEOGRAPHY

The teaching of science can be easily correlated with * geography. A number of topics are common to both science and geography. For example, the study of rock & soil, study of plant and animal life etc.

* Physical geography requires an elementary knowledge of science for its education.
• In science, various concepts relating to the atmosphere and earth in which living and non-living beings exist are made. For this reason, temperature, wind directions and measurement of rainfall are conducted in the subject of science by making use of various apparatus.

- c) CORRELATION WITH HISTORY
- * It sounds quite amazing that some kind of correlation can exist in between the science and history as earlier subject is practical in nature while nature of later subject is purely theoretical. However, it is possible to co-relate these subjects with each other.
- * While mentioning about the various scientific discoveries taken place in the earlier periods, teacher can relate with the major events of the world history.
- For Instance - A chemistry teacher while teaching
- about iron and steel correlates incidentally with history by telling about the famous Delhi Pillar and the metallurgical skill of the people of Ayurvedic period.

d) CORRELATION WITH ART

An artist should know the principles of light and shade, objects and background for drawing or keeping the colour contrast in attractive condition.

Thus, it can be said that some common features are found in the subjects of science and art, because of which they can be co-related with each other effectively.

e) CORRELATION WITH CRAFT

* Science involves making of models for different purposes. The craft making courses can develop the skills those are essential for science students.

During craft periods, students can be provided with the task of designing various pieces of scientific apparatuses and equipments. Through such step, scientific interest can be developed in the students, which will help in arousing the interest of students in various scientific incidences.

f) CORRELATION WITH MUSIC

In our nation, music has its own importance as different kinds of songs are found in different parts of the nation.

Various types of instruments are based on different principles of science.

* In the study of music, its technicalities like tones, pitch etc can be easily understood if the student has a basic knowledge of science.

g) CORRELATION WITH LANGUAGE

* Although science is a practical subject, it is very important for it's learners to express their views and ideas in clear and attractive form.

For this purpose, it is necessary that they should have good knowledge of language which they use.

* Student who does not have good control over the language, cannot express his views and various scientific laws and principles in front of others.

APPROACHES OF CURRICULUM CONSTRUCTION

- **<u>TOPICAL APPROACH</u>**

- Simplest of all approaches

- Topics dealing with a theme are selected

- Arranged in the order of relevance

- Cover the topics a whole in a particular grade

- No repetition of the topic in senior grades

- For example if we include topic "heat" in the curriculum of physical sciences of class VII then we must include here all what is to be taught to the students in the subject physical sciences during the entire stage of secondary education.

Egs:

1. Units based on life centered topics
- Unit 1. World that science has built
- Unit 2. The air we breath
- Unit 3. The water we use
- Unit 4. The food we eat

Unit 5. How man gets food?

2. Units based on environment centered topics
- Unit 1. The atmosphere
- Unit 2. Water, vital need of life
- Unit 3. The earth surface
- Unit 4. Fire and heat
- Unit 5. Effect of heating and cooling on air and water

Merits

- Integrated knowledge is imparted

- Learning is related with life and environment

- Provides a solution for dealing with a vast material in a logical and rational fashion

Demerits

- Difficult to adopt: Impossible to study everything at once (Overload)

- Chance of boredom

- Presupposes good library resources

- Requires very competent and resourceful teachers

SPIRAL/ CONCENTRIC APPROACH

- A spiral curriculum can be defined as a course of study in which students will see the same topics throughout their school career, with each encounter increasing in complexity and reinforcing previous learning
- Spreading the topic over to different grades by covering easier portion in the lower grades and the difficult ones in the higher and higher grades

- The term "spiral" indicates continuity and linkage between successive years

- While moving from lower to higher grade, curriculum ascends and enlarges

- Approach is identical to the spiral arrangement of a watch spring

Topic : Acids

1st year- food items having sour taste

2nd year- common properties of acids

3rd year- strong and weak acids, prepration

4th year- monobasic and dibasic acids

5th year- electronic concept

Merrits

- Develops interest for learning
- Revision of topics
- Topic advances from easy to difficult
- Considers mental level of pupils

Demerrits

- Some facts are repeated again and again
- Possibility of losing freshness
- Needs very resourceful teachers

UNIT APPROACH

- Most popular approach
- A unit has some very definite objectives, like developing an understanding, a skill or an attitude
- The objectives serve as a torch stone by which to determine the inclusion or exclusion of details of a particular material.
- In unit approach the selected contents and learning experiences meant for the study of science at a particular stage (elementary or secondary) is first divided into some appropriate and meaningful units and then putting them into the curriculum of any of the grades or classes according to their suitability to the age and mental levels of the students.

Merrits

- Well suited for the growth and development of the abilities and skills
- Facilitates the child's learning of significant relationships, concepts and processes
- Needs of learner are given top consideration
- It is impossible to study everything at once. Unit is a logically useful division

Demerrits

- Organization of curriculum requires experienced and expert teachers
- It may be impossible to distribute the topics and units evenly.
- All the content material may not be suitable for categorization

TYPE STUDY

- A type is a typical representative of a group which exemplifies all the characteristics of that particular group
- Encourages inductive reasoning and gives training in scientific thinking
- All content areas cannot be classified into types

Eg:

- Chlorine – Halogens
- Scissor – First Order Lever
- Hibiscus – Flower
- Iron - Metals

INTEGRATED

- Originates from 'seamless cloak of knowledge', 'unity of learning' or a single view of the world & life
- In contrast to fragmentation of curriculum – limits enquiry, set up barriers, & confines study to a limited range of information
- Division is artificial and does not reflect correctlt the essential unity of reality and of our ordinary way of understanding and judging
- Integrates multiple subjects, which are usually taught seperately
- Goal is to help students remain engaged and use multiple sets of skills, experiences and sources to aid & accelerate the learning process
- Suitable for resourceful teachers who are prepared to experiment with new styles of teaching

DISCIPLINARY

- Fragmentation of science into an array of sub- disciplines or specialities

- Integration ignores important philosophical, conceptual and methodological differences between the basic disciplines

- Presently at higher levels of education

INTERDISCIPLINARY

- Consciously applies knowledge & methodology from more than one discipline to examine a central theme, issue, problem, topic, or experience
- Emphasis is on deliberately identifying the relationship between disciplines
- Student takes courses in many disciplines but learn and integrate the content and skills in the different disciplines
- In contrast to integrated approach, the interdisciplinary approach recognises the individuality of disciplines and treat them as distinct, but believes in the collaboration of different disciplines to solve complex problems.

GRASS ROOT MODEL

Hilda Taba (1902-1967)

- An architect, a curriculum theorist, a curriculum reformer and a teacher educator
- Student of John Dewey
- Author of "Curriculum development: Theory and Practice"
- Worked with

# GRASS-ROOTS APPROACH TO CURRICULUM DEVELOPMENT

- curriculum should be designed by the teachers rather than handed down by higher authority.
- teachers should begin the process by creating teaching-learning units for their students in their schools rather initially in creating a general curriculum design.
- An inductive approach to curriculum development, starting   with specifics and building up to a general design
- Initiated by teachers of individual schools
- Employs democratic group methods of decision making
- Assumptions

  - Curriculum will be successful only if teachers involved in it

  - Not only high level officials, but teachers, parents and community members are to participate in the process

Principles

- Curriculum improves as the professional competency of the teachers improve
- Competency of the teachers will be improved only when teachers involved in it
- Reality oriented
- Consensus

Criticism

- Applies the method of participatory democracy to a highly technical, complex and specialized process
- One man one vote is not necessarily result in good decision

2 Mark Questions

- 1)Define Curriculum.
- 2) Give two stages of curriculum construction
- 3) Expand - a) PSSC
- b) CBA
- c) CHEM
- 3. write two major principles of curriculum construction
- 4.What is disciplinary approach of science curriculim
-

4 Mark Short Essays

1. Describe the foundation of curriculum construction.
2. What are the characteristics of a good textbook?
3. What is concentric plan of curriculum approach
4. How would you teach physical science by connecting with other subjects
5. What is correlation? Give two examples where a science teacher can correlate the subject with other discipline

10 Mark Essays

1. 1. Describe in detail the principles of curriculum construction. What are the stage of curriculum construction?
2. Explain major approaches to curriculum construction.

EDU 05.12   THEORETICAL BASIS OF TEACHING PHYSICAL SCIENCE

UNIT 5

METHODS AND STRATEGIES OF TEACHING PHYSICAL SCIENCES

Group Members

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Methods of instruction

- 'Method' means 'mode' in Latin.
- Method of teaching denote the ways commonly used by teachers to impart knowledge upon students.
- There is no single best method ,Teacher have the right to choose a method.

1.LECTURE CUM DEMONSTRATION METHOD

In lecture method central board is teacher and is an oldest method of teaching.

In demonstration method teacher perform a particular activity, lecture cum demonstration method is Combination of merits of lecture and demonstration method.

Steps
1. Planning and preparation
2. Introduction of lesson
3. Presentation
4. Performing demonstration
5. Reflection

Merits

- Equal participation of teacher and student
- It improves rational thinking and observation power of student
- It is economical compared to individual laboratory method
- Important maxims of teaching such as proceed from known to unknown , simple to complex , analysis to synthesis are followed in this method.
- Less time consuming
- Multi sensory approach is followed here

Demerits

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

2.PROJECT METHOD

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.

Characteristics

- Purposeful activity
- Inside or outside of the school
- Child centered
- Co-operative
- Based on real experiment
- Individual difference is present.

Basic principles

- Principle of purposefulness
- Principle of activity
- Principle of freedom
- Principle of experiment
- Principle of learning by doing
- Principle of social development
- Principle of Reality
- Principle of Planning
- Principle of utility

Types

1. Constructive project -Related to cognitive or mental activity
2. Aesthetic project -Involves aesthetic skills
3. Problematic project -To solve problem
4. Drill project -Here the objective is to attain mastery of a skill.

Steps

1. Providing a situation -Create a problematic situation
2. Selection of problem
3. Fixing objective
4. Planning
5. Executing the project
6. Evaluation
7. Reporting and recording

Role of teacher
-A guide ,Friend ,Philosopher
-Helps to solve problem
-Encourages the student
-Helps to avoid mistakes
-Always remain alert
-Provide democratic atmosphere.

Advantages
- Student centered
- Activity based
- Develop problem solving skill
- Develop self confidence and discipline
- Develop social qualities
- Make outer world contact
- Follow psychological principle
- Make real life connection

Disadvantages

- Time consuming
- It is costly
- All re not applicable
- Not applicable to all schools
- Some times it makes overload

3.PROBLEM SOLVING METHOD

Problem solving is the scientific process of solving problem.

Characteristics of a problem in a learning situation

- Clear and definite
- Challenging and hence interest generating
- Suitable for the age ,needs , and mental and physical capability of pupils.
- Related to actual life situations.
- Understandable to the learners who face it
- Thought provoking
- Correlated to the existing knowledge of the learners
- Feasible within the time available

Steps

1. Sensing the problem
2. Interpreting ,defining and delimiting the problem
3. Collecting the relevant data
4. Organizing and evaluating the data
5. Formulating tentative solution
6. Arriving at the final solution

Teacher's role

Maintain the spirit of discovery among students

Give proper guidance from the beginning till the end

Establish rapport with students

Extend optimum help to each student in case difficulties are experienced.

Merits
- Method is psychological and scientific in nature
- The pupil get valuable social experience
- Help to improve knowledge and experience
- Stimulates thinking
- It inculcates the habit of open mindedness and tolerance
- Learning by doing and learning by observing the concrete situations makes the teaching learning process more meaningful.

Demerits
- Not suitable for lower class
- Waste of time
- Not economic
- Lack of reference
- Talented teachers are required
- This method is not proper for immature students because they cannot follow the relevant material of science properly.

4.INDIVIDUALISED LABORATORY METHOD

-It is a child centered method

-More suitable for Physical and natural Science classes

-It provides hands on experience to students

Role of teacher

- Teacher should give individual attention
- Should give guidance and brief instruction
- Clear doubts and help to setting apparatus
- Check the observation for error

Merits

- It develops the process skills like observation , experimentation etc.
- Learning by doing
- Individual learning

Demerits

- Not suitable for all subjects
- Time consuming
- Expensive
- Requires large infrastructure and resources.

5.DALTON PLAN

Dalton plan is not a particular method of teaching any particular subject, but a method of organizing the work of the school to promote self activity . Here classroom teaching is abolished to a great extent.

Principles of Dalton Plan

- The Principle of freedom
- The principle of individual work
- The principle of self effort
- The principle of group interaction

Features

➢ Subject laboratories – Instead of class room there will be subject laboratories
➢ Subject teachers or specialized teachers-Instead of class teachers there will be subject teachers specialized in subject concerned.
➢ Assignments or contracts.
➢ Records- The progress of each student is recorded by means of graphs and diagrams.
➢ Conferences –The teacher may some times hold conferences to discuss common difficulties or to introduce something new.

Advantages

- Teaching is individualized
- Continuity of work is assured
- Self effort brings confidence
- Develop initiative and resourcefulness
- Problem of indiscipline is solved

Disadvantages

- It may result in damages of apparatus
- It limits opportunities for group work
- It is impracticable in ordinary schools
- It is difficult to prepare assignments.

6.SUPERVISED STUDY

Supervised study affords a practical method of teaching pupils what to study and how and also to

bring the pupils into intimate contact with the teacher and the learning process.

Activities during supervised study

➢ Teach pupils to effectively memorize
➢ Teach pupils to Read rapidly and with understanding
➢ Guide pupils in finding materials from books
➢ Guide pupils in the use of reference books , maps , chart , diagram etc
➢   Guide pupils in the preparation of notes
➢ Teach pupils to Prepare reports
➢ Supervise the collection and organization of data
➢ Assist pupils in the formulation of Hypothesis

Planning for supervised study

- ❑ Double period plan-one for class activity ,other for supervised study
- ❑ The daily extra period plan
- ❑ The library study plan-pupil may go to the library and work on assignment under the supervision of teacher
- ❑ The divided period plan-One period is divided into two parts one for class activity and other for supervised study
- ❑ Special teacher plan-A special teacher is employed to clarify the doubts of pupil

Advantages

- It enable the teacher to give individual attention to the pupils
- It enable the Pupils to get thorough training in study habits
- It gives the pupils training in effective use of library
- Encourages development of democratic human relations
- It creates better pupil –teacher relation
- It enforces daily preparation and accelerates student progress.

TEACHING TECHNIQUES AND STRATEGIES

1.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.

Characteristics

- It encourages the students for contemplation and problem solving
- Useful in achieving the high objectives of knowledge
- It makes use of creative instincts of the students
- Collective thinking and discussion helps in giving valuable thoughts
- Promote to think independently
- Creative thinking method.

Basic rules

➢ No criticism is allowed
➢ Quantity is important
➢ Wildness is good, crazy ideas are welcome

Advantages

- It is possible to refine ideas of different people for a better solution to the problem.
- Allow people to use maximum creativity to find solution
- Increase harmony among people
- The person participating may not be highly qualified
- Easy to understand , not complicated technique
- General solutions and ideas are used

Disadvantages

- Some damp ideas are also be accepted for evaluation
- Overlapping of ideas
- Time consuming

2.BUZZ SESSION

A buzz session consists in dividing an audience into small groups to discuss an issue or to carry out a task

When to use a Buzz

- To ensure participation of every one in large group
- To identify the audience's need and point of interests
- To obtain participants feedback
- To warm up a group before a forum

How to organize a Buzz session

- Divide the audience into groups of 5-8 members
- A moderator is there
- Before beginning introduce themselves
- Give different task for each groups
- Conduct a group discussion , no more than 20 minutes
- Warn before two minutes of end
- After the discussion all groups reassembles
- A short summery of discussion is present in front of the whole group
- The unsolved problem if any are referred back to the sub group
- Finally the general group reaches a concensus of the final solution

Advantages

- It develops critical thinking among students
- It is an effective way to find out a feasible solution to a problematic situation, in a class room
- The discussion always leads to an in depth knowledge in the subject
- Technique helps to develop positive attitudes such as democratic outlook , tolerance to different view point , group cohesion etc.

Disadvantages

- Lack of proper organization of this technique will leads to confusion and hence waste of time.
- If proper control is not exerted by the teacher, the programme would have an adverse effect
- It is not applicable to lower level classes
- There is a possibility of leader domination

3.CONCEPT MAP

- A concept map is visual organization and representation of knowledge.

- It is a graphical tool.

- It shows concepts, ideas and relationship among them.

- A concept map is created by writing key words and then drawing arrows between the ideas that are related.

- Ideas are connected with labeled arrows in a downward –branching hierarchical structure.

- Concept mapping was developed by Joseph Novak and his research team at the Cornell university in the 1970.

- Concept maps are based on Ausubel's Assimilation theory.

- This is build around the fact that new knowledge can be learned effectively by linking it to what is already known. Concept maps are seen as a methodological tool of the theory.

Uses of Concept Map

- Note taking and summarizing concept, their relationship and hierarchy from documents and source materials.
- New knowledge creation.
- Institutional knowledge preservation.
- Collaborative knowledge modeling and transfer of expert knowledge.
- Facilitate in the creation of shared vision and shared understanding within a team or organization.
- Increase in meaningful learning.
- Communicating complex ideas and arguments.
- Examine the symmetry of complex ideas and arguments and associated terminology.

Use concept maps in the following ways:

- Use as an in-class pre-assessment.
- Do as a small group activity.
- Do as a whole class activity.
- Fill in the blanks.
- Organize your research.

4 .MIND MAP

- Mind maps are graphical representation of information.

- A type of spider diagram.

- It is created around a single concept, major ideas are connected directly to the central concept and other ideas branch out from these.

Characteristics

- A central image.

- Curvilinear branches.

- Network of smaller branches at different levels.

- Conscious use of color.

- A single key word for each branch.

Advantages of Mind mapping.

- Mind mapping is a highly effective way of getting information in and out of brain.
- Mind mapping is creative and logical means of note taking.
- Mind mapping convert a long list of modern autonomous information into colorful, memorable and the highly organized diagram.
- With the help of mind mapping students can put their ideas for any order. They are not constrained by thinking in order.
- It can be drawn by hand either as rough notes during a lecture, meeting etc.

Concept Map	Mind Map
Linear/hierarchical.	Radiant structure.
Represents available concepts.	Pools in new ideas
Main idea located on top.	Main idea located in the center of the map.
Branching in one direction	Profusely branching with curved lines.
More formal.	Casual with color and image.

5.QUESTIONING TECHNIQUES

- An ancient method.
- Questioning tend to be an universal teaching strategy.
- Through systematic questioning teacher may determine students entry skills and knowledge levels for specific content areas.

Purpose
- For exposing difficulties.
- Promoting thinking, searching out new ideas.
- For developing appreciation.
- For directing learning to deeper and broader understanding.
- For preparing people's mind to receive nude material.
- For revising work covered earlier.

Characteristics of Question-Answer Method

- The students are active.

- They are curious towards new knowledge.

- It is based on psychological principles.

- It is useful for training institutes and small children.

- The power of thought and expression is enhanced.

- It helps in the development of the lesson.

- It helps in the recapitulation and recall of the topic.

- It can provide the knowledge regarding specific problem and difficulties of students.

- It is useful in the evaluation of the knowledge of the students.

Limitations

- Sometimes it becomes mechanical and uninteresting.
- Special training is required for its execution.
- Formulation of good questions is an art in which everyone is not proficient.
- It is not complete in itself. The help of other methods like lecture method is also required.
- It is not very useful for higher classes.

Suggestions for use

- The questions should be short, clear and to the point.
- They should be inter-related.
- They should be formulated keeping in mind the level of the student and nature of the curriculum.
- Their language should be easy.
- They should be posed in clear voice, correctly and in complete sentences.
- They should be distributed evenly among all students.
- The use of Yes/No type or suggestive type of questions should be avoided .

6.ANALOGY

- An analogy is a comparison of the similarities of two concepts.
- Generally means a comparison between one thing and another, typically for the purpose of explanation or clarification.
- The analogies used in class rooms, textbooks, and web-based instruction should be designed to promote the cognitive process of constructing relations between what is already known and what is new.
- Example: Atomic structure and solar system.

Characteristics

- Increases retention and retrieval of information.
- It makes information more concrete.
- It provide a structural framework for learning the new schema and help in the assimilation of the new information.

7.MNEMONICS

- Mnemonics are memory tools that serve as bridges to help you recall information and concepts from long-term memory.
- They involve creating some form of an association.
- Best if used only for information that is difficult to recall.

Benefits of Mnemonics

❑ Improvement in Memory.
❑ Helps Children with Dyslexia.
❑ Enhances Imagination.
❑ Sensory Stimulation.
❑ Retrieves Important Information.
❑ Memorize Long answers.
❑Memorize Mathematics Formulae.
❑ Memorize Periodic Table.
❑ Memorizing History dates.
❑ Sharpen Your brain.

Kinds of mnemonics:

- **Acronyms**:-A word or phrase made by using the first letter of key words in a list of items to remember. e.g. **VIBGYOR**
- **Acrostic:-**A sentence made by using the first letter of key words in a list of items to remember. e.g.**BB ROY** of **G**reat **B**rittan has **V**ery **G**ood **W**ife wearing **G**old **S**ilver **N**ecklace
- **Word Associations:-**Rhymes and short songs that work as memory tools to recall information.
- **Picture Associations:-**Visual suggestions to help you to easily remember and recall information.
- **The Loci Method:-**Associating items or topics with specific rooms in a familiar building.

8.GRAPHIC ORGANIZER

- A communication tool that uses visual symbols to express knowledge, concepts, thoughts or ideas and the relationship between them.
- The main purpose is to provide a visual aid to facilitate learning and instruction.
- Helps to organize ideas, see relationships and retain information.
- Facilitate effective learning via organizing concepts, ideas and facts graphically.

Importance of using graphic organizer

❑Retention
❑Reading comprehension
❑Student achievement
❑Thinking and learning skills
❑Critical thinking

9.DEBATE

- A debate is a discussion or structured contest about an issue or a resolution.
- It is a collective and creative process of eliciting all related facts of a topic.
- Enrich participant's knowledge through healthy dialogue.
- In the context of a classroom, the topic for debate will be guided by the knowledge, skill, and value outcomes in the curriculum.
- Used for developing the skill of critical thinking, positive interaction etc.

Structure of debate

- ❑ A debate usually involves three groups:
  - Affirmative team
  - Opposing team
  - A chair or moderator.
- ❑ The affirmative and opposing teams usually consist of three members each.
- ❑ The judging may be done by the teacher, a small group of students, or the class as a whole.
- ❑ A specific resolution is developed and rules for the debate are established.

Stages of organizing a debate

- Topic selection:- The topic should be relevant and having potential for different view points.
- Selection of panels:- At least two panels of students may be selected to argue for and against the topic.
- Selection of a moderator: -A student representative should be selected to moderate the section. In the initial state teacher may act as a moderator.
- Collection of information:-The panel of students should be guided by the teacher to collect as enough information from various sources.
- Conducting the debate:-The teacher acts as overall guide and moderator will facilitated the debate. Both the panel can raises their views and arguments on the topic.
- Conclusion:- Moderator should conclude the debate by expressing his final version based on the views evolved from the debate.

10.SYMPOSIUM

- Symposium is defined as a teaching technique that serves as an excellent method for informing the audience, crystallizing their opinion and preparing them for arriving at decision regarding a particular issue or a topic.
- Symposium is a discussion method in which different view points on a single aspect of a topic is discussed.
- Symposium is a series of speeches on single aspect of a topic.
- It is more formal or academic gathering, featuring multiple experts delivering short presentation on a particular topic.

Advantages

- ❏ Symposium can be used to address a large group or class.
- ❏ This method can be frequently used to present broad topics for discussion at conventions and organization of meetings.
- ❏ In symposium, the principle of organization is high as the speeches are prepared beforehand.
- ❏ It gives a deeper insight into a topic.
- ❏ It directs the students to continuous independent study.
- ❏ This method can be used in political meetings.

Disadvantages

- ❏ Symposium does not provide adequate opportunity for all the students to participate actively. It has limited audience participation.
- ❏ The speech is limited to 10 to 20 minutes.
- ❏ Questions and Answer session is limited to 3 to 4 minutes.
- ❏ It has possibility of overlapping of subjects.
- ❏ The chairman has no control over the speakers as they have full freedom to prepare the theme for discussion. They can present any aspect of the theme or problem.
- ❏ There is a possibility of repetition of content.

11.SEMINAR

- Seminar is an instructional technique of higher learning which involves paper reading on a theme and followed by the group discussion to clarify the complex aspects of the theme.

- 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 off special children, improvement of science curriculum, science practical of different classes etc.

Advantages

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

Disadvantages

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

SEMINAR	SYMPOSIUM
Topics are related to recent trends and developments in a discipline	Topics are related to controversial issues in a discipline
Multiple aspects of the topic under consideration is discussed	Single aspect of the topic is discussed
Chairperson has to exert less control	Chairperson has to exert more control
Less time for discussion involving participants	More time for discussion involving participants.
Comparatively less preparation from the sides of participants	Demand more preparation from the side of participants

12.PANEL DISCUSSION

- Panel is a discussion in which a few persons carry on a conversation in front of the audience.
- The discussion provides the equal opportunities in the instructional situations to every participant.
- Panel discussion is a specific format used in a meeting, conference or convention.
- Developed by Harry A Overstreet in 1929.
- "The panel method is a discussion in which 4-8 persons who are qualified to talk about the topic, sit and discuss a given problem or the topic, in front of large group or audience."

                                                            - Prof. Harry A Overstreet

Purposes

- It stimulates thoughts and discussion and clarifies thinking.
- It influences the facts, opinions and plans
- It influences the audience to an open minded attitude and respect
- It can be helpful to stimulate discussion and developing group opinions.

Types of panel discussion

1. Public panel.
2. Educational panel.

PUBLIC PANEL	EDUCATIONAL PANEL
▪ It is used for common man. ▪ It is used to provide factual information regarding current problem. ▪ It determines social values of current issues. ▪ Example- Unemployment, Annual Budget, Job delinking, Increase in prize of things.	▪ It is used in educational institutions. ▪ It is used to provide conceptual knowledge and clarification of certain theories and principles. ▪ It provides solution of certain problems. ▪ Examples- Scope of educational technology in our country, examination reform, population education etc.

13.BLENDED LEARNING

- Blended learning is an educational program that combines online digital media with traditional classroom methods.
- Blended learning is a student centered approach that integrates learning experiences in online and face-to-face environment.
- It means integration of online with the traditional face-to-face class activities in a planned pedagogically valuable manner.
- Also known as Hybrid learning, Technology mediated instruction ,Web enhanced instruction and Mixed mode of instruction.

It includes:
- ❑ Face to face teaching
- ❑ Student interaction with course content
- ❑ Peer group interaction
- ❑ Group discussion and exchange of ideas
- ❑ Accessing e-library
- ❑ Virtual classroom
- ❑ Online assessment
- ❑ e-tuitions
- ❑ Accessing and maintaining educational blogs
- ❑ Webinars
- ❑ Viewing expert lectures in YouTube
- ❑ Online learning through videos and audios
- ❑ Virtual laboratories

Advantage of blended learning

- As part of learning is done through ICT, online or offline mode so teachers and students get more time in the classroom for creative and cooperative exercise.
- Students gain advantage of online learning and computer assisted learning without losing social interaction element and human touch of traditional teaching'
- It provides more scope for communication. Communication cycle is completed in blended learning which is not possible if we follow only traditional approach
- Students become more techno savvy and they as they develop qualities like self-motivation, self-responsibility, discipline gain enhanced digital fluency
- Students have more strengthened professionalism
- It updates course content and so gives new life to established courses

Disadvantage of blended learning

- ❑ The technology can be challenging rather than useful.
- ❑ Blended learning makes teachers overwork.
- ❑ Students can experience cognitive load, too
- ❑ Credibility of sources and plagiarism become even a bigger issue

14.PROBLEM BASED LEARNING

- Problem based learning is a student centered pedagogy in which students will learn about a subject through the experiences of problem solving.
- PBL is an instructional strategy in which students work in group, takes responsibility for solving real problems.
- PBL process does not focus on problem solving with a definite solution, but it allows for the development of other desirable skills and attributes.
- Include knowledge acquisition and enhanced group collaboration and communication.

Characteristics

❏ Learning is driven by challenging, open-ended problems with one no one right answer.
❏ Problems are context-specific.
❏ Students work as self directed, active investigators, problem solvers in small collaborative groups.
❏ A key problem is identified and a solution is agreed upon and implemented.
❏ Teachers adopt the role as facilitator of learning, guiding learning process and promote an environment of enquiry.

Steps of PBL

- 1
  - Identify the problem

- 2
  - Explore the pre existing knowledge

- 3
  - Generate hypothesis and possible mechanism

- 4
  - Identify learning issues

- 5
  - Self study

- 6
  - Re-evaluation and application of new knowledge to the problem

- 7
  - Assessment and reflection on learning

Advantages

- It is student focused, which allows for active learning and better understanding and retention of knowledge.
- Develop life skills that are applicable to many domains.
- It can be used to enhance content knowledge
- It fosters the development of communication, problem solving, critical thinking collaboration and self-directed learning skills.
- It may position students to optimally function using real-world experiences.

2 Mark Questions

1. Give two characteristics of brain storming?
2. What is concept map?
3. Give any two teaching technique helpful in science class?
4. Give two features of symposium?
5. List various steps involved in project method?
6. Mention a topic that may be taught through problem solving method, write the problem you may frame for the topic?
7. What are the disadvantages of individual laboratory method?
8. What are the various stages of brain storming technique?
9. Write the role of teacher in project method?
10. Why do teacher prefer lecture cum demonstration method?
11. List the advantages of supervised study?

4 Mark Short Essays

1. What are mnemonics , Give two mnemonics helpful in science learning?

2. Suggest four proposals for conducting seminar effectively?

3. Explain Dalton plan?

4. Explain project method?

5. "Is science blessing or curse" How will you conduct a debate on this topic in secondary school class?

6. Explain problem solving method of science teaching?

4 Mark Short Essays

7. Describe any four pattern by which you can implement supervised study in your class room?

8. Explain any two graphic organizers with example?

9. Describe the problem solving cycle?

10. Distinguish between project method and problem solving method?

11. Questioning technique is helpful for developing thinking skill. Explain?

12. What is analogy, what are the advantages of using analogy in science class?

13. Explain the significance of lecture cum demonstration method?

14. Explain concept map with an example from physical science?

10 Mark Essays

1. Problem solving method is a significant method of instruction in science classes ,elaborate the statement?

2. Describe Dalton plan bringing its merits and demerits?