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Course 7 (a): Pedagogy of Biological Science

(Part –I Methodology)

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UNIT I: Aims and Objectives of Teaching Biological Science

Objectives:

- To obtain knowledge on the nature and scope of biological science.
- To understand the aims and objectives of teaching of biological science.
- To examine the need and significance of teaching of biological science.
- To explore the values of teaching of biological science.

INTRODUCTION

The science which deals with the study of living objects is called Biology. Thus the subject involves the studies of all kinds of micro-organisms, plants and animals. Biology is related to mankind ever since the origin of man, therefore this branch of science stands first in order of studies as compared to other branches of science. Ever since the origin of life man is eager to know about various phenomenon of life processes such as health and disease, birth, growth and death. However, man depends on plants and animals for food, shelter and clothing which are immediate needs of life, come from Biology. Perhaps it was the elementary need of man to know about the living beings, so that maximum benefits can be drawn out of them. Though biology involves study of life, but now a days it is mostly centralised with the study of agriculture, animal husbandry, health and microbiology and related branches. Today study of any branch of science is not possible in isolation as it also involves principles of physics, chemistry and various other branches.

MEANING

Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, identification and taxonomy.

Biology literally means "the study of life". Biology is such a broad field, covering the minute workings of chemical machines inside our cells, to broad scale concepts of ecosystems and global climate change. Biologists study intimate details of the human brain, the composition of our genes, and even the functioning of our reproductive system.

Human's exploratory activities have resulted in the accumulation of vast source of knowledge called Biology. In Biology, we study about nature which means the entire universe. The knowledge is now organised in several disciplines for the convenience of study. This knowledge is based on

inquiry, observations and logical extensions, and is testable by experiment or has logically convincing explanation.

It is this organised knowledge with inquiry, logical reasoning and experimentation as its central themes that we call science. Science may rightly be said to be a domain of inquiry.

NATURE AND SCOPE

Biology has certain characteristics which distinguish it from other spheres of human endeavour. These characteristics define the nature of biology. Humans have always been curious about the world around them. The inquiring and imaginative human mind has responded to the wonder and awe of nature in different ways. One kind of response from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world. This human endeavour is Biology. But Biology is ultimately a social endeavour. Biology is knowledge and knowledge is power. With power can come wisdom and liberation. Or, as sometimes happens unfortunately, power can breed arrogance and domination. Biology has the potential to be beneficial or harmful, emancipative or oppressive. History, particularly of the twentieth century, is full of examples of this dual role of Biology.

In a progressive forward-looking society, Biology can play a truly liberating role, helping people out of the vicious circle of poverty, ignorance and superstition. Biology, tempered with wisdom, is the surest and the only way to human welfare. This conviction provides the basic rationale for Biology education.

Science promotes scepticism; scientists are highly sceptic people. Scientists look at everything with suspicion. Every new observation or a new theory is received with a lot of scepticism. It leads to a lot of debate among scientist. A new observation is accepted only when experimental observations have been checked by independent individuals or groups at various places with identical results. Similarly, a new theory is accepted when theoretical calculations have been repeated by other scientists independently with identical results.

Science, and biology in particular, holds several foundational values that should be conveyed to students as they pursue careers as scientists or science teachers.

Science is based on at least four fundamental values:

- Curiosity is good and should be encouraged.
- Knowledge itself is good—it is good to acquire knowledge.
- It is wrong to falsify or fabricate the data on which knowledge is based.
- It is good to keep an open mind (to be willing to examine and consider new evidence and arguments), tempered by a vigilant level of scepticism.

Curiosity is surely the most essential trait a scientist can possess. Curiosity leads to a search for knowledge for its own sake, which is the driving force behind the great majority of scientific discoveries ever made. Acquiring knowledge for curiosity's sake leads naturally to the second value that knowledge is good— not because it may be useful in some pragmatic way, but simply because it increases our store of knowledge about the universe in which we live. Staying open-minded and sceptical is certainly a value and goal for all scientists, provided that one's open-mindedness is reserved for objective evidence, as opposed to subjective opinion.

Curiosity can be a hard sell because, sadly, many of today's students seem to lack curiosity about the world and universe outside their personal spheres of relevance. Even at the college level, many students appear to have no interest in learning about anything as remote as stellar evolution, photosynthesis, Krebs cycle, the Burgess Shale fossils, hydrothermal vent communities, lateral gene transfer, the bacterial origin of mitochondria, and so on. Yet these topics would not seem remote if they were approached in a creative and spirited manner.

Most investigations in science involve some form of scientific method. It shows creativity of humankind in seeking solution to its problems. The approach used by the scientists in the study of astronomy and ecology is observation and prediction. In microbiology they rely on laboratory experiment focused on cause and effect relationship. This is a glimpse of the process by which science works. The essential elements of this process have been collected in what is known as scientific method.

In science, experimentation and theory building complement each other. Sometimes a new experiment throws up observations which force modification in an existing theory or demand the development of an altogether new theory. At other times, theoretical development in a theory

predicts new phenomena which needs to be verified by experiment. This interplay between theory and experiment is a fascinating facet of the scientific process.

Broadly speaking, science is a particular way of looking at nature, which may also be called scientific attitude. One of the most important characteristics of science is that even the most established theories can be modified, or even abandoned, if new experimental results do not fit into the existing theories. This promotes scepticism among scientists. They look at every new observation or theoretical calculation with a healthy dose of scepticism and do not accept it till the result has been reproduced by many scientists at various places. Reproducibility is one of the important criteria for a scientific result to be acceptable. It is believed that scientists, in their exploration, employ inquiry and scientific method. The use of scientific method and inquiry in daily life promotes scientific temper and rationality. That is why it has been emphasised that all of us should imbibe the spirit of scientific inquiry in our personal lives. So, science can never belong to a country or region. It belongs to the whole mankind.

AIMS AND OBJECTIVES OF TEACHING BIOLOGICAL SCIENCE IN SCHOOLS

One of the important aims of education is to help students to become responsible democratic citizens of the country. The responsibility of science teachers is not only to teach facts, principles and processes of science, but also to facilitate students to discharge their social responsibilities and preserve democracy as well. They should appreciate how science and technology have developed and are affected by many diverse individuals, cultures and societies. They need to be encouraged to appreciate and participate in the responsible use of science and technology for the benefit of society, to visualize future of our nation and to become sensitive and responsible citizens. It is important to develop critical thinking in them about interconnectivity of science, technology and society in order to maintain a healthy and sustainable society. Students should be encouraged to develop a scientific vision about different issues, about acquiring and processing information, about scientific and technological developments and their relevance to everyday life and long-term implications to society.

Science education aims to make students develop scientific attitude, so that in later life they can help society make rational choices when confronted with various possibilities and challenges.

Humans' inquisitiveness and usefulness of the knowledge of science are the two main factors which have led them to continuously strive to understand the behaviour of nature and use the

knowledge of science to make their life more comfortable. In doing so humans systematised knowledge by classifying it into various fields of their activities, built concepts to understand the behaviour of nature and found various ways to exploit it. All these endeavours of the humankind resulted in a new discipline known as science. Science has influenced and benefited us so immensely that it has become indispensable. At the same time, the society has also helped science to grow.

Science enhances the quality of our life and it is visible in all walks of life. Since science has been developed by people who are part of a group, society or a country, it is expected that their social, psychological, political, economic perceptions could change the course of development of science.

The science education is aimed for the learner to

- know the facts and principles of science and its applications, consistent with the stage of cognitive development;
- acquire the skills and understand the methods of processes that lead to generation and validation of scientific knowledge;
- develop a historical and developmental perspective of science and to enable her to view science as a continuing social enterprise;
- relate science education to environment (natural environment, artifacts and people), local as well as global and appreciate the issues at the interface of science, technology and society;
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work;
- nurture the natural curiosity, aesthetic sense and creativity in science and technology;
- imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment; and
- cultivate scientific temper- objectivity, scepticism, critical thinking and freedom from fear and prejudice.

Acquisition of knowledge and understanding

An important trait of humans is to wonder, observe and interact with the surroundings and look for the meaningful patterns and relations by making and using new tools and build conceptual models to understand this universe. This humans' endeavour has led to modern science which took thousands of years to get crystallised. So one can say that science leads to generation of ideas helping to make sense of observed facts that get accepted if they fit observations, but may be refuted until

tested through evidence. These ideas represent a broad view and are generalised as the scientific principles that are true universally.

It is important for children to acquire the knowledge of science content, i.e., concepts and underlying principles as they provide a sound base to explore the unknown and build further knowledge, yet these cannot be passed to children directly. In addition, their understanding cannot be developed by rote learning. It can be done by providing children relevant and age appropriate learning opportunities that allow them to undergo experiential learning through exploration and interaction with their environment and construct their knowledge. Creation of knowledge is crucial to children's learning. Their previous experiences are very important for it, as the experiences lead them to develop new ideas. Teachers need to collect such experiences of children to build further knowledge on their previous knowledge. For this they may engage the children in meaningful discussions through questioning and listening. Even children's drawings, concept maps also serve as good tools to acquire such information.

Development of skills

Science is about asking questions and finding answers to them through scientific method and inquiry. The processes that scientists use in it are science process skills. Science is important to all young people for not only to acquire the knowledge associated with it, but also to imbibe its inquiry and process skills. These skills enable them to develop into adults who are able to take informed and responsible action while engaging and reflecting upon different ideas, opinions, beliefs or values. These are longlasting ;thus, tend to be useful throughout each area of our lives. These skills involve the use of all the senseorgans providing hands-on experiences for enjoyable and effective learning.

Doing experiments require certain skills, which are called laboratory skills. In order to do experiments, students have to handle apparatus carefully, set up the apparatus to perform the experiment and make correct observations. These are the skills which come under laboratory skills. Some simple apparatus can be prepared by the students which also require some skill. When they do experiments in laboratory they have to move with other students cooperatively sharing the responsibilities. This develops feeling in the students. This is called general skill. They also need to develop drawing skill. These skills are necessary for the students to develop when they study biology. All these basic skills are important individually as well as when they are integrated.

Development of scientific attitude

Scientific attitude is a composite of a number of mental processes or tendencies to react consistently in certain ways to a novel or problematic situation. These include accuracy, intellectual honesty, open-mindedness, respect for evidence, scepticism, suspended judgement, critical thinking, perseverance and looking at true cause and effect relationship. Scientists, because of their thirst for knowledge become perpetual learners. They are constantly curious and continually seeking knowledge by inquiring. This in turn nurtures the trait of scientific attitude.

Students who study science are curious. So students of biology are also curious. They are also open-minded to hear anything from anybody. They receive information and come to a conclusion or judgement only based on facts. At the same time they are ready to test and verify their judgements. This makes them believe that nothing is final in biology. They are truthful in doing experiments, making observations, recording and reporting. They also have faith in cause and effect relationship. The students of biology possess all these qualities and also develop these qualities while studying biology. These qualities are called as scientific attitude.

Science attitude can be nurtured over a period of time through the process relevant learning situations that require creating an open classroom environment encouraging children to perform activities and experiments and reading scientific literature, freely interacting with their surroundings and asking questions. A science teacher needs to provide children experiences of a number of scientific activities as base for a thorough understanding of science and developing scientific attitude and temper.

Development of thinking abilities

In science, critical thinking increases science learning potentials. It requires deliberate review of the way in which activities are carried out, the ideas emerge and the way these can be improved. It is the ability to analyse information and experiences in an objective manner. Reflecting on the processes of thinking does not come readily to young children as it involves abstract thinking as well. Teachers can facilitate this by engaging the children in discussions through activities.

The process of linkage of the past experiences in terms of cause and effect relationship on a model of set rules, i.e. thinking with reasoning is known as logical thinking. Children should be

helped to reason out consistently before arriving at conclusion. Scientific temper is the refined logical thinking.

Nurturing curiosity

Thus curiosity led to questions in her mind like why, what and how. When students ask such questions, the teacher should not discourage them. She should facilitate them to find answer using scientific principles. Science is nothing but all that happens around us. Students come across many questions out of curiosity. Curiosity leads to inculcation of *learning to learn* aspect of education. Curiosity can be generated in the learners by taking them to science centres; providing opportunities to work on science projects and to read scientific literature; facilitating interaction with persons having scientific attitude; encouraging to participate in science exhibition and science quiz, etc. Science activities can be designed to encompass several factors making up curiosity. Curiosity gets aroused as a result of doubt, perplexity, contradiction, cognitive conflict, ambiguity, lack of clarity, etc. A teacher needs to create suitable learning situations for this.

Nurturing creativity

Creative thinking is a novel or innovative way of seeing or doing things. Creative thinking enables a learner to explore available alternatives and consequences of actions or non-actions and contributes to decision-making and problem solving.

Creativity has been defined in different ways. It is the production of relevant and novel product and process. Also, it involves classification and assessment of different components of the problem or delineation, manipulation and linkage of ideas in a novel manner to solve a problem, or to deal with an idea or to confirm a conclusion. Creativity is doing or seeing the things differently. It cannot be taught, but developed in children by using planned strategies and techniques.

The teacher plays an important role for nurturing creativity in learners. From pedagogical perspective of physical science, inquiry and activity oriented, process based teaching-learning can facilitate in nurturing creativity. Therefore, the role of the teacher should be to–

- assist students in developing models of inquiry and discovery;
- guide students in the use of multidisciplinary approach;
- recognise and appreciate creative ideas and products of students;
- provide rich variety of learning experiences to students;

- encourage students to frame questions and browse variety of reading materials; and
- express to the students that their ideas have value

A creative child thinks differently, expresses unending curiosity and possesses divergent thinking ability. She wonders what makes things work. She is always a keen observer who ponders over the outcome of an event or phenomena and seeks information. She has original, divergent, independent, fearless and intuitive thinking and welcomes new ideas. She likes to ask thought-provoking questions rather than fact seeking or memory type questions. Teachers should identify these traits and provide a variety of learning experiences of inquiry and discovery of science to nurture creativity.

Nurturing aesthetic sense

Aesthetics deals with the creation and appreciation of beauty that gives us happiness. Harmony, order and pattern are some of the criteria which define beauty. A learner of science is also concerned with them. She gets motivated to see some patterns in the properties of substances and other things in her surroundings. She appreciates her creation and derives joy when finds that a particular toy or a gadget works on same scientific principle that she has already learnt.

For nurturing aesthetic sense through science teaching learning, the teacher may encourage students to consider the following steps:

- Observe keenly while doing any work. For example, observing the flowers while walking in the garden one can appreciate their colour and wonders why the flower is of that particular colour. Observe, analyse and reject what is not scientific.
- One should be conscious of one's inner being.
- Learn to be generous. One should develop the sense of sacrifice and self-righteousness.

Development of Problem solving skill

Problem solving means that an individual has learned the skills and acquired relevant information necessary to solve problems that are not only curricular, but also related to everyday life.

Various skills required for problem solving can be enhanced by providing opportunities to students to ask questions, think aloud, look for alternative explanations and procedures, isolate and control variables, keep record, apply reasoning and analogy, make models, and apply process skills

in teaching-learning of science. Students can explore such potentiality while working on the problem. They feel a sense of achievement on getting success and develop self-confidence.

In order to provide opportunities of problem solving we need to inculcate the following abilities among the learners:

- Flexible and divergent thinking;
- Decision-making and generating self-confidence;
- Accepting/rejecting hypothesis;
- Correlating between various quantities/phenomena;
- Checking the validity of results;
- Expressing the task in terms of goals;
- Searching for innovative practices;
- Creating new challenges for life; and
- Developing positive and cooperative attitude.

To solve problems in science, students must acquire what cognitive psychologists call *declarative knowledge* which consists of the body of knowledge and facts needed to work in science. .Simply acquiring knowledge of science is not sufficient. One must organise this knowledge in such a way that can be retrieved easily to solve problems. Simultaneously, with acquiring and organising declarative knowledge, one must also acquire *procedural knowledge* (knowledge of processes) which are procedures and heuristics that can be applied to solve problems.

NEED AND SIGNIFICANCE OF TEACHING BIOLOGICAL SCIENCE

Science has been given due place in our school education programmed by being made as a compulsory subject. Not only is that more and more emphasis now being paid over the scientific and technical education. By doing so infact a right step has been taken to push our country forward and to enable us to compete with other progressive nations. It has necessitated to lay due emphasis on the teaching of science right from the primary stage. Realising such need Kothari Commission has very rightly remarked in their recommendations as follows:

“Science and Mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first ten years of schooling”.

Utilitarian value of day to day use.

Modern age is science age. We see a network of scientific gadgets based on latest scientific inventions all around us. Science has revolutionised our way of living. Now our lives depend on scientifically invented gadgets so much that we cannot do without them. It is now imperative for everyone not only to understand science but to master it from all angles. According to Herbert Spencer, “The knowledge gained through science is much more useful in guiding our life style than gained through other sources”.

Intellectual value

The study of science provide us the opportunity of developing our mental faculties of reasoning, imagination, memory, observation, concentration, analysis, originality and of systematic thinking. Science gives us the insight which enables us to search the truth and the reality of nature around us. Science does not permit us to accept anything which we cannot prove by actual observation, reasoning and experimentation. The queries of all problems and phenomena can be satisfactorily answered only by the wisdom of science.

Disciplinary value

Science develops our personality as a whole. It inculcates spirit of enquiry, seriousness, and systematic thinking. It brings about total transformation of one's view point and makes thought process more organised. Science makes us think seriously and helps to observe the real nature of the problem. It helps us to judge all the good and bad points, together with the gain and loss likely to be incurred in the plan of action contemplated. Science is only the one subject which promotes interest in study, concentration and habit of hard and systematic work. It also inculcates the habit of viewing a problem impartially with an alert mind. This helps to lead one's daily life successfully in a well organised and systematic way.

Cultural value

From time immemorial man has been trying to maintain and preserve their way of life and standard through the use of science. But somehow our way of life has been changing with the passage of time and progress of science. This change in our life-style is due to the inventions of science. The development of culture is the history of science. We can judge the progress of civilisation and culture

of a nation by its progress in science. Science not only develops our culture but also helps in preserving it.

Moral value

Some people believe that Science is responsible for lack of faith in God, but in reality the situation is reverse. Science does not permit blind faith, it also does not admit faith in idol worship nor follows many useless customs and rituals. The search for truth or reality of nature and search of God are identical aims. Thus pursuit of knowledge of nature or study of science cannot be called contrary to religion and faithlessness. Science and its pursuit not only include all the traits of morality but also develop them. The qualities of honesty of purpose, truth, justice, punctuality, determination, patience, self-control, self-respect, self-confidence and tolerance are automatically developed in man if he follows scientific method in his pursuit of knowledge. In science every conclusion depends upon tests and actual observations and not by cheat and deceit.

Aesthetic value

Science is beauty, art, a source of entertainment and a successful means of attaining physical comforts. Even the study of science is a source of great pleasure, when one gets answers to his questions about the mysteries of nature. Science helps us to utilise our leisure purposefully.

Social value

Science is of great value to society. Science makes a man a useful citizen. Science gives impetus to the progress of society by its new thoughts and inventions. From the very beginning of our civilisation science has played an important role in its development. In fact, the world has become a small social group. Today's society stands on pillars of scientific techniques and knowledge. All our social activities depend upon science. Science is essential for the progress of our society and nation. By studying science we can make our social life happy and comfortable by leading a healthy life and by gaining from public welfare activities based on science.

Vocational value

Science has opened vast vistas of vocations, because scientific principles and inventions have become so universal and pervasive in our daily life. Scientific inventions have now helped widely all

the traditional vocations nowadays like – agriculture, poultry farming and dairy farming. Science has also revolutionized modern vocations like – telephone, radio and television broadcasting etc.

Psychological value

Study of science fulfils the psychological needs of man and helps in evolution of natural curiosity and other instincts like instinct of collection, ego, and self-expression. The instincts of curiosity is responsible for the urge of investigation, experimentation and research. In this way study of science develops all the latent faculties of a child.

Whether we consider from personal or social point of view, the study of science has its special importance. The joy and bliss are obtained from successful investigation of scientific problems but in addition it also gives children self-confidence and insight for solving any life-problem facing them. In brief, the study of science gives us self-confidence and teaches us to lead a successful and meaningful life.

Develops problem-solving skills

With the knowledge of science, you learn to think logically and solve a problem. It is this problem-solving skill, which is learnt in the early years that have enables a person to solve problems. Communications, medicine, transportation, and almost everything you see around you are mainly present because individuals have used their knowledge of science to create real life applications. Knowledge in this subject also enables you to understand many other subjects better.

Awareness about technology

Learning the basics of how certain devices work can help you develop ideas of your own and invent new technology. Even the knowledge of how to use telescopes, microscopes, and other devices in a laboratory can help you in examining objects and determining differences between them. Fixing minor problems in electronic objects in your own home is possible when you have the basic knowledge about technology.

How to conserve natural resources

All aspects of the environment have a deep impact on our lives. As a student, science helps you to learn about how the earth functions, and how to make use of natural resources. It also teaches you how the lack of these resources affects living things, and how you can conserve these resources.

When you learn about wildlife in science, you will learn about the many species that are already extinct, because of shortage or absence of certain resources and environmental changes. Awareness about such aspects can help you contribute towards preserving wildlife. Science also teaches you to recycle and reuse products and promote a greener environment. This knowledge is very essential to help save our planet for the future.

Instils survival skills

Science helps to learn about the various weather conditions, and helps to distinguish between normal weather and dangerous weather. With this knowledge, learner can stay alert about natural disasters or survive the disaster. Because the learner learn about the characteristics of different objects that they use in day-to-day life, learner will be able to distinguish between things that are safe to eat and those that they should not. Almost everything that a person does requires a basic knowledge of science, and logical reasoning that is based on this subject. So, it is undoubtedly important to learn science from the early days of school.

VALUES OF TEACHING BIOLOGICAL SCIENCE

Teaching science inevitably involves value messages for instance in the management of the curriculum (e.g. science can be presented as physics, chemistry and biology or as rural science, or domestic science or as environmental science each of these involving different value judgements) and the particular selection of knowledge which is included in the curriculum (e.g. breathing and circulation are conventionally taught in a biology programme in such a way as to emphasise anatomy and physiology related to the preparatory needs of future medical students).

In many parts of the world today there is a concern about the role science education may play in establishing a sense of personal and social identity for a student. Implicit in this concern is the recognition of

- The powerful social, economic and cultural impact of contemporary science world-wide;
- The importance of the process, ideas and products of science to individual citizens irrespective of their particular role and status in society; and
- The urgent need to harness science to human welfare.

Baez (1984) in discussion issues of science, environment, education and basic human needs identifies survival needs such as food, shelter, health and safety, development needs such as education and employment, and perceived needs such as wealth, security and growth. He notes that all these are in some form or other dependent upon the physical environment in which we live.

However he goes further in his identification of basic human needs making the point that....'Man does not live by bread alone. His needs go beyond the purely physical and include such things as leisure time and the human qualities of respect, care and affection. Deprived of these a person may languish as surely as if he were deprived of food and water'.

Jennings (1983) in discussing the place of biology in the curriculum and its role in the education of the individual argues that the respectability of school biology as a scientific study was hard earned and the rigour and precision of modern biology make it important for schools to sustain the scientific process dimension to the biology curriculum. However he adds that the key issue is that while retaining this scientific biology curriculum it is necessary to extend it adequately along a human social dimension. He presents an interesting distillation of objectives associated with biology programmes in which he identifies affective as well as cognitive aspects.

According to Kelly (1980), 'It is one of the greatest challenges to biological education to formulate a biosocial synthesis in a way that gives it credibility and a rightful place in the curriculum'.

The affective dimension of biological education has often been more effectively developed in terms of translating affective aims into effective teaching strategies when biological science has been placed in a broader curriculum context such as that of environmental education, health education or personal and social education. The perception of the relevance of biological processes and concepts to the individual has in such programmes been sharpened by the need to look more at the whole education of the person and so individual and social need rather than deriving teaching programmes solely based on the internal logic of the subject. Environmental education

programmes for instance often focus upon issues which involve scientific knowledge within a framework of social values and aesthetic personal life, through their community, culture and environment. In such contexts as these it has been necessary to explore teaching strategies which go beyond the cognitive and give scope for affective development.

Tones (1981) in discussing this aspect of health education suggests that the options open to teachers in Affective Education and Health. It is attempted to be implemented in science programmes that the values context of the cognitive processes starts to be recognised creating problems for the teachers' role in relation to imparting particular sets of values. Teachers may not wish to impose their own values, or those of a particular class or culture in the community. A particular approach that has been used by teachers taking this attitude has been that of value clarification. Simon (1972) has defined value clarification as involving a hierarchy of seven sub-processes:

Prizing: 1. Prizing and cherishing.

2. Publicly affirming, when appropriate.

3. Choosing from alternatives.

Choosing 4. Choosing after consideration of concern

5. Choosing freely.

Acting 6. Acting

7. Acting with a pattern, consistency and repetition.

The U.K. Association for Science Education in a discussion paper on Planning for Science in the Curriculum (1985) has argued that a broad balanced science curriculum should be seen within the context of a broad balanced general education and that each teacher should be aware of the total package that is being prepared for and offered to the students. It is further argued that 'Learning experiences should be constructed so as to take account of student's needs and not only the entry requirements of the profession and higher education or the perceived needs of the nation. Students have to be helped to develop their own identities so that they can become autonomous learners and decision makers and feel a sense of confidence and success in their personal relationships'. This does not necessarily mean that the traditional subjects are not an appropriate way in which to organise teaching, but it does mean that there should be co-ordination across the curriculum. Perhaps in such

away we may be able to see means though which science education can contribute not only to man's physical needs but also to those such as leisure and human qualities of respect, care and affection.

CONCLUSION

Biology teaching seen in this way can be developed to contribute to linguistic, mathematical, scientific, personal, aesthetic and physical development, rather than at times actually inhibit or even conflict with some of these development aims an effective science education will be one that is placed in a values context and contributes to the education of the whole individual. Science and in particular biology teaching has affective aims which are essential contexts for the cognitive aims. Science teaching in a whole curriculum perspective can be effectively organised and lead to a useful rethinking of the purpose of science programmes for individuals especially at the Upper Secondary level where, increasingly, the number of students who will go on to professional or technical level careers in science, technology or related fields is limited (Unesco,1980).

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Questions for Discussion and Reflection

1. Discuss the nature and scope of biological science.
2. How will you develop the Problem solving skill of a learner?
3. Describe the aims and objectives teaching of biological science in schools.
4. Critically analyse the need and significance of teaching of biological science.
5. Explain the values of teaching biological science.

Unit II Planning For Instruction

Objectives

After the completion of the unit, the learners will be able to:

1. explain the steps involved in the lesson plan.
2. design a unit plan for Biological Science
3. formulate instructional objectives based on the domains
4. construct test items for formative evaluation
5. discuss the different types of test items

Introduction

Planning is essential in any sort of activity and more so when a teacher is going to a classroom for teaching a subject. Especially for a science teacher, it is absolutely essential that he plans the topic well in advance so as to make his teaching interesting and efficient by organizing simple demonstration experiments and other activities. After all science is doing and children should learn science as a fun. Teachers should avoid reading the science text book in class room. Planning helps the teacher in systematic presentation of subject matter. The teacher has to plan every step and should go to the classroom with a written plan.

Effective lesson planning requires the knowledge of the physiological developments and the intellectual maturity of the students. It also requires knowledge about the needs, interests and abilities of the students. The knowledge of psychology of learning, principals of teaching, previous knowledge of the students, and effective mastery of the subject matter are essential for lesson planning. A lesson plan demands sufficient experience of the teacher to plan classroom activities to develop understanding, interest, aptitude and skill of students in addition to the scientific knowledge in all its aspects- scientific terms, facts and principals ideas and concepts. In a lesson plan there should be scope for creative activities by the students and should provide opportunity for critical thinking. How to prepare such a plan is discussed in this unit.

LESSON PLANNING

Different teaching methods are available for teaching science and all these methods are discussed in an earlier unit. Similarly various teaching aids are available for transacting the curriculum. Before going to the classroom the teacher has to select the appropriate method for teaching the topic and also the proper teaching aid which will help the learner to understand the concepts in the topic. This is sometimes called planning the strategy.

- The lesson plan stimulates the teacher to think in an organized manner. It helps the teacher to outline the objectives properly.
- The lesson plan helps in creating the interest of pupils towards the lesson.
- A proper correlation is established between the new and old lesson.
- The lesson plan provides guidance to the teacher as to what and how he should teach.
- This compels the teacher to think about using teaching aids.
- This helps the teacher to choose the best teaching method.
- The lesson plan inspires the teacher to ask proper and important questions.
- This helps the teacher to teach, keeping in the mind the individual differences.
- The subject matter is organized in a time frame and with proper sequence.
- This develops self-confidence in the teacher.
- This helps the teacher in evaluating his teaching.

Definition of Lesson Plan

Bossing defines, “A lesson plan is an organized statement of general and specific goals together with the specific means by which these goals are to be attained by the learner under the guidance of the teacher on a given day.”

In the words of Lester B. Stands. “A lesson plan is actually a plan of action. It includes the working philosophy of the teacher, his knowledge of philosophy, his knowledge about students, objectives, material to be taught and his ability to utilize effective methods.”

Like a dexterous craftsman a teacher should plan his tools and techniques, which may help him in moulding his materials that is students in the right way. In other words, it is a window through which teacher can see his originality and teaching talents. Lesson plan is teacher’s mental and emotional visualization of classroom activities.

Components of a Lesson plan

Teacher should follow specific steps in writing lesson plans. J.F. Herbart and other educationists after him have emphasized the following steps. These steps are called as Herbartian Formal steps. They are:

1. Preparation or Introduction.
2. Presentation.
3. Comparison or Association.
4. Generalization.
5. Application.

6. Recapitulation.

1. Preparation or Introduction

According to J.F. Herbart the mind of the students must be prepared to receive new knowledge. It is first like preparing the land before sowing the seed.

This step should be brief and nothing new to be told to the students. The teacher should ascertain what the students know already related to the topic and should provide a link between the previous knowledge and the new lesson. This step may involve.

- (a) Testing the previous knowledge of the students
- (b) Arousing curiosity by the novelty of experimentation or activity.
- (c) Use of charts, pictures and models.
- (d) Skillful discussion.

This is most important step because “well-begun” is half done.”

1. Presentation

Immediately after the preparation, the aim of the lesson should clearly be stated. This becomes the second step.

In the second step the actual lesson begins. Students get new ideas and knowledge. The teacher presents the subject matter to the students. The students passively listen and learn the ideas told by the teacher. The teacher may demonstrate any experiment, use any aid or do any activities.

2. Comparison or Association

The new ideas or knowledge learnt should be compared and associated with already known ideas and facts. It is felt that knowledge is not like piling up of bricks, but it is like a tree that grows. This step is most important when the teacher is establishing principals or generalizing definitions.

3. Generalization

In most of the science lessons teachers have to arrive at certain generalizations. Formulas, principles or law are to be established. As far as possible the students should draw out the conclusion themselves. Sometimes the student’s generalizations may be incomplete or irrelevant. At this time the teacher should guide them to make corrections.

4. Application

A lesson of science will be incomplete if the rules or formulas are not applied to new life situations. It is always the desire of the students to make use of generalizations and to verify whether they really work in new situations. Knowledge becomes clear and meaningful in this stage.

5. Recapitulation

This is the last step in the process. Here the teacher ascertains whether the students have understood and grasped the subject matter or not. It is generally done by one of the following ways:

- (a) Asking suitable questions on the topic taught.
- (b) Applying a short objective type test.
- (c) Asking the students to label the unlabeled sketch.

It should be remembered that these forms of Herbartian steps are not final. These are tentative guidelines. We should not always try to rigidly follow them. Moreover it is not possible to follow all these steps in all types of lessons.

In the modern days these Herbartian steps are included in four steps, which are as follows:

- 1. Preparation
- 2. Development
- 3. Review
- 4. Assignment

In this you know very well about preparation. The second step development involves the activities of both teacher and students. Teacher helps the students to learn the lesson. Both the students and teacher participate in the development. The teacher is expected to develop the lesson with students' participation. The third step review is equivalent to recapitulation. The fourth step assignment is the homework to be given to the students. These are the four steps involved in the lesson plan.

Advantages of lesson planning

Lesson plan is actually a plan of action. A teacher without lesson plan ends his efforts to keep proper discipline in the class and discouraged with his failures. A teacher with good plans is also tired, but his tiredness is tempered with the joy of satisfaction. The advantage of lesson plan can be listed as follows:

- 1. It makes the teacher's work regular, well organized and systematic.
- 2. It prompts confidence and self-reliance in the teacher.
- 3. It helps the teacher to proceed with particular aims in view and thus makes him conscious of interests and attitudes to be developed in the students.
- 4. It renders a saving in time, for the students have a better understanding of the subject and develop some desirable attitudes in a specified time, while in the absence of a plan it might have taken more time for the similar understanding.

5. Lesson plans establish proper connections between different lessons of study. Therefore, they provide continuity in the teaching process.
6. It stimulates the teacher to introduce striking questions and illustrations.
7. It provides greater freedom in teaching, for a teacher who has properly planned his lesson, enters the classroom with confidence; without any anxiety, ready to attack the problem and prepared to carry it out like a skilled workman.
8. It helps the teacher to plan the teaching aids to be used in the class, well in advance and also ensure their workability.
9. It avoids wastage of time.

Criteria of a Good Lesson Plan

The following are the criteria of a good lesson plan. Any lesson plan should contain these criteria.

1. A lesson plan should be written and well prepared assuming that teacher has gone through the matter from all aspects.
2. General Objectives also called non-behavioural objectives of the lesson should be clearly stated.
3. Specific objectives also called behavioural objectives should be clearly stated.
4. Types of aids that are to be used along with the situation in which they are able to be used should be used.
5. Content, learning experiences and evaluation tools and procedure should be stated.
6. Review and assignment should be written at the end of the lesson.
7. A good lesson plan should reveal the type of activities to be performed by the teacher and the students.
8. Active participation of the students should be made possible in the lesson plan.
9. Questions should be well planned and unambiguous.
10. There should be provision for individual attention.

Writing objectives in behavioural terms

In a lesson plan general objectives should be clearly stated in the beginning itself. After that specific objectives should be stated. These are the specific behaviours exhibited by the students in order to achieve the objectives. The specification or performance objective should not be a description of what the lesson is about, but it is a statement of what the learner will be able to do at the end of the learning at the activity. A key to write good performance objective is use of a verb that describes what the student's action or activity will be. Some verbs are open to many interpretations and are vague. Only

those verbs, which are direct and have only one interpretation, should be used in writing the behavioural objectives. The following list of verbs will make the point clear.

Verbs open to many interpretations	Verbs open to few interpretations
to know	to write
to understand	to recite
to appreciate	to identify
to enjoy	to solve
to believe	to list

STRUCTURE OF A FOUR FOLD LESSON PLAN

Content

The teacher elicit the content to be taught to the students in the classroom . The students develop skills in terms of cognitive, affective and psychomotor domain after attending the teaching session of this content.

Specification of Behavioural Outcomes

Specification of behavioural outcomes helps us to state the instructional objectives of various school subjects. These objectives, however, are too vague for the teacher. They should be specific and must be expressed in behaviors terms. Vague, general objectives often do not offer an adequate enough direction to the teacher. As a result, he cannot prepare and organize appropriate learning activities for his pupils. Hence the need for specifications. We have also discussed that the term specifications mean specific objectives or behavioural objectives. The statement of a specification contains an action verb. The statement of specification should be in the form of the student's achievement and not in the form of the teacher's intentions.

Learning Experiences

Learning Experiences results from the active participation of students in the stimulus situation which the teacher provides in the classroom. It is the interaction of the learner and the situation provided by the teacher. It should be purposeful, continuous, interactive based on facts, concepts, principles, generalization for making learning experience more functional and effective in teaching learning process.

Evaluation

The teachers can adopt internal and external methods of evaluation to assess whether their transaction is proper according to the pedagogy of teaching in science classrooms. So the objectives, learning

experience and evaluation are the three interrelated and interdependent aspects in the teaching learning process.

MODEL LESSON PLAN - BOTANY

Name of the School:

Name of the Student Teacher:

Standard: IX

Name of the Guide Teacher:

Subject: Biology

Date:

Topic: The structure of a cell

Time: 45 Minutes

Instructional Objectives: The Students

- define the basic unit of all the living organisms.
- identify the outer cell wall of the plant cell.
- explain the cell wall is made up of cellulose.
- describe the matter inside the cell wall is protoplasm.
- identify protoplasm which is divided into cytoplasm and nucleus.
- explain cytoplasm is a viscous fluid.
- discuss the reasons for the presence of cell membrane in animal cell.
- list out the cell organelles.
- differentiate between plant and animal cell.

Instructional resources required:

1. Slides of cells of different plants and slide projector.
2. Charts of plant cell and animal cell.
3. Slide of animal cell

Previous Knowledge of learners:

- ❖ The teacher ask questions regarding cell, plants and animals and bring out the previous knowledge of the student about the cell.

Pupils answers the following questions:

- What is a living organism?
- What is a non-living organism?

- What is the difference between living and non-living organism?
- What are the organs found in man?
- What constitute the organs?
- What constitute the tissues?

Content	Specification of behavioural outcomes	Learning Experiences	Evaluation
Cell	define	The teacher defines the basic unit of all the living organisms as cell. The student understands that the cell is the fundamental unit of living organisms	What is the fundamental unit of life? Define a cell?
Cell wall	identify	The teacher ask the student to identify that the plant cell is surrounded by the outer cell wall. The student identifies the outer cell wall of the plant cell from the slide.	What is the boundary of the plant cell?
Cellulose	explain	The teacher explains that the cell wall is made up of cellulose in plant. The student identifies the cellulose from the chart.	What does the cell wall made up of?
Protoplasm	describe	The teacher describes that the matter inside the cell wall is protoplasm. The students understand that the protoplasm is found within the cell wall.	What is a cell wall? What is the name for the matter inside the cellwall?
Cytoplasm and the nucleus	Identify	The teacher describes that protoplasm is divided into cytoplasm and nucleus.	What parts do you find with in the cell wall?

		The student identifies from the chart that protoplasm consists of two parts, the cytoplasm and the nucleus	
Cytoplasm	explain	The teacher explains that cytoplasm is a viscous fluid that fills the major part of cell. The nucleus is a spherical body found embedded in the cytoplasm. It is deeper than the cytoplasm The student explains cytoplasm among themselves and identifies nucleus and cytoplasm from the chart.	What is the viscous fluid called? What is the central spherical body called? Is the spherical body denser than the fluid?
Cell membrane.	discuss	The teacher discusses the reasons for the presence of cell membrane in animal cell. The student discusses among themselves that the animal cell does not possess a cell wall but possess only cell membrane.	What is a cell membrane?
Cell organelles	list	The teacher lists out the cell organelles and small vacuoles in the cytoplasm. The student lists out the cell organelles and identifies Centrosome, Golgi bodies, Mitochondria, endoplasmic reticulum in the cytoplasm from the chart. Many small vacuoles are also seen.	Where is centrosome? List out the cell organelles.
Plant cell and animal cell	differentiate	The teacher explains the differences between plant and animal cell. The student differentiates that the plant cell possesses cell wall, chloroplast and many large	Which cell possesses chloroplast? Where do you find large vacuoles? Where do you find cell

		vacuoles. Animal cell membrane, small and a few vacuoles but no chloroplast.	membrane?
Important points of the topic	Summarize draw	The teacher summarizes the important points of the topic and the student practices to draw the plant and animal cell structure.	Draw the diagram of animal and plant cell? Label the parts. What is its importance?

Follow up activities:

1. Draw and label diagram of a plant cell?
2. Describe the structure of an animal cell with neat labeled diagram.

Name of the Guide Teacher

Name of the Student Teacher

UNIT PLAN**Unit Plan**

“A unit may be defined as a means of organizing materials for instructional purposes which utilizes significant subject matter content, involve pupils learning activities through active participation intellectually and physically and modifies the pupils behavior to the extent that he is able to cope with new problems and situations more competently”.

H.C. Morrison**What is a unit?**

A unit is a large subdivision of subject matter with a common fabric of knowledge. The unit is not just blocks of subject matter, but is composed of both method and content. Thus, a unit organizes instruction and increases the probability that instruction will be presented in a cohesive, meaningful and logic way. A properly planned unit integrates many type of activities, some of which provide new information and others help pupils evaluate and retain this information. Units of break up a course into meaningful segments that is larger than lesson plans. They are organized around specific topics so they are neither a block of subject matter nor a series of independent lessons, but represent a

careful organization of subject matter and learning experiences. So a unit can be treated as a 'compound' of lessons and not a 'mixture' of lessons.

Definitions of a Unit

Burton: 'the important thing to provide a combination of subject matter and processes which will have real meaning for the learner which will aid him in continuously integrating his learning is through h a unit'.

Preston: 'A unit is as large a block of related subject matter as can be over viewed by the learner'.

Stanford: 'A unit is an outline of carefully selected subject matter which has been isolated because of its relationship to pupil's need's and interests'.

Characteristics of a Good Unit

- It should keep in view, the needs, the capabilities and the interest of the pupil
- It should take into account the previous experience and background of the pupil
- It should provide for new experiences which the students have not done before
- The length of the unit should maintain interest of the pupil till the last
- The material of the unit should consist of familiar and related topics and not as remote and strange one
- It should be related to social and physical environment of the pupil
- It should help to anticipate and satisfy some of the future needs of the pupil
- It should be a part of the sequence that permits growth from year to year
- It should be a results of the co-operative planning of the teacher as far as possible
- It should provide the basis for its evaluation
- It should be flexible enough to provide individual differences
- It should permit a variety of field trips, experiments, demonstrations, and projects etc.
- It should be practicable in the given setting

Steps in Unit Planning

1. Content analysis (the What of the unit)
2. Objectives with specifications (the Why of the unit)
3. Learning activities (the How of the unit)
4. Testing procedures (evidence of achievement)

i. Content analysis

In unit planning emphasis is placed on analyzing the content into terms, facts, concepts, situations, processes, generalizations, principles, laws etc. the analysis helps the teacher to get a thorough I n-depth of the subject understanding and this also increases the confidence of the teacher.

ii. Objectives and specifications

After analyzing the content, teacher should identify the general and specific objectives of the content.

iii. Learning activities

Learning is not a pouring in process, but a gradual process that comes about as a result of experience. Activities like field trips, experiments, demonstrations and projects can be used in different settings. The experience can be backed up with reference books films and slides. Keeping in mind of the individual differences, the psychology of learning, the content and objectives, suitable learning activities can be planned to which the students will be exposed during the course of the unit.

iv. Testing procedures

The last step is the choice of suitable evaluation tools and techniques through which teacher can evaluate the content coverage and teaching method used.

Format of a Unit Plan

1. -----
2. -----
3. -----

Sl. No.	Concepts	Process skills	Activities/ strategies	Learning materials	Product	Evaluation	No. of Periods

Advantages of Unit Planning

1. It is establishes general as well as specific aims of teaching.
2. It breaks up the entire work into smaller sections, small enough so that pupils can easily grasp the scope of these during a brief overview. Short tasks are easily completed than long ones.

3. It helps to cater the needs, nature and aptitude of the students.
4. It is economical in terms of time.
5. Since several activities are involved it helps to develop the skills in the students.
6. It develops self confidence among students because it provides opportunities for meaningful experience wherein they can organize and review their learning.
7. It gives an overall view to handle each and every lessons as the unit structure.

BLOOMS TAXONOMY OF EDUCATIONAL OBJECTIVES

Taxonomy of educational objectives is intended to provide the classification of goals of our educational systems. The idea of classification of educational objectives was given by Dr.Benjamin S Bloom of Chicago University USA. He classified educational objectives in to three main areas or domains called Cognitive, Affective and Psychomotor. The three domains are interrelated and mutually dependent.

TAXONOMY OF EDUCATIONAL OBJECTIVES

Cognitive Domain	Affective Domain	Psycho – motor Domain
1. Knowledge	1. Receiving (appreciation)	1.Perception
2. Comprehension	2. Responding	2. Imitation
3. Application	3. Valuing	3. Manipulation
4. Analysis	4. Organising	4. precision
5. Synthesis	5. Characterizing	5. Articulation
6. Evaluation		6. Naturalization

Cognitive Domain: The recall or recognition of knowledge and the development of intellectual abilities and skills.

Affective Domain: The changes in interests and values and the development of applications

Psychomotor Domain: The development of manipulative or motor skills

The three domains of learning do not occur in isolation but rather work together to make up one whole being.

Cognitive Domain

Cognitive domain includes those objectives which deal with the recall and recognition of knowledge and development of intellectual abilities and skills. **-Blooms et al.**

Benjamthe domain in S Bloom and his coworkers have done the taxonomical classification of this domain in 1956. The domain contains six major objectives arranged in an order on the basis of increasing complexity of tasks. Each of these six is further divided in to specified behavioural objectives.

Categories in the Cognitive Domain

1. Knowledge

This is the first and the lowest level of cognitive domain. It includes recall of information such as specifies, facts, methods, processes, generalizations, patterns etc., Thus, the knowledge objective emphasizes what can be described as memory.

2. Comprehension

This second category includes translation, interpretation and extrapolation. This is also related to the use of ideas. It refers to a type of understanding of the materials or literal message contained in a communication.

3. Application

This third level includes the ability to apply abstract ideas to a concrete situation. The abstraction may in the form of general ideas, rules or procedures or generalized method.

4. Analysis

It means the “breakdown of the materials into the constituent parts and detection of the relationship of the parts and of the way they are organized”. Analysis includes analysis of elements, analysis of relationship and analysis of organizational principles.

5. Synthesis

This category is just the opposite of analysis. Synthesis is the “putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts, elements and arranging and combining them in such a way as to constitute a pattern or structure, not clearly there before”.

6. Evaluation

It is the assignment of symbols to phenomenon, in order to characterize the worth or value of a phenomenon, usually with reference to some social, cultural or scientific standards. Evaluation involves judgments in terms of internal evidence as well as external criteria.

To conclude, it may be pointed out that the above six major categories in the cognitive domain do not always appear in isolation from one another.

Affective Domain

This domain involves attitudes, interest, values and appreciation. The affective domain is concerned with 'feeling'. The objectives under affective domain are difficult to define and evaluate. The hierarchy of objectives in affective domain has been developed by Krathwohl, Bloom and Masia in 1964. The order of objectives is in such a way that each category is more abstract and complex than the previous one.

Categories in the Affective Domain

1. Receiving:

This is at the lowest point of the affective domain. Receiving may be defined as "sensitivity to the existence of certain phenomenon and stimuli, that is, the willingness to receive or attend to them".

2. Responding:

Responding refers to a behavior which goes beyond merely attending to the phenomenon; it implies active attending, doing something with or about the phenomenon, and not merely perceiving them.

3. Valuing:

Valuing implies "perceiving them as having worth or value. The three sub-categories of this objective are, acceptance of value, preference for a value and commitment.

4. Organizing:

This involves building up of organized system of values. The individual organizes a set of values such as truth, goodness and helping others, in determining their relationships and deciding their need and priority.

5. Characterizing:

In this category the individual displays the integration of values and it becomes a lifestyle with him. He gets these values organized into some kind of internally consistent system, which has controlled the behavior of the individual for a sufficient time. This category is concerned with one's view of the universe and one's philosophy of life.

Categories in the Psycho-motor Domain

Psychomotor domain concerns with the attainment of neuro-muscular coordination. Here the objectives which deal with manual or motor skills. As the level of coordination goes up, the action becomes more refined, speedy and automatic. Simpson, Kibler were working on this area for

systematically classifying educational objectives. R.H. Dave has given the classification of educational objectives under this domain 1969. The order of objectives in such a way that coordination is to be brought about among different parts of a given act or different acts performed with required articulation.

1. Perception

Skill of keen observation, skill of sensing a problem and skill of developing self-motivation are the specific objectives under this category.

2. Imitation

Skill of repeating actions and skill of reflective thinking are the specific objectives under this category.

3. Manipulation

Skill to operate upon with intelligence and manage cleverly are the specific activities that fall in this category.

4. Precision

Skill of experimentation, skill of precise movements and neat execution of skills are the activities which fall under this objective.

5. Articulation

Skill of logical thinking, reflective thinking, skill of mind and body and development of mathematical skill are specific objectives to attain this step.

6. Naturalization

As we practice a skill, in due course it becomes our natural habit. Skill of attaining success and skill of multiple actions are the specific activities under this objective.

TYPES OF TEST ITEMS

Achievement tests are conducted using different types of test items. Hence science teacher should master the skills of constructing test items. A constructor should take the following precautions while framing the test items.

- The items should cover as far as possible, the whole range of topics prescribed in the syllabus.
- No item or part of the item should be set which is outside the syllabus.
- More items should be set to test higher objectives. For this purpose items should be in the context of new situations.

- Items should provide clear direction to the students regarding the scope and length of responses
- The language of the items should be simple and within the easy grasp of students

A. Objective Type test item

An objective type test item is one in which the response will be objective. The responses are made fixed and hence the freedom of the respondent to deviate subjectively is restricted. Objective type test item can be broadly classified into two they are

1. Supply Type (Recall Type)
2. Selection Type (Recognition Type)

For supply type test items the respondents have to supply the response where as for the selection type they have to select the responses from among the given responses. Usually five different forms of objective type items are in vogue. They are true-false type, multiple choice types, matching type, simple recall type and completion type. Of these simple recall and completion type items are supply type and the other three belongs to the selection type.

a) True – False Items (Alternate Response Type)

A true – false. The respondent is asked to read a statement and indicate in some specific manner suggested, whether it is true or false, right or wrong, correct or incorrect, agree or disagree, yes or no. it tests the ability to discriminate between misconceptions and scientific truth. It is suitable for young children who have poor vocabulary. Large sample of subject matter can be covered within a short period.

b) Multiple choice Test Items (Changing Alternative type)

These are items presenting four or more responses in which one is either correct or definitely better than the others. The examinee has to find this out and record this in the manner required in the paper. Here the chances of guess work are minimized. Multiple choice items consist of two parts.

The first part of the item is called stem presented in the form of a direct question or incomplete statements. The second part of the item is called options or alternatives or responses, usually four or five in number among the options one is the keyed response and others are called distracters or misleads or foils. The stem gives data for the selection of the keyed response. The respondent has to read the stem and options and select the correct or best alternative. The different forms multiple choice test items in vogue are correct answer form, best answer form, multiple response form, etc.

Scoring Formula or Correction Formula for Multiple Choice Test Item

Scoring formula is used for reducing the chances of guessing. An item with four options has a chance of 25% guess work, which is rather very high. The formula based on statistical assumptions (Theory of Probability) is

$$S = R - \frac{W}{N-1}$$

Where

S = resultant score that a respondent deserves

R= Number of right responses

W= Number of wrong responses

N= Number of alternatives in an item

c) Matching Type Test Item

This is a modified version of the multiple choice test items. In fact matching type is an economized form of combining a number of multiple choice items in the same question- a condensation of several multiple choice items. It consists of two parallel columns, with each phrase, word or number or symbol in one column (Usually the first) being matched to a word, phrase or sentence in the other column. The items in the column for which a match is sought are called premises or stem and items in the column from which selection is made is called responses or options. The respondent is required to make some sort of association between each premise and each response in the two columns.

d) Simple Recall Type Test Items

This test requires the respondent to recall a response to a direct question. The typical response should be short preferably a word, a number or a small phrase. It eliminates the chance of guessing.

e) Completion Type Test Item

A completion type item consists of a series of sentences in which certain words are omitted and replaced by blanks. The respondents are expected to fill in the blanks with a word or a number or at the most a phrase. The probability of guess work is completely eliminated.

Advantages of Objective Type Item

1. As a large number of question are set, a wide coverage of the syllabus is possible.
2. Questions can be set which are designed to assess one particular educational quality. For example ability to apply.
3. Marking of such tests is objective and can be done speedily
4. They are more valid and reliable, since the response/ answers are definite
5. There is greater administration use and control

6. They have higher diagnostic value
7. They are less time consuming

Disadvantages of Objective Type Items

1. Such tests do not encourage verbal fluency or a student's ability to development argument
2. Chancing of guessing are high
3. An objective test is difficult and expensive to construct
4. Emphasis on testing superficial knowledge
5. Inefficiency in testing complicated skill.
6. Objective type items are often ambiguous, particularly for the better students.
7. Such tests when over used can have a negative effect on teaching, since they encourage the student to learn bits of knowledge rather than the whole.

B. Short Answer Type

A question requiring value points at the most may be defined as a short answer question. The term value points indicates a point to be given credit in the expected answer. Thus the length of the answer expected from a short answer question becomes very short. This diminishes subjectivity. In this way it is an improvement upon essay type question. Such question are of great helping having wide coverage of content and each item can be set to a test a definite objective. Because of this reason, a fair proportion of such questions should be included in a test.

Advantages of Short Answer Type

1. Questions of this form can be made stimulating
2. Students can be trained to select relevant information and present it in a few short, crisp Sentences
3. Short answers are easy to score
4. Reliability of scoring is high
5. Questions can cover a wider content area than easy type test items. It is possible to achieve a more expensive sampling in the short answer test than in the essay type test
6. The short answer test is especially useful in diagnosis. In part, this follows from the factor of extensive sampling

Disadvantages of Short Answer Type

1. It is more subjective than the objective type of items
2. Its excessive use may encourage a student to memorize facts and develop poor study habits
3. Mechanical scoring is not possible because of the subjectivity involved

C. Essay Type

According to dictionary by Good, essay test is a type of examination in which the subject or examinee is asked to discuss, enumerate, compare, state, evaluate, analyze, summarize or criticize and involves writing at specific length on a given topic involving the processed listed above.

The essay type questions get its name from the manner in which the examinee responds. The term essay implies a written response which may consists of many sentences to several pages. The student is allowed freedom with respect to what his answer will include its wording length and organization.

Advantages of Essay Type

1. They are easy to construct
2. They can be used to test the student's language mastery, expression and organizational ability of a student
3. Chances of copying are minimal
4. A student's ability to use knowledge effectively can be assessed. It helps to develop a variety of skills. In addition to self-expression, students have to select pertinent material, organize this material into a coherent discussion and arrive at conclusions.
5. Guessing creates few problems
6. It encourages good study habits. A student preparing for an essay test is likely to highlight important units, look for relationships and exercise judgement in deciding points of emphasis.

Disadvantages of Essay Type

1. Subjective bias could creep in as these test are based on the examiner's moods and whims
2. Essay type encourages rote memory. The higher levels of the cognitive domain cannot be completely assessed by this method.
3. Sampling is limited. Adequate sampling is essential in good testing. But time limitations make it impossible to achieve good sampling in an easy test, assuming that a large body of subject matter has been covered.
4. There is danger of bluffing. The "gift of gap" can be encountered in written as well as in oral communication. It requires a discerning teacher to realize that nothing much is been said.
5. Essay type test are difficult to score. Besides no two teachers agree on the score given to a particular paper, the hand writing, presentation and so on. Thus score rating cannot be generalized.

CONSTRUCTION OF AN ACHIEVEMENT TEST (FORMATIVE EVALUATION)

Formative Evaluation

Formative evaluation is concerned with making decisions relating to forming or development of students as well as of the courses. It provides feedback at appropriate stages of the teaching learning process which helps in making changes in the curriculum, teaching strategies and the learning environment. Formative evaluation is done during the process of teaching learning with the following main purposes

- To monitor student learning for the purpose of providing individualized instruction
- To evaluate teaching effectiveness
- To evaluate courses and curricula with the purpose of modification, updating or replacement if necessary
- To evaluate curriculum materials
- To evaluate the learning environment with a view to improving it.

Since evaluation is an integral part of teaching and learning, students are observed in various situations continuously with a view to assess their level of achievement in terms of what have been expected of them. Written examination is one of the most commonly employed and widely acceptable techniques for measuring student's achievement. The construction of an achievement test has its importance in student evaluation.

Steps involved in the Construction of an Achievement test

1. Planning of the test
2. Preparation of a design
3. Preparation of the Blue print
4. Writing of Items
5. Preparation of the Scoring key and Marking scheme
6. Preparation of Question wise Analysis

Planning of an Achievement Test

A test is meant to serve many essential and important purposes. Therefore, it should be well planned and systematically developed. The first consideration which is of utmost importance is what the paper setter intends to find out through the achievement test. There are certain outcomes of learning which any teacher would like to realize by teaching every unit. The paper setter should aim at testing the achievement of these objectives. The next step is to determine the maximum time, maximum marks

and the nature of the test. These should be decided in terms of the nature and scope of the sub units or units involved in the testing.

Preparation of a design for the Test

After determining the board scope of the test, a design has to be developed in tune with it. The objectives, content, forms of questions, difficulty levels of items, scheme of options and the scheme of sections are the most important factors to be considered in such of a design.

i. Weightage to objectives

This indicate what objectives are to be tested and what weightage has to be given to each objective. Suppose the teacher wants to make his pupil acquire knowledge of certain facts, develop understandings of certain concepts and principals, the ability to apply these in new situations and the skill to perform certain task, while teaching the specific subject matter for which the test is being designed. He should decide the relative importance of each of these objectives after carefully studying the prescribed curriculum and in tune with the nature of the content covered. This step will ensure objective based ness to the test, which is required for scientific evaluation.

ii. Weightage to Content

The content refers to the topics where the achievement test is to be conducted. The content is taken for properly distributing marks in each unit by which proper coverage is made possible. This indicates the various aspects of the content to be tested and the weightage to be given to each of these aspects.

iii. Weightage to Form of Questions

This indicates the forms of questions, objective type, short answer type and essay type to be included in the test and the weightage to each form of questions. The setter should select those forms of questions that are suitable to the objectives and content to be tested.

iv. Weightage to difficulty level

It is desirable to construct the test with some questions with some questions as easy, some difficult and the others of average difficulty. A good test will contain some question which even the dull pupils can answer. Some items which only the bight one's can answer and many items that most can answer. This would help us to discriminate between the bright, average and the dull students.

v. Scheme of Options

Scheme of option means the option or choices given to the students to select certain questions. There may be external option as well as internal options. External option (overall option) means the

choice is given to the students for selecting a given number of questions only from among the total number of questions provided. For example the students are asked to attend any eight questions out of the given ten. But in case of internal options the choice is given within a question for example write an essay on one of the following.

vi. Scheme of sections

The test will be in three sections. Section A will contain only objective type items and Section B short answer and section C essay type items.

Design of Achievement Test in Biology

Standard: VIII

Time: 1 hour

1. Weightage to Curricular Objectives

No.	Objectives	Marks	%
1	Knowledge	4	16
2	Understanding	6	24
3	Application	8	32
4	Skill	7	28
	Total	25	100

2. Weightage to Content

No.	Objectives	Marks	%
1	Plant Cell	9	36
2	Animal Cell	7	28
3	Nucleus	9	36
	Total	25	100

3. Weightage to Form of Questions

No.	Objectives	No. of Question	Marks	%
1	Objective	10	5	16
2	Very Short Answer	8	8	24
3	Short Answer	5	7.5	32
4	Essay	1	4.5	28
	Total	24	25	100

4. Weightage to Difficulty Level

No.	Objectives	Marks	%
1	Easy	4	16
2	Average	17	68
3	Difficult	4	16
	Total	25	100

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Questions for Discussion and Reflection

1. Explain the steps included in a lesson plan nowadays.
2. State the criteria of a good lesson plan.
3. Present a format of a lesson plan.
4. Choosing a topic from IX Std. Biology content develop a lesson plan, indicating the different steps involved.
5. What do you mean by 'unit plan'? Explain the steps involved in developing a unit plan.
6. Discuss in detail the classification of cognitive domain objectives.
7. Discuss in brief the classification of affective and psycho-motor domain objectives.
8. Discuss Bloom's Taxonomy of Educational objectives and its importance.
9. Mention the various types of tests employed in assessing achievement in biology.
10. Discuss briefly the steps involved in the construction and standardization an achievement test in biology.

Unit- III Practising the teaching skills in Biological Science

Objectives:

- To obtain knowledge on the meaning of Teaching.
- To understand the teaching skills.
- To analyse the major steps in teaching a mini-lesson.
- To explore, observe and feedback on integration of teaching steps in mini-teaching

INTRODUCTION

An educational institution performs a significant function of providing learning experiences to lead their students from the darkness of ignorance to the light of knowledge. The key personnel in the institutions who play an important role to bring about this transformation are teachers. As stated by NCTE (1998) in Quality Concerns in Secondary Teacher Education, –The teacher is the most important element in any educational program. It is the teacher who is mainly responsible for implementation of the educational process at any stage. This shows that it is imperative to invest in the preparation of teachers, so that the future of a nation is secure. The importance of competent teachers to the nation's school system can in no way be overemphasized. There is widespread consensus, however, that our education systems are failing to adequately prepare all students with the essential 21st century knowledge and skills necessary to succeed in life, career and citizenship.

MEANING OF TEACHING

Teaching includes all the activities of providing education to other. The person who provides education is called teacher. The teacher uses different method for giving best knowledge to his students. He tries his best to make understand students. His duty is to encourage students to learn the subjects. Teaching means interaction of teacher and students. They participate for their mutual benefits. Both have their own objective and target is to achieve them.

Teaching skill is a group of teaching acts/ behaviours intended to facilitate student's learning directly/ indirectly.

Nature and characteristics of teaching

1. The main character of teaching is to provide guidance and training.
2. Teaching is interaction between teacher and students.

3. Teaching is an art to give knowledge to students with effective way.
4. Teaching is a science to educate fact and causes of different topics of different subjects.
5. Teaching is continues process.
6. Teacher can teach effectively, if he has full confidence on the subject.
7. Teaching encourages students to learn more and more.
8. Teaching is formal as well as informal
9. Teaching is communication of information to students. In teaching, teacher imparts information in interesting way so that students can easily understand the information.
10. Teaching is tool to help student to adjust himself in society and its environment.

Characteristics of Teaching Skill

1. Teaching skill is a set of strictly overt or observable behaviours.
2. Purely cognitive skills such as problem solving is not considered as teaching skill.
3. Teaching skills have three basic components viz., perception, cognition and action.
4. Teaching skills have three dimensions viz., Non-verbal behaviour, openness, nature of moves in teaching to which skill belongs.

UNDERSTANDING MAJOR TEACHING SKILLS

Teaching skills would include providing training and practice in the different techniques, approaches and strategies that would help the teachers to plan and impart instruction, provide appropriate reinforcement and conduct effective assessment. It includes effective classroom management skills, preparation and use of instructional materials and communication skills.

1. Introducing

This is an important skill required for a teacher. Well begun is half done is a saying which indicates the importance of introducing a lesson. It is the duty of a teacher to bring the students into the classroom mentally. The skill is intended for making effectiveness in introducing of the content. This is always done at the start of a class. Here teacher gives a brief introduction about the lesson in order to pre-dispose the pupil's mind to it.

There are many ways to present an introduction. Here are a few:

- Asking questions to get the students thinking about the topic of the lesson.
- Showing pictures that relate to the lesson topic.
- Telling a story to show the importance of the topic.
- Bringing in real objects related to the lesson.

2. Explaining

Teaching is not primarily telling. It's helping other people learn. That means the focus is on the learners, not the teacher. People learn best through experiencing something themselves, so when you are striving to teach something, you are constantly trying to Get into the shoes of the learners so that you can better understand where they are and what they need from you to learn the subject under study.

Explaining can be defined as an activity to bring about an understanding of a concept, principle etc. it is an activity to fill the gap in someone's understanding.

In classroom the teacher explains ideas and concepts. It is the most commonly used skill and is the essence of instruction. Explanation is a key skill. Generally, the skill of explanation is complex. Explanation is to explain or to give understanding to another person. It leads from the known to the unknown, it bridges the gap between a person's knowledge or experience and new phenomena, and it may also aim to show the interdependence of phenomena in a general subtle manner. It assists the learner to assimilate and accommodate new data or experience.

In a classroom, an explanation is a set of interrelated statements made by the teacher related to a phenomenon, an idea, etc. in order to bring about or increase understanding in the pupils about it. The teacher should practice more and more of desirable behaviours like using explaining links using beginning and concluding statements and testing pupil understands behaviours like making irrelevant statements, lacking in continuity, using inappropriate vocabulary, lacking in fluency, and using vague words and phrases as far as possible.

A class is not homogeneous group. Some pupils are intelligent some have normal intelligence, some are mature and others are immature. But the teacher has to impart knowledge to all. To present the subject matter in the simplified form before the pupils and making it acquirable is called the skill of explanation. It is necessary in all the subjects. In its absence the presentation of the subject matter is

not possible. In the skill of explanation, such words are used in the statements by which the statements exhibit the clarity of their meanings.

The explanation serves two purposes: (1) to introduce the subject by giving some background about its usefulness and application; and (2) to describe the subject in a simple, complete, and tantalizing way. The explanation should create a desire to become proficient in the subject under study

The components of skill of explaining involved

- Clarity
- Continuity
- Relevance to content using beginning and concluding statements
- Covering essential points
- Simple
- Relevant and interesting examples appropriate media
- Use of inducts, deductive approach, it can be functional, causal or sequential

Characteristics of effective explanation

- Coordination in Statements. Coordination in the statements used during the explanation is very essential; otherwise there will be all hotch- potch.
- Relevant Statements. While presenting the subject matter, the concerned statements should be relevant.
- Fluency in Language. The teacher should use fluent language so that the pupils may listen and understand his thoughts.
- Connecting Links. The use of words, idioms or connecting links such as 'therefore' as a result of etc. is essential to link the different thought or statements.
- Clear Beginning Statement. Before starting any explanation, the teacher should make the pupils aware of what he is to teach on that day through a clear beginning statement.
- Use of proper Words. The teacher should use proper words for explaining an object or an event otherwise he would be in a state of confusion

3. Questioning

Successful teaching highly dependent on questioning technique employed in the teaching sessions. Questioning is an important teaching skill that a teacher must learn. The teacher should learn to ask suitable, appropriate and meaningful questions. Questioning is definitely a skill. We can very easily answer a question but it is too difficult to ask a question.

A question is any sentence which has an interrogative form or function. In classroom settings, teacher questions are defined as instructional cues or stimuli that convey to students the content elements to be learned and directions for what they are to do and how they are to do it. Questioning promotes involvement, initiates thinking, creates motivation and enhances learning.

Effective questioning is a real compliment to the instructional skills. It shows the ability to understand the student's real needs. It shows that for meaning that's deeper than the spoken message. Effective questioning is a powerful, learned skill.

For students, questioning strategies help to categorize and anticipate exam questions, allowing for more effective preparation. The strategies are also useful for study groups, focusing efforts and allowing members to test each other. They improve the student's ability to clarify, reorganize, and accurately explain new information. Questioning also aids in self-assessment and self-monitoring.

Basis of Questioning skill

Questioning skills refer to one's ability to formulate and respond to questions about situations, objects, concepts, and ideas. Questions may derive from oneself or from other people.

There are two levels of questions:

1. Low-level questions refer to questions that require one to recall information that has been registered in memory. Low-level questions operate on the level of knowledge, drawing from one's knowledge base of a subject.
2. The High-level questions encompass questions that require one to process information rather than simply recall it. High-level questions operate on one's ability to comprehend, apply, analyze, synthesize, and evaluate information.

Questioning techniques

Good questions are essential to effective communication between: the teacher and the student: the teacher who lack the skill to effectively question their student create disinterest and boredom on the part of the student. They also ignore a fine opportunity to open communication lines for determining the effectiveness of the lesson. Good questions expand on central thoughts, develops the subject, and not on minor, nice-to-know points. Let us look at some rules for asking questions.

- Distribute questions at random. Do not always ask the same student or those sitting in a particular area. Ask questions of the entire class to promote thinking in all students and get them involved.
- Acknowledge all answers to ensure incorrect or vague answers are clarified.
- Don't use catch or trick questions. Students will not participate and you could possibly lose them if they feel humiliated.
- Allow enough time for the student to think about and give an answer. Do not waste time waiting if the student clearly does not know the answer, but do not cut the student off before ample time is given for the complete thought process or answer period.
- Begin questions with the words that require thoughtful answers, such as, "Why, When, How, What," etc. Stay away from questions that can be answered with a simple yes or no. This will help stimulate and even guide students thinking.
- Avoid frequent group or choral responses. This method provides answers that are often unintelligible and errors that are hard to pick up.
- Do not waste time "pumping" a student. If the trainee does not know the answer, either offer an explanation or ask the question of another student.

4. Skill of closure

This skill is useful for a teacher to close his teaching properly. The teacher is to summarise all the teaching during the period and provide opportunities for the students to correlate the learnt matter with the past and future knowledge. This is to be done by statements or by asking questions.

5. Skill of Reinforcement

This skill is the most important one than other teaching skills. Reinforcement, the term implies the use of the technique for influencing behaviour of individuals in desired direction. The concept of reinforcement is based on the hedonistic principles, which envisages that all individuals tend to repeat the pleasant experiences and avoid unpleasant ones. The skill is being used to utilize good behaviours of the learners and to avoid the undesirable behaviours of the learners. The teacher would like the student's desirable behaviours and criterion responses to be retained and undesirable behaviours to be eliminated. For reinforcing student's desirable behaviours and criterion responses he uses positive verbal and non-verbal reinforcers. These reinforcers not only strengthen the student's desirable behaviours but also develop confidence in them. Besides, they enhance their positive self-concept. Absence of positive reinforcers for student's desirable behaviours may erode their confidence and lead to poor self-image. Positive reinforcements encourage students to participate actively in classroom interactions. It stimulates them to achieve more, thereby, creating a sense of achievement.

Skilled use of reinforcers helps a teacher to promote student's learning. The skill of reinforcement refers to the effective use of reinforcers. It, can therefore be defined as 'the effective use of reinforcers to modify student's behaviour in the desired direction'.

6. Skill of varying the stimulus

Varying the stimulus is described as a deliberate change in the behaviours of the teacher in order to sustain the attention of the learners throughout the lesson. The variation in the stimulus helps in avoiding monotony and in generating interest among the students which in turn makes learning effective.

Learning in the classroom depends, to a large extent, on the attention of the students on the learning task. It is therefore, essential for the teacher to secure and sustain student's attention for making his teaching effective. Continuous use of the same stimulus or activity for longer period induces inattention. The inattention is caused in two ways: one is continued focus of the students on the same stimulus for a long time restricts his postural mobility which leads to fatigue. Next is the continued use of the same stimulus for longer duration introduces the element of monotony, which brings in dullness. This will be further aggravated because of the short span of student's attention. Their attention tends to shift from one stimulus to another frequently. They find it difficult to attend to one

stimulus for more than a few minutes. The problem of inattention is a challenge to the teacher, unless he is in a position to secure and sustain student's attention. It is therefore, essential for the teacher to secure and sustain student's attention towards the topic of the lesson.

One of the significant ways to secure and sustain students' attention is to introduce the elements of variation in teaching. The variation can be introduced in several ways depending upon the teaching activity. Appropriate variation in different dimensions can help a teacher to secure and sustain students' attention. The set of teacher behaviours that tend to secure and sustain student's attention in teaching learning situation in the classroom constitutes the skill of varying the stimulus.

Some of the components of varying the stimulus are as follows:

- ❖ Movement
- ❖ Gestures
- ❖ Change in voice
- ❖ Focusing
- ❖ Change in interaction pattern
- ❖ Pausing
- ❖ Student's physical participation
- ❖ Aural visual switching

7. Non- verbal cues

Non-verbal communication has been defined as communication without words. They are usually made with the help of the movements of the eye, hand, head, body, and facial expressions. Facial expression will lead to encourage pupil to participate actively in learning situations. Positive non-verbal cues include smiling, nodding the head, a delighted laugh, patting on the shoulder, asking the students to clap. The students can be asked to clap their hands for correct answers given by a student.

Disapproval without using words has the effect on negative reinforcement. Negative non-verbal cues include staring, looking angry, shaking the head, beating, caning, bruising, raising the eyebrows, tapping foot impatiently and walking around etc.

8. Fluency in communication

Communication in general is a process of sending and receiving messages that enables humans to share knowledge, attitude, and skills. Communication is a series of experiences of hearing, seeing, smelling, tasting, and touching / feeling. Although we usually identify communication with speech, communication is composed of two dimension: verbal and non-verbal. Both verbal and non-verbal plays a significant role in teaching learning process. Verbal communication is divided into Intra verbal: intonation of word and sound and extra verbal: implication of words and phrases, semantics.

The teacher uses knowledge of effective verbal and nonverbal communication techniques as well as instructional media and technology to foster active inquiry, collaboration, and supportive interaction in the classroom.

MINI-LESSON

- It is a teaching training technique for learning teaching skills.
- It employs real teaching situation for developing skills and helps to get deeper knowledge regarding the art of teaching.
- A mini lesson is a basic precursor to a bigger or broader topic. It is a short lesson that can be taught in just a few minutes, but it can benefit the students in lessons to come.
- For instance, you may teach a basic topic like fact versus opinion by sharing a variety of statements and having students tell you if the statement is fact or opinion.
- This practice may take only 20 minutes, but teaches a valuable lesson to the students and sets the foundation for further discussion of writing styles or reading concepts.

PRACTISING A MINI-LESSON WITH MULTIPLE TEACHING SKILLS

Name : xxxxx

Subject: Biology

Topic : External features of a Bird

Date :

Time :

Objectives:

- Acquires knowledge of the technical terminology used to describe the external characters of a bird.
- Understands the significance of the various external features of a bird.
- Applies the knowledge in identifying birds.
- Develops skills in drawing and labelling the external characters of a bird.
- Appreciates the flying minstrels of nature.

Materials

- A pigeon (specimen)
- Stuffed birds
- Bird photographs
- Chart – external characters of pigeon

Content Outline

- A bird is with a bundle of feathers with different colouration, boat shaped contour with flight adaptation.
- Birds have fore limbs modified into wings. Birds are bipeds.
- The body of the bird is divided into four regions: head, neck, trunk (body) and tail. The head consists of beak which is modified according to feeding habits.
- Lateral eyes with well developed vision.
- External ear opening completely covered by feathers.
- Neck is highly mobile.
- Entire body is clothed with feathers. The two wings and two legs are attached to the middle of the body

- Tail varies in length and colour with the function of balance and direction.

Teaching skills

Important skills are as follows:

1. Introducing

A bird is an animal with a bundle of feathers with different colouration, boat shaped contour with flight adaptation

2. Explaining

Birds have fore limbs modified into wings. Birds are bipeds. Birds are divided into two types: a) Flying birds. E.g. Pigeon. b) Running birds. E.g. Ostrich. The body of the bird is divided into four regions: head, neck, trunk (body) and tail. The head consists of beak which is modified according to feeding habits with absence of teeth. Lateral eyes with well-developed vision. Nostrils in the dorsal aspect of the upper beak present proximally. External ear opening is present completely covered by feathers. Tongue is modified according to the feeding habits. Neck is highly mobile (rotation 30°). Entire body is clothed with feathers. The two wings and two legs are attached to the middle of the body. Legs are with 4 claws and modified according to locomotion and feeding. Tail varies in length and colour with the function of balance and direction. Cloaca is present at the base of the tail.

3. Questioning

How are the forelimbs modified?

The legs of the Ostrich are strongly built because _____.

Mention the different types of tails found in birds.

The external ear openings in birds cannot be seen because _____.

4. Varying the stimulus

There can be variation of teachers' position in the classroom while he is teaching. Variation in voice represents another dimension. Use of media like Bird photographs, specimen and Chart showing external characters of pigeon provides yet another area of vibration. There can also be variation in the classroom interaction pattern.

5. Non verbal cues

Positive non-verbal cues include smiling, nodding the head, a delighted laugh, patting on the shoulder, asking the students to clap etc can be used while the class is going on.

The students can be asked to clap their hands for correct answers given by a student.

6. Reinforcement

Positive verbal reinforcers like saying good, very good, excellent, fantastic, splendid, right, yes, correct, fine etc can be used in the class for the desirable behavior of the students like being calm, clarifying their doubts, answering the questions, drawing the pictures on the board etc.

7. Closure/Summing up

The topic will be summed up as a bird is with a bundle of feathers with different colouration, boat shaped contour with flight adaptation. The body of the bird is divided into four regions: head, neck, trunk (body) and tail. The beaks and limbs are modified according to the feeding habit of the bird. Mention the names of birds that you know? Observe and examine the pigeon and locate its parts. Draw the diagram of a pigeon step by step and label the parts.

8. Fluency in communication

The topic will be discussed by explaining and interacting with the students by asking questions and making the students to observe the specimen, photos and charts. The teacher uses knowledge of effective verbal and nonverbal communication techniques as well as instructional media and technology to foster active inquiry, collaboration, and supportive interaction in the classroom.

OBSERVATION AND FEEDBACK ON THE PRACTICE OF INTEGRATION OF TEACHING SKILLS

The complex teaching act can be split into component skills, each simple, well defined and limited. These skills can be identified, practiced, evaluated, controlled and acquired through training.

McIntyre et.al (1977) defined teaching skill as a set 'set of related teaching behaviours which is specified the achievement of specified types of educational objectives'.

Passi (1976) defines teaching skill as 'a group of teaching acts or behaviours intended to facilitate pupils learning directly or indirectly'.

The teaching skills developed through training are to be observed by the peers/ teacher educators. Immediate feedback may be given to the student-teachers individually using the feedback forms.

Integration of teaching skills feedback form:

Name of the student teacher:

Duration: 20 minutes

INTEGRATING SKILLS IN MINI TEACHING (Assessment by Peers/Teacher Educators)				
Teaching skills	AVERAGE (SCORE 1)	GOOD (SCORE 2)	VERY GOOD (SCORE 3)	TOTAL
Introducing				
Explaining				
Questioning				
Varying the stimulus				
Non verbal cues				
Reinforcement				
Closure				
Fluency in Communication				
Total				

Range of scores:8-24

OVERALL ASSESSMENT OF MINI-TEACHING

AVERAGE ____ GOOD ____ VERY GOOD ____

Interpretation of scores

Average : 8

Good : 9-16

Very Good :17-24

Signature of the Observer

UNDERSTANDING MAJOR STEPS IN TEACHING A MINI-LESSON

Instructional Procedures and Activities: Provide a detailed discussion of the mini lesson (15-20 min) using the following headings:

Motivation

This step is considered to be the preparatory step, wherein the teacher is trying to prepare the minds of the students ready to receive the subject matter. Hence, this step identifies the mental readiness of the students. The teacher will be able to check the students' entering behavior before he starts teaching the lesson. Thus testing students' previous knowledge develops interest in the minds of students and helps to maintain curiosity of the students.

Presentation

It is the key step and only through which the actual process of teaching is going to take place. Here the aims of the lesson should be stated clearly and the heading should be written on the blackboard. We have to provide situation for both the teacher and the students to participate in the process of teaching and learning. Our ultimate aim of the presentation is to make the concepts understandable to the students. Therefore, use of simple language is recommended. Appropriate and specific examples and illustrations of the concepts will make the understanding better. The interest of the students on the subject matter should be maintained continuously by the way of asking questions from time to time in this stage. Use of instructional aids like charts, audiovisuals, specimen etc in an appropriate manner is strongly recommended during presentation.

Interaction

Interaction in the classroom will be done by speaking, sharing opinion, listening to others and establishing a mutual consent. Students in the learning process support when they are done by interacting directly with the object of learning and communicating in groups and also provide the ability of gaining mastery over the subject.

Reflection

Students will be given opportunity to express their ideas, experiences and opinions. Students will be cooperative, respect the opinions of others, responsible, honest on information receiving and able to give decisions.

Summing-up

This stage is meant for the teachers to know whether the students have grasped and understood the concepts taught or not. This can be achieved by reviewing the lesson and by giving assignments to the students. Only through this step achieving closure is possible.

PRACTICING A MINI-LESSON WITH FIVE TEACHING STEPS

INSTRUCTIONAL PROCEDURES AND ACTIVITIES: Provide a detailed discussion of the mini lesson (15-20 min) using the following headings:

INTRODUCTORY ACTIVITIES

1. *Motivation* (Skill of Introduction – use of previous knowledge)

The teacher asks the students questions related to their knowledge of birds, as follows:

- What do you know about birds?
- Do you how birds are flying?
- Give the names of birds that you know?
- Name the bird which do not fly?

DEVELOPMENT ACTIVITIES (*Presentation, Interaction, Reflection*)

2. **Presentation**

- The teacher announces the topic as, “External features of a bird” and writes it on the black board. (**Skill of Explaining – Cognitive link**).
- The teacher ask the student to catalogue the birds known by them. (**Recalls**)
- The teacher ask the students to Observe and name the stuffed birds shown to them. (**Recognizes**)
- Birds have fore limbs modified into wings. Birds are bipeds.
- Birds are divided into two types: a) Flying birds. E.g. Pigeon. b) Running birds. E.g. Ostrich. The body of the bird is divided into four regions: head, neck, trunk (body) and tail.
- The teacher uses aids like chart and specimen to show the body of the bird and to observe the streamlined body contour and identify the four regions. (**Skill of Explaining – uses of Illustrations**)
- The head consist of beak which is modified according to feeding habits with absence of teeth.

- Lateral eyes with well developed vision.
- Nostrils in the dorsal aspect of the upper beak present proximally.
- External ear opening is present completely covered by feathers.
- Tongue is modified according to the feeding habits.
- Neck is highly mobile (rotation 30°).
- Entire body is clothed with feathers.
- The two wings and two legs are attached to the middle of the body.
- Legs are with 4 claws and modified according to locomotion and feeding.
- Tail varies in length and colour with the function of balance and direction.
- Cloaca is present at the base of the tail.

3. Interaction: (Skill of Questioning –specificity)

- Give some examples for flying and running birds.
- How are the forelimbs modified?
- The legs of the Ostrich are strongly built because _____.
- Mention the different types of tails found in birds.
- We cannot see the external ear of the bird? Why? The teacher points out by lifting the features that the external ear openings in birds cannot be seen because it is completely covered by feathers.

4. Reflection: (Skill of Stimulus Variation – Audio visuals)

- The teacher ask to student to Observe and identify the birds from photographs and drawing. **(Identifies)**
- The teacher now shows the chart illustrating different regions and asks pupils to identify the various parts of the bird.**(identifies)**
- The teacher ask the students to observe the specimen and locate the upper eyelid, the lower eyelid and nictitating membrane. **(locates)**

- The teacher points out the neck which is highly mobile (rotation 30°). Then teacher ask the students to examine the neck of the bird. **(Recognises)**
- Observe the diagram of the pigeon and compare it with the actual specimen. **(Comparing)**

5. Concluding Activities (*summing Up/Closure*)

The bird is an animal with a bundle of feathers with different colouration, boat shaped contour with flight adaptation. The body of the bird is divided into four regions: head, neck, trunk (body) and tail. The beaks and limbs are modified according to the feeding habit of the bird. Observe and examine the pigeon and locate its parts. Draw the diagram of a pigeon step by step and label the parts.

EVALUATION AND ASSESSMENT

List how the pre-service teachers (peers) will demonstrate their learning. That is, how will you know the mini-lesson has been successful?

Distribute a copy of both Assessment formats (skills & steps) to the pre-service teachers (peers)

OBSERVATION AND FEEDBACK ON INTEGRATION OF TEACHING STEPS IN MINI-TEACHING

Name of the Student teacher:

Duration: 20 minutes

INTEGRATING THE STEPS IN MINI TEACHING (Assessment by Peers/Teacher Education)				
TEACHING STEPS	AVERAGE (SCORE 1)	GOOD (SCORE 2)	VERY GOOD (SCORE 3)	TOTAL
Motivation				
Presentation				
Interaction				
Reflection				
Summing Up				

Range of scores: 5-15

OVERALL ASSESSMENT OF TEACHING STEPS

AVERAGE ____ GOOD ____ VERY GOOD ____

Interpretation of scores

Average : 5

Good : 6-10

Very Good :11-15

Signature of the Observer

CONCLUSION

Teaching means interaction of teacher and students. They participate for their mutual benefits. Both have their own objective and target is to achieve them. Teaching skills would include providing training and practice in the different techniques, approaches and strategies that would help the teachers to plan and impart instruction, provide appropriate reinforcement and conduct effective assessment. Thus teaching skills can be identified, practiced, evaluated, controlled and acquired through training. A mini lesson is a basic precursor to a bigger or broader topic. It is a short lesson that can be taught in just a few minutes, but it can benefit the students in lessons to come. This practice may take only 20 minutes, but teaches a valuable lesson to the students and sets the foundation for further discussion of writing styles or reading concepts.

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Questions for Discussion and Reflection

6. Write the meaning of 'teaching'.
7. Give the Characteristics of Teaching Skill.
8. Explain any three teaching skill in detail.
9. Write a mini-lesson with five teaching skill for Class IX in the Science subject.
10. Critically analyse the Skill of varying the stimulus.

Unit –IV Methods of Teaching Biological Science

Objectives

After the completion of the unit, the learners will be able to:

1. explain the various methods of teaching Biological Science
2. identify the different teacher centered methods of teaching
3. analyse the recent trends in teaching and learning methods
4. adopt the small group interactive learning methods
5. discuss the various learner centered methods

Introduction

Teaching is an art and there are some born teachers, but majority of the teachers that we have today are not successful in delivering their acquired knowledge to their learners, and those teachers who have no inherent flair for teaching are unable to arouse in their learners. The flair for teaching and the ability to get acquainted with the trends and developments in teaching learning pedagogy can be improved by knowledge of different methods of teaching. A teacher has got freedom to choose any of the method of teaching according to his knowledge, interest and experience. A single method is not preferred for all topics as the best one, but the combination of methods can be used as more effective.

Methods of Teaching in Science

‘Science is not only knowledge about universe; it is also a way of obtaining knowledge’. Each teacher may find ways in which he could get the best results. Etymologically method is derived from Greek word ‘Methodos’ which means pursuit of knowledge. Method refers to the way of delivering knowledge and transmitting scientific skills by a teacher to his pupils. Methods of teaching science can be classified into two types

1. Teacher –centred
2. Pupil Centered

Teacher Centred Teaching

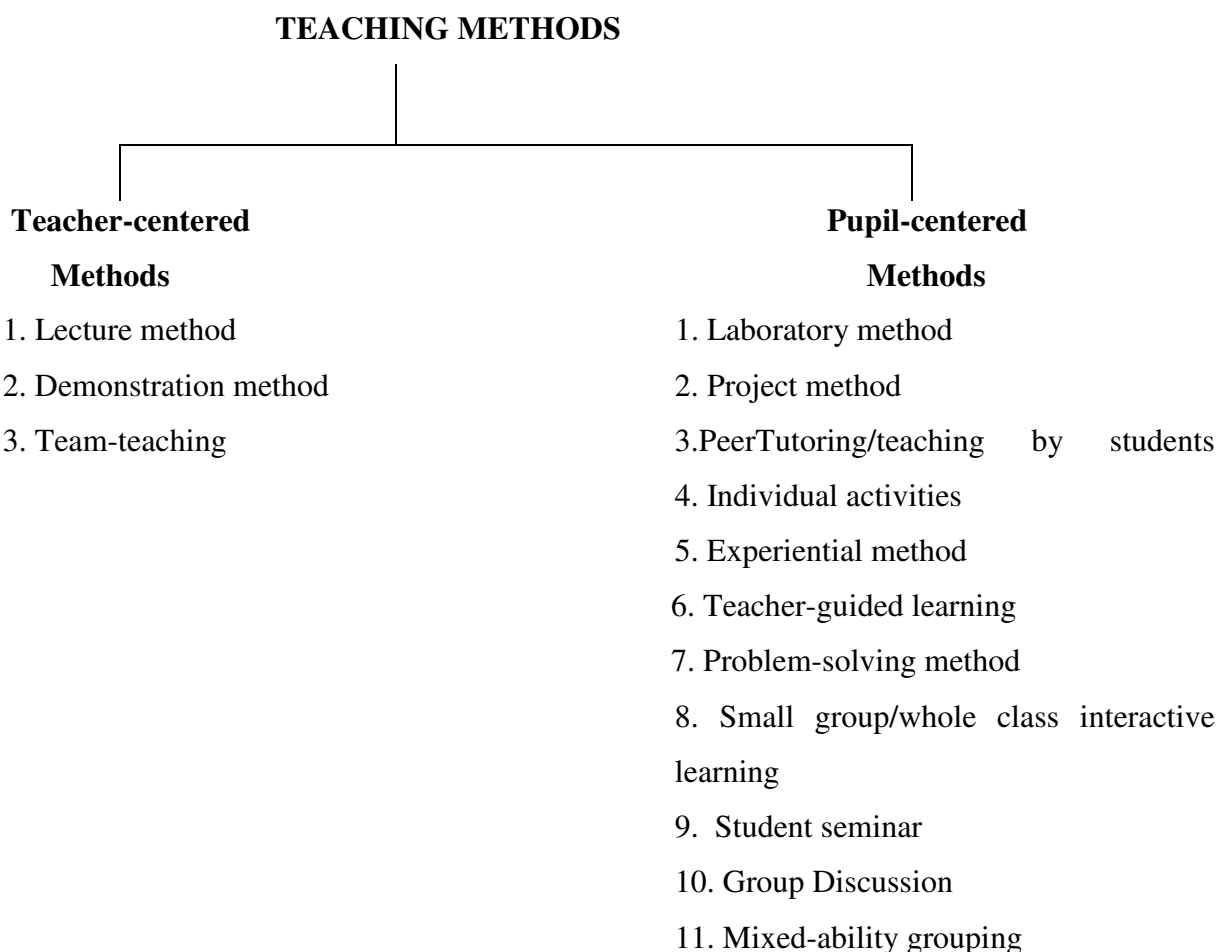
The teacher –centered teaching is mainly expository in type in which the focus is on telling, memorization and recalling information. The students are passive recipients of knowledge. The teaching environment is very much formalized and the teacher occupies a central position in the classroom.

Pupil-centered Teaching

In the pupil centred teaching the whole teaching learning process is geared to the needs, requirements, capabilities and interest of the pupils. The purpose is to develop the learner's skills and abilities in independent learning and problem solving.

Categories of “Teaching Methods”

We shall deal with some of the commonly used methods of teaching Biological science. Generally teaching methods can be categorized as follows:



Criteria of Choosing the Method of Teaching

There is no such thing as the best method of teaching. A method ‘best’ for one teacher and applicable for a class under some conditions may totally be a failure for another teacher to teach the same class or other class under the same or different conditions. Teaching methods are like the tools in the kit of a carpenter. An efficient carpenter chooses his tool from the kit, depending upon the purpose, availability of time and helpers, and the nature of wood he had to deal with. Similarly the teacher has to select the method of teaching, based on the following factors.

1. Level of the class

e.g. For lower classes, lecture method is highly inappropriate, pupil-centered methods in the class-room setting will be appropriate.

2. Size of the class

For large classes teacher-centered methods are preferable. In higher classes, when the strength of students is more, pupil-centered methods in socialized classroom setting are more preferable.

3. Availability of time

When the time available is short, lecture method or demonstration be employed in preference to methods demanding socialized classroom-setting.

4. Availability of materials and facilities

Depending on the resources available, methods involving instructional technology could be used.

5. Nature of the topics to be taught

Choice of selection of teaching method is also influenced by the nature of the topic to be dealt. On the whole it could be said that teacher should try to select the method which facilitates for greater pupil-participation and individualized learning with the optimum use of available resources in the school.

B. TEACHER-CENTERED METHOD

I. LECTURE METHOD

This is a method generally followed in colleges and schools with big classes. In this method only the teacher talks: the students are passive listeners and they do not take any active part in the development of the lesson. Student listen, get bored, yawn and sometimes go to sleep as well. The teacher acts like a chatterbox, talking and talking all the time without ascertaining whether the students are following him or not. The students are spoon fed and their powers of observation and reasoning the exercise of which are not essential in learning process are not stimulated. Perhaps this method originated in very ancient times, when printing press was not invented and hand-written manuscripts were very few, hardly for the use of teacher. The lecture is one of the most basic pedagogic tool which is generally followed in schools and colleges, here the teacher talks and the pupil listens. Despite the fact that this method does not cater for realizing the aims of teaching science and is not in accordance with the principles of teaching, it is the most dominating method today and is liked by majority of teachers. The lecture is an exposition of knowledge, facts, principles or other information which a teacher wishes to present to her students. In short a lecture means one person addressing many students.

When to use lecture method?

Although lecture method has more disadvantages than advantages yet we cannot reject it outright. This method may not be very helpful for teaching lower classes. However, it can prove very successful for higher classes when we want to:

- i. Cover the syllabus quickly.
- ii. Introduce some new and difficult topics.
- iii. Arrive at generalization from the facts students already possess.
- iv. Impart factual knowledge.
- v. Explain certain difficult points.
- vi. Revise and summarise the lessons already learn.
- vii. Give some background material for a topic.

So lecture method can be more useful in the above circumstances.

Planning the lecture

Who is your audience? – WHO

What is the purpose of your lecture? – WHY

How much time is available? – HOW LONG

What is your subject matter? – WHAT

Phases of a lecture

There are three phases of a lecture. They are preparatory phase, development phase and consolidation phase.

I. Preparatory Phase (Warm up Phase)

In this phase students are to be prepared to receive the contents of a lecture. Variety of formal and informal techniques can be used to prepare the students or to arouse their level of motivation or curiosity. In the classrooms normally teacher relates the contents of the lecture to the previous knowledge of the students.

II. Development Phase

This is the most important phase of the lecture. The entire body of the lecture is delivered in this phase only. Some activities of this phase are using analogies, giving suitable examples, proper illustration, comparison and differentiation, use of proper aids and in recent time's proper use of audio visual technology in classrooms.

III. Consolidation Phase

This is the end part of the lecture. Here the lectures pin point the important aspects of the lecture once again by summarizing. Now proper reviewing can be done to check the level of understanding by asking questions. Provide assignments, feedback and can relate the topic to the future learning content.

Skills associated with good lecture

1. Use of body language
2. Use of communication boosters
3. Varying the stimulus
4. Voice modulation
5. Use of proper language

Area of application of Lecture method

- To introduce new and difficult topic
- To revise the topics already covered
- To give some background of a certain topic
- To present the life histories of great scientist and their struggles and achievement in life
- To explain about certain procedures
- To impart factual knowledge
- To explain too deep theoretical factors

Merits:

1. **Attractive and concise:** It is very attractive, concise and very easy to follow without much botheration on the part of the teacher and the taught. The teacher feels secure and satisfied.
2. **Economical:** It is economical because no laboratory is needed and one teacher can teach a large number of students at a time.
3. **Speedy:** Lengthy syllabi can be covered in a short time by this method.
4. **Useful for Factual Information:** Factual information and historical anecdotes can be easily imparted by this method.
5. **Useful for Logical Sequence:** The logical sequence of the subject can be easily maintained. Since the teacher has to plan the lectures in advance, there cannot be gaps or over-lapping in the development of the lesson.
6. **Time Saving:** In this method there is no student activity, no project no demonstration, therefore there is hardly any wastage of time and lesson can go at top speed.

7. **Inspirational Value:** Good lectures have high inspirational value. Sometimes students pick up motivation, inspiration, instigation, zeal, ambitious ideas and do something creative in life.

Demerits

1. **Memory based:** It lays too much stress on memory work, experimental work is neglected and the power of observation of a child is seldom exercised.
2. **Spoon feeding:** It does not encourage independent thinking, discovering, exploring and taking initiative. It is a type of spoon feeding and all the faculties of the child are not allowed to develop.
3. **Teacher centered:** When the teacher lectures, there is no guarantee whether the pupils are concentrating and understanding all what the teacher is teaching.
4. **Too rapid:** the rate of imparting knowledge and information may be too rapid and the students may not get necessary connections of thought.
5. **Un - psychological:** In this method the teacher is active participant while the students are passive listeners, which is opposed to the principles of psychology. The interests, aptitudes and capabilities of the pupils are ignored.
6. **No inculcation of scientific attitude:** It does not help to inculcate scientific attitudes and training in scientific method among the pupils.
7. **No learning by Doing:** There is no place for learning by doing in this method. The very root of science is cut when practically nothing is done, for science is something which must work.
8. **Authoritarian:** This method is undemocratic the pupils are encouraged to depend upon one authority i.e., the teacher. They cannot challenge or question his verdict.
9. **No critical Thinking:** It fails to develop critical thinking and reasoning power, so essential for democratic living.

An informal talk, punctuated by suitable by suitable questions and made spicy by the use of audio visual aids providing a more vivid picture, will be able to secure sustained attention of the pupils and will result in considerable amount of learning.

10. Useful for higher classes:

This method may not be very helpful for teaching lower classes. However, it can prove very successful for higher classes i.e. tenth, eleventh, and twelfth classes when we want to:-

- Cover the syllabus quickly.

- Introduce some new and difficult topics, such as evolution of man, discovery of natural magnet etc.
 - Arrive at generalizations from the facts, gathered by students.
 - Impart factual knowledge.
 - Explain a practical demonstration which is to be done or which has been done.
 - Revise and summarize the lessons already learnt.
 - Give some background material for a topic.
 - Give biographical sketch of a scientist or relate some of his anecdotes.
11. Any lecture has to be planned well in advance. Selecting the content, objectives of teaching the content, structuring the lecture, summarizing at every step and also at the end must all be planned.
12. **Notes-taking:** while making use of this method, it will be beneficial if the teachers give some training in the art of notes taking while the lecture is on.
13. **Student's Question:** At the end of the lecture, time should be given for the students to ask questions and such questions be answered by the teacher without any hesitation. In this way the teacher can make sure whether the students have understood the lesson or not.

Conclusion

Lecture technique is useful for communicating information to students. As there is little opportunity for getting feedback from students, it is a less effective method of teaching. In science, the laboratory work and problem solving exercises help the teacher to find out the effectiveness of lecture.

II. DEMONSTRATION METHOD

This method includes the advantages of both lecture and demonstration method and avoids the disadvantages of both the methods. The main demerit of the lecture is that it is a one-side process. The teacher talks too much and the students are neglected. The best method is that which involves a kind of interaction between the teacher and the taught because they are really part of an educative process. The teacher performs experiments before the class and meanwhile goes on asking relevant questions. The students are compelled to observe carefully because they have to describe each and every step of the experiment accurately and draw inferences. The students are questioned and cross-questioned concerning the problem in hand and their inferences are discussed in the class. Thus unlike in a lecture, the students are active participants in a demonstration and their faculties of observation and reasoning are properly exercised. The students see the actual apparatus and

operations and help the teacher in demonstrating the experiment and thereby they feel interesting in learning. It is difficult to talk about the thing, which the students have to imagine. It is always easy for the students to understand and remember the concrete things. This method is said to be in accordance with the maxim of teaching “from concrete to abstract”.

The lecture-demonstration method can prove to be one of the best methods if the demonstrations are, well planned and rehearsed by the teacher. If the demonstration fails, it creates a very undesirable effect upon the moral and attitude of the students. If failure is too frequent, confidence of students in the teacher is lost. And if the demonstration is successful it will form a desirable effect on the students and will help in achieving the objectives of teaching of biology.

Criteria of a Good Demonstration

There are several criteria, which are more important for this method. If they are kept in a view by the teacher the demonstration will be a successful one. The following are the criteria of good demonstration.

- The demonstration should be planned and rehearsed well in advance. Planning and rehearsing of the experiment is very essential for it gives confidence to the teacher. He finds the difficulties involved in the experiments and the precautions to be observed. The students will be discouraged because of the badly planned lessons. If the experiment fails the students may lose interest and confidence in the teacher and in the lesson. In some instances a well – rehearsed experiment may also fail in the class. At such occasions the teacher should turn it into a problem for the students. In this way, the interest and confidence of students will not be lost but on the other hand they will feel more interested in finding out the cause and then presenting it before the class. This will encourage the students to exercise the powers of observation and reasoning and at the same time their instinct of self-expression will also be satisfied.
- The teacher should be clear of the purpose of demonstration. He should be very clear about the objectives of the demonstration, the comparisons to be made the generalization to be arrived at, applications to be made and the attitudes to be developed.
- The teacher should get the help of students in arranging, filling up and performing the experiment. It should be the participation of both the students and teacher.
- The teacher should ask questions in order to know that the students have understood and are attentive in observing the demonstration.

- The teacher should explain the important and difficult points involved in the demonstration in simple and comprehensive language and should write them on the blackboard.
- The apparatus for demonstration should be arranged in order. It is always better to keep the apparatus to be used on the right hand and the used one on the left hand side.
- The demonstration should be visible to all the students in the class.
- The demonstration should be at a little higher level than the student's table.
- Proper care should be taken for adequate lightning and to size the clarity of the apparatus.
- Demonstration experiments should be simple and speedy. Lengthy demonstrations in which the students have to wait for long time destroy the interest of the students. At the same time the complicated apparatus, which is above the understanding of average students, also discourages them. So the experiment should be simple and move on quickly to the conclusion.
- Demonstration should fix in the sequence of experiment, which the students carry out themselves and should be consciously connected with the things seen and handled by the students.
- Demonstration should be in accordance with the time and season otherwise it will prove to be a failure.
- Demonstration should be supplemented with other teaching aids to make it more real and interesting.
- Demonstration should create problems for the students and also make provision for solving them through their own efforts. In this way the students will find a chance to exercise their own abilities to observe, explain, analyze, verify and review. They will get training in scientific method of solving problems.
- The teacher should maintain the interest of the students throughout the experiment.

Principle

This method is based on the principle: Truth is that which works. The teacher has to work out something and then only the students will believe.

Requisites for a Good Demonstration

The method, though very popular and most widely used, may not prove successful with some teachers. The following are some of the requirements which will assure that the demonstration will be a success.

- **Appropriate Arrangements:** while performing an experiment the teacher must be sure that everything done on the demonstration table is clearly visible to the pupils. There will be no

difficulty if a lecture gallery is available but in its absence there are several ways of enabling the pupils to get a better view.

- **When there is no demonstration table:** The teacher may carry on the experiments on one of the student's table located in the front row and the class can view the demonstration by standing at some distance round the table. This method may prove very useful with small classes.
- **Sufficient Light:** Attention must be paid to adequate lighting of the demonstration table and the back-ground. Additional illumination may be used if necessary. Proper back-ground is very important. Black things should never be shown in front of the black-board.
- **Demonstration Apparatus:** Demonstration apparatus should be large as possible such as a big model of electric bell, vernier calipers etc. and the graduations on any instrument should be clearly visible.
- **Arrangement of Apparatus:** everything must be placed in order before the demonstration starts. The apparatus to be used should be placed on the left hand side of the table and arranged in order in which it will be shown. After a particular thing or apparatus has been used, it should be transferred to the right hand side. When several things are to be shown, they should not be placed all at once. A wealth of apparatus may impress a student but it can confuse him as well. The general order and tidiness of the demonstration table is very essential. Nothing looks worse than a demonstration table littered with books and other useless things. Only the things relevant to the lesson should be placed on the demonstration table.
- **Preparation by teacher:** the teacher must be sure that the experiments will succeed and are strikingly clear. This demands adequate preparation on the part of the teacher and rehearsal of the experiments under the conditions prevailing in the class-room.
- **Securing attention:** Attention of the class is very important. The teacher should know various methods of arresting and creating interest. He may, at occasions, be a bit of a 'showman'. To inspire the class with a sense of dramatization and to arouse an atmosphere of suspense just before the critical point of an experiment, is an art. It is useful to a teacher as to an actor.
- **Effect of Season:** Proper account should be taken of time and season. Climate conditions sometimes affect the apparatus. For instance, frictional electricity experiments should not be done during rainy season. Hot season is best for experiments with ice. White phosphorus can be safely used on a cool day.

- **Teaching Aids:** Demonstration experiments should be supplemented with teaching aids like charts, pictures, diagrams, models, film strips etc.
- **Use of Black board:** A large black-board behind the teacher's demonstration table is most essential. During the lesson the teacher can use it to great advantage. Tabular statements for entering data, principals arrived at, as a result of demonstration, can be written on the black-board. Necessary simple diagrams can be drawn on it.

Conduct of a Demonstration Lesson

Lecture demonstration method is the most suitable method to teach biology. It, therefore, seems appropriate to discuss some of the essential steps to be followed in a demonstration lesson.

1. Planning and Preparation

The adoption of demonstration method requires a thorough preparation on the part of the teacher. While preparing, he must bear in mind the following points:

- a. Subject matter
- b. Lesson plan including the questions to be asked.
- c. Collection and arrangement of apparatus required.
- d. Rehearsal of experiments.

The teacher should study the lesson before he enters the classroom. This will enable him to be exact and to the point. Drawing up a lesson plan is equally necessary and this should include a list of the principles to be explained, a list of the experiments to be demonstrated and the type of questions to be put to the students. This will make his work very systematic. Each and every experiment should be rehearsed under the same conditions that prevail at the time of demonstration. Rehearsal of experiments will enable the teacher to collect all the requisites for the demonstration work. It is all the more important that each and everything is arranged on the demonstration table in a wise and proper order so that no difficulty is felt at the time of demonstration.

2. Introducing the Lesson

It is useless to start a lesson without properly motivating and preparing the minds of the students for it. The lesson should be introduced in a problematic manner so that the student can appreciate and realize the importance of topic in hand. When a teacher is able to awaken the keenness and enthusiasm of his students half the game is over. Much depends upon starting a lesson in the right way. The teacher should begin the lesson with some personal experience or mind incident, a simple and interesting experiment, a familiar anecdote or by telling a story. He should keep in mind the value of an interesting experiment the experiment, which will set his students talking in school

and out of it, about the wonderful things they have seen or done in the biology lesson. The teacher should maintain the interest and enthusiasm of the students alive throughout the lesson.

3. Presentation of the Subject matter

The actual lesson may be concerning some prescribed topic, but the teacher is at liberty to treat it in narrow sense or to introduce into his teaching material and illustrations from a wide field of knowledge and experience. Even if the lesson deals with a particular topic of biology, a widely read and well informed teacher will draw illustration from all branches of science. In addition to this wherever practicable, reference should be made to the names of great scientists and their works. The lives and achievements of great men are always sources of inspiration and an acquaintance with their early difficulties encourages the students.

Teaching, as far as possible, should be through well thought out and judicious questions. The questions should be so arranged that their answers form a complete teaching unit. In the teaching of a lesson the voice of the teacher plays an important role. The teacher should speak slowly, deliberately and with correct pronunciation. The teacher should use voice effectively. It should be pleasant and not jarring. The tone his voice should be modulated according the nature of the statement.

4. Performance of experiments

The work at the demonstration table should be a model for the students to copy. The demonstration table should be clean and dry. The experiments must work and their results should be clear and striking. The experiments should be simple and speed. They should be well spaced throughout the lesson. They should be convincing and striking. Reserve apparatus should always be kept near the demonstration table so that much time is not wasted in collecting the apparatus in case of breakage. It is wise to keep the demonstration apparatus intact until it is to be used again.

5. Blackboard work

In the lecture demonstration method backboard is very useful. It mainly used for:

- a. Writing important results and principles in summarized form.
- b. Draw necessary sketches and diagrams.

As the face is an index to one's mind, blackboard work is an index to a teacher's ability. The writing on the blackboard should be neat, clean and legible. "Single lined" diagrams should be preferred to 'double line' diagrams. Every part of the diagram must be properly labeled. The labeling should be written in script and not in running hand.

Copying and Supervision

At the end of the demonstration the students should be given time to copy the black board summary and the sketches. A record of the blackboard summary will prove very useful for further reference.

Common Errors in a Demonstration Lesson

Some of the most common errors committed by the beginners in giving demonstration lesson are summarized below:

1. The apparatus may not be ready for use.
2. The teacher may fail to show how the demonstration fits into the problem in hand.
3. The teacher may not be able to focus the attention of the students to the important facts of the experiment.
4. Black-board may not be used properly.
5. The minor facts may be given as much importance as the major facts.
6. The teacher may arrive at the generalization himself rather than getting it done by the pupils.
7. The teacher may fail to emphasize the generalization.
8. The language used by the teacher may be difficult for the students to understand.
9. Right type of questions may not have been asked.
10. The persistent and continuous talking by the teacher may have marred the enthusiasm of the children.
11. Sufficient time for recording data may not have been given to the pupils.
12. The student's interest for further study may have been over-looked.

Merits:

- **Psychological Method:** This method is psychological because the students need not imagine anything, instead they are shown concrete things and living specimens. Consequently they take active interest in teaching –learning process. It, therefore, motivates their interest and enthusiasm of science.
- **Sensitive Apparatus:** Demonstration is very suitable technique when the apparatus is very costly or very sensitive and is likely to be damaged if handled by the students e.g., Fortin's barometer, electric dynamo etc.
- **Useful in dangerous Experiments:** It is helpful in case of dangerous experiments like preparation of chlorine, burning of hydrogen etc.

- **Economical:** The method is considered most economical. When apparatus is not sufficient for the students to do practical individually, the teacher may perform the experiment before the whole class. Also it saves time when a number of experiments can be performed in a short time.
- **Time Saving:** It is a time-saving method. If compared to Heuristic, project or Experimental methods, it saves much time. On this score it cannot be compared to lecture method, which is too fast.
- **Based on Activities:** Although it is not a child-centered method, yet the students are kept engaged in various activities like observing, taking notes, answering questions, drawing diagrams and sometimes involving in the actual performance of experiments.
- **Useful for everyone:** It is suitable method for all types of students i.e. average, below-average and above-average.

Demerits

- **Not Based on learning by Doing:** There is no scope for 'learning by doing' which is an important principle of learning and the students do not realize the joys of direct personal experience.
- **Not Child Centered:** It is not child centered. The teacher has the final responsibility to manipulate and perform the experiments in any manner he likes. Therefore, to some extent it is an authoritarian approach, and is teacher dominated.
- **No scope for Individual differences:** This method does not provide food for individual differences. Slow learners and genius are made to crawl at the same pace.
- **Obstacle in Progress:** The desirable laboratory skills are not developed among the students.
- **Not based on Scientific Attitude:** It does not inculcate the most-needed scientific attitude and training in scientific method.

Conclusion

This method is one of the best methods for teaching science to secondary classes. However, if the teacher feels that it will tax upon his time and he will have to put in more work by rehearsing, arranging and then demonstrating, it is suggested that the teacher can, to much extent, call upon his pupils for help. There can also be pupil-demonstrations. Let the pupils do everything regarding arranging, rehearsing etc. No doubt the teacher will always be guiding. In this way, the objection against this method that it is devoid of 'learning by doing' will also be removed.

III. TEAM TEACHING

Introduction

The present system of education demands too much from a teacher curtailing his freedom. He has to teach same subject-matter every year and he is forced to teach the same content to two or three section of the same class. It is very boring for him and stifles his interest in the subject. Sometimes he is assigned to teach the subject in which he has no interest to teach but he is forced to do so. Moreover the present day classrooms are appropriate only for the average students. Team teaching is one of the most modern techniques in the field of educational technology. The concept of team teaching arose in 1957. Although begun in some secondary schools, the team teaching idea was given momentum by activities of the Commission on staff utilization of the national Association of Secondary School Principals (U.S.A). This is the result of numerous and successive January issues of the bulletin of the national association of secondary school principals beginning in 1958. Noall has defined team teaching as “a combination of two or more teachers who work with variable size group of students during an adjustable period which covers two or more regular section”. The best-known and commonly used plan is the trump plan of teaching, so named after Professor J. Lloyd trump, associate secretary of the national association of secondary school principals.

Origin of Team Teaching

The concept of ‘Team – Teaching’ has its origin from America during the mid-1950. It reached England in the 1960. J. Freedom’s team teaching in Britain gives an account of its growth in the country. It has occupied a place for itself in schools and colleges.

Harvard University is the first institution which has initiated an internship plan in 1955. The second mile stone in team teaching is the project in Lexington (1957-64) which has been influenced by the Harvard programme.

Francis Chase of the University of Chicago has developed the need of team teaching to use the best teachers more effectively.

J. Leyod Trump made valuable contribution for the success of team-teaching. Team-Teaching was not only confined to educational institutions but its use was extended to armed forces for teaching purpose during second world war.

It is difficult to trace the origin of team teaching because so many individuals and organizations have been conducting studies in their own areas for last two decades all over the world.

In India many educationists are aware of this system; but they are not confident to implement it even though it will best suit to our teaching learning situations.

Meaning of Team Teaching

The term 'team teaching' has been defined by several persons because they have designed and conducted experiments to understand the nature of team teaching. Warwick has tried to define the term more comprehensively. According to him "Team-teaching is a form of organization in which individual teachers decide to pool resources, interests and expertise in order to devise and implement a scheme of work suitable for the needs of their pupils and the facilities of their schools."

According to J. Lloyd Trump, teaching is "an arrangement whereby two or more teachers with assistants plan, instruct and evaluate co-operatively two or more classes in order to take advantage of their respective special competencies as teachers".

According to **Harold S. Davis**, "Team Teaching may be considered to be any form of teaching in which two or more teachers regularly and purposefully share responsibilities for the planning and correlating of lessons to one or more classes of students".

Definition of Team-Teaching

Carlo-Olson has defined team-teaching as:

"An instructional situation where two or more teachers possessing complementary teaching skills cooperatively plan and implement the instruction for a single group of students using flexible scheduling and grouping techniques to meet the particular instruction."

Another definition of team-teaching is:

"An arrangement whereby two or more teachers, with or without teaching-aids cooperatively plan, instruct and evaluate one or more class groups in an appropriate instructional space and given length of time so as to take advantage of the special competencies of the team members."

It may be inferred from the definitions of team-teaching that it has the following of the team members."

- It involves two or more teachers to teach a class.
- In this type of teaching, a group of teachers is responsible rather than an individual teacher.
- A team or group of teachers of the same subject work together to deal a significant content to same group of students jointly.
- It can be termed as co-operative teaching, in which individual teachers plan to pool resources, interests and their experts for teaching a content for the same group or class of students.
- Every individual teacher gets appropriate instruction space and length of time so as to use special competencies of teaching a content to a group of students.

- A group of teachers shares responsibilities of planning, organizing, teaching, controlling and evaluating the same class of students.
- In team-teaching the group of teachers has to consider the needs of their pupils and they should teach jointly to satisfy its needs and remove the difficulties of their students.

Chaplin has defined team teaching in the following lines:

“Team teaching is a type of instructional organization involving teaching teams and the students assigned to them, in which two or more teachers are given responsibility, working together, for all or a significant part of instruction of the same group of students”.

We can generalize that “team teaching is any form of teaching in which two or more teachers purposefully share responsibility for the planning, organizing and evaluating the learning of a large group of students. It has shared responsibility with a purpose that teachers can accomplish more by working together with their different expertise”.

Purpose of Team Teaching

Team Teaching offers an opportunity for better education to a large group of students through a team of teachers. Some of the purposes are as follows:

- 1) The goal of team teaching is the improvement of teaching through a better utilization of a group of teachers.
- 2) It utilizes teacher's specialized expertise, interests, instruction skill, time and energy.
- 3) It ensures preparation of lessons, materials and other aids to create motivation among the students and better learning situations.
- 4) The team concept itself increases the possibility of variety of instruction based on pooled talent to the teachers.

Characteristics of Team Teaching

The theoretical design for team teaching is based on the co-operative planning but there are many other aspects of team teaching such as.

1. Role differentiation of team members.
2. Regrouping of students.
3. Rescheduling of time.
4. Redesign of teaching space.
5. Common time for planning.
6. Integration of learning in a meaningful way, and
7. Development of resource centres.

The teaching involves much different combination of teachers and other staff personnel, for example one team may consist of a subject matter specialist and a guidance and counselor. Another team would have groups of teachers comprising such related specialization as Zoology, Botany, Physiology and Bacteriology. In the large combined class they would teach in an interdisciplinary fashion. This large class would then be broken down periodically so that each specialist might meet small class discussion groups with those students whose interests or course requirements call for problems more deeply in the various areas of specialization. Still other types of teams use a master-teacher, regular teacher combination with master teacher conducting the large group lesson and the regular teachers being the instructional leaders in the subdivided small group classes.

Types of Team-Teaching

There are different styles of organizing team teaching in schools. One of the common methods adopted is that the teachers teaching the students of same standard and subject join together, collaborate and perform the task. The whole team can plan the lecture and discuss which teacher is best suited to lecture, for small group discussion, for guiding library work, for setting up demonstration and visual aids that can be used in presentation in large groups and for preparing evaluation materials. Each of the members in the team has a specific assignment.

All the students of four sections meet at the large hall for large group instruction. One teacher gives a lecture and another teacher demonstrates. This lecture is arranged after thorough preparation in consultation with the other teachers in the team. The purpose of the lecture is to motivate the students and initiate them in the learning activity.

Team teaching can be effective only when this lecture in a large group is immediately followed by small group discussions under the guidance of all the teachers in the team. The large group is split up into small groups of homogeneous abilities and the teacher's pay individual attention and work as counsellor or consultant to these small groups. This homogeneous grouping can be accomplished on the basis of student's abilities, interests, needs and achievements.

Another style of team teaching can be that the team members join together, discuss the topics, plan the work, prepare the teaching aids and then go to their respective classes and teach the subject matter.

In yet another approach, when a topic of common concern to different disciplines is to be discussed, teachers of these subjects after proper planning together, can go to the same class and teach the subject matter in coordinated manner. One teacher is followed by another teacher and the

discussion is completed from each one's point of view. This may bring about the interrelatedness of knowledge through discussion by different subject teachers.

Objectives of Team-Teaching

The teaching strategies have been designed to achieve certain objectives. The team-teaching has been evolved to realize the following objectives:

1. To make the best use of expertise of teachers under team-teaching.
2. To improve the quality of teaching. The services of the expert teachers are shared by a large number of students.
3. To develop the feelings of co-operation or group work in teaching-learning situation.
4. To help the students, to satisfy the needs and difficulties relating to the special content.

Principals of Team-Teaching

The team-teaching is based upon certain general principals which are helpful in organizing team-teaching. The principals provide a guideline for planning and organizing team-teaching. The following are the important principals of this team-teaching.

1. **Principal of Size and Composition:** The size of the group or class should vary according to the objective or purpose of team-teaching. For example, if the purpose of team-teaching is to remove the difficulties of the students in certain topic of a subject, obviously, the size of the group should be small involving the students who have similar type of difficulties.
2. **Principal of Duties Assigning to Teachers of the Team:** the team-teaching involves two types of tasks: lead lecture and group work cum follow-up work. Therefore, this task must be assigned to a competent person.
3. **Principal of Learning Environment:** Every subject requires its own learning situation or environment. Therefore, learning environment must be generated by employing appropriate teaching aids and equipments, e.g., laboratory, workshop, field work, good library and lecture room, etc.
4. **Principal of Time Factor:** The team-teaching is a well-organized teaching task, and therefore time schedule should be prepared by allotting appropriate time for lead lecture task and group-work or follow up task. In this type of teaching, time arrangement should be fairly fluid.

5. Principal of Supervision: The focus of team teaching is to develop the mastery over subject-matter by employing the expertise of teachers. The supervised-study is essential for assimilating the knowledge of a topic or concepts. The nature and duration of the supervision of the student's activities depend upon the purpose of team teaching.

Procedure of Organizing Team-Teaching

The team-teaching serves several purposes of teaching and it has different forms or types. Therefore, it is difficult to provide a general procedure for organizing team-teaching, but it involves the following steps:

Step 1 – Planning, Step 2 – organizing and Step 3 – Evaluating. The details of activities of these steps have been given in the following paragraphs:-

Step 1-Planning of Team-Teaching:

This step involves the following activities which are decided by the team members.

- Deciding the topic to be taught.
- Writing the terminal objectives in behavior terms.
- Identify the entering or initial behavior of the learners of the group.
- Preparing a tentative schedule of teaching.
- Assigning duties to teachers, considering their interest and competencies during Lead lecture (2) follow-up work and (3) supervision.
- Fixing up the level of instruction.
- Selecting appropriate teaching aids and demonstration equipment's for generating learning environment; deciding ways and means for evaluating the student's performance: oral or written questions for practical work, etc.

These activities are finalized by the team of teachers who are taking part in the team-teaching expertise of every teacher must be fully utilized. There should not be imposition of activities on them.

Step 2-Organizing Team Teaching:

The organization of team-teaching is decided by considering the purpose or needs of the learners of the groups. The following are the general activities which are usually performed by team of teachers:

- Determining the level of instruction: Some questions are asked to explore the background of the learners.

- Presentation of lead lecture by a competent teacher of the team: other teachers listen to the lecture and note down the elements of topic which are not easily understandable to the learners group or not appropriately presented.
- Follow up work, the other teachers have to supplement the lead lecture by explaining the elements of the topic in a more simple way so that learners can understand easily.
- Providing motivation or reinforcement by teachers to the learners in both the situations: lead lecture and follow up work.
- Supervision of students-activities which are assigned in lead lecture or group work or follow-up work. This stage is considered to be important for assimilation.

Every member of the team should be conscious about time schedule and about the duty assigned to him.

Step 3- Evaluating Team- Teaching:

The evaluation is an important aspect of any type of teaching. It is helpful to measure the performance of learners which determines the level of achievement of the objectives. It also provides the reinforcement to team members. Thus, it involves the following activities:

- Asking oral questions, writing questions and practical work. Each question should measure a particular objective of team-teaching.
- Taking decision about the level of performance and realization of the objectives.
- Diagnosing the difficulties of the learners and provide the remediation.
- Revising the planning and organizing phases of team-teaching on the basis of evaluation of students.

Team Organization

This is based on hierarchy whose basic unit is a teacher. The teacher's experience, skill and specialty are the criteria of joining the team. There is joint responsibility for instruction but the teacher enjoys his status and prestige. Typically, from three to eight teachers take responsibility for the instruction of 75 to 240 students of similar age and class. The clerical and secretarial needs of the team are cared by the clerical staff.

Types of teams:

1) Single Subject Team

In single-subject teams, two or more teachers agree to teach the same subject at a particular class level to the same group in a common period. The strength of the students varies according to the number of teachers.

2) Interdisciplinary Teams

In these teams teachers of different subjects assume responsibility for the same large group and are given a block of time in which to work with them.

3) Hierarchical Teams

Some teams are hierarchical in nature consisting of teachers, clerks and assistants. Job descriptions give the difference of roles played by each member.

In these teams one professional teacher is taken as team leader and functions as administrator in-charge. The remaining teachers perform professional duties. Similarly, clerks perform secretarial work and prepare cyclostyled materials.

4) Synergetic Teams

These are some teams, which work together as a team, and there is a minimum of hierarchical approach.

Facilities Required

Team Teaching necessitates flexibility. Time schedules must be organized in such a way that there are large blocks of time allotted by the combined large group-small group lesson. The school building itself must be flexible so that large rooms can be easily transformed by movable partitions into separate rooms for small class discussion. School organization must be flexible so that students get to know one another better. Such fine support is necessary for effective group discussion.

Advantages

The team-teaching is a perspective and economical device of teaching to cater to the needs of the students. It is highly flexible. It has the following major advantages:

- The team-teaching utilizes the competencies of the teachers.
- It creates the learning environment for better comprehension and mastery over the subject among the learners.
- It provides an opportunity for free discussion in the small group work.
- It provides an opportunity to the teachers to develop the professional status and competency in teaching by mutual sharing of ideas.
- It develops the team spirit and the team members utilize the best use of multimedia. Time and energy are saved by the team teaching. It maintains the discipline in the class and creates a conducive environment of learning.
- It is highly flexible method of teaching while traditional methods of teaching are rigid.

- It enables the students to become more aware of their own approach, knowledge of content and simultaneously to the other experts of the same area. It brings excellence of teaching in them.

Limitations

With all the advantages, the method has got some demerits.

- It is very difficult to seek co-operation among teachers to work jointly in teaching-learning situation. There is no mutual regard and respect among the teachers. Every teacher considers himself expert of the subject. Every teacher has his own style of teaching.
- The teachers do not like to deviate from the routine method of teaching and they do not prefer any change in system of education. Generally they are of the opinion that it can be used in Western countries not in Indian schools.

This type of attitude of teachers hampers in the progress and improvement of educational system.

Suggestions regarding the Use of Team-Teaching:

The team-teaching can be used effectively by incorporating the following suggestions:

- The research studies have established for its workability and effectiveness but its success will depend upon the way it works in practice. The meaning and understanding of team-teaching should be given to the school teachers and favorable attitude would be developed among them towards team-teaching.
- The success of team-teaching rests upon the co-operation and devotion of the teachers. Only those teachers who are willing to work in a team must be invited for this method.
- The teachers should not be assigned the duties but they themselves should prefer the activities of teaching. They should be given full freedom to work at various stages of team-teaching. It is always better to have a leader for the team.
- In teacher education departments and institutions, pupils-teachers should be trained for this type of teaching.
- Anderson, Warwick and other experts and other experts in the fields of team-teaching consider hierarchical structure and composition as a very logical and attractive arrangement. The success of team-teaching plan largely depends upon a balanced team in which all the teachers feel their responsibility and co-operate willingly in organizing teaching.

B. LEARNER-CENTERED METHOD

Learner-centered methods are those methods where the focus of attraction is learners than teachers. It is through the involvement of learners the method develops. The recent psychological approaches in the classrooms give more importance to learner centered methods than teacher centered methods.

I. LABORATORY METHOD

This method is considered to be one of the best methods of teaching science, as it provides learning by doing. In this method, the students perform experiments on their own. The main difference between the demonstration method and this method is that in demonstration method the teacher performs experiments and the students observe the activity. But in this method, the students perform the experiments under the supervision of the teacher. Unless the students perform experiments on their own they will not come to know what science really is. In this method they may do experiments individually or in small groups.

The famous quote of the Indian education commission report (1964-1966), “to learn science is to do science. There is no other way of learning science.” Since biology is a branch of science is applies to biology is also. In a modern science teaching, practical and experiences occupy an important place. So the branch of science, which does not give importance to practical, will not be considered as a complete subject. Since psychologists emphasise the principal of “learning by doing” the practical should be commenced from the school stage itself. Then only the scientific concepts and principals should be meaningful. Students understand more from the real specimens than from the printed pictures or diagrams drawn on the black board. All students like to involve in activities. These activities satisfy the emotions of the students; activities. These activities satisfy the emotions of the students; develop their thinking ability.

Laboratory is used to do experiments. These experiments are used to prove the theories in the lessons. The history of biology shows a number of examples to prove how they are treated. So a theory, however strong it may be, unless it is proved by experiment, will not be accepted. So, in order to prove a theory, experiment is necessary.

Objectives of Laboratory method

- To develop the skill of drawing
- To develop the skill of computation
- To develop manipulative skills
- To develop scientific attitude

- To develop and maintain interest in science
- To promote accurate observations and proper recording
- To verify facts and principles

Development of Laboratories

Laboratories were not given much importance in school education till 1000 A.D. Laboratories came into existence only during the period of Francis Bacon. He was considered as the father of scientific researches. After him during the period of Gilbert laboratories were used in the development of scientific method. In the beginning only chemistry laboratories developed. When electives were introduced in school curriculum laboratories in all branches of science flourished well.

Advantages of Laboratory

1. The laboratory work broadens the interest of the students because they can see and confirm things stated in the textbook.
2. The students get accustomed to use scientific tools and equipments.
3. They get an environment to carry out scientific activity and get an opportunity to exercise their ingenuity.
4. They learn to work in co-operation with others, which is a necessary tradition in any scientific pursuit.
5. They learn to rely on facts, which they actually see happening rather than opinions stated by others.
6. They prove the scientific theories by experiments.
7. They acquire the skills in handling apparatus reading scales, drawing diagrams and graphs and other scientific disciplines such as careful observation, collection and arrangement of data, drawing conclusions and taking necessary precautions.
8. The laboratory experience is pleasant to the students as they can satisfy their sense of curiosity.
9. They like the excitement and challenge of the unknown, the opportunity to manipulate things, materials comparatively, freely.
10. They gain the satisfaction of achieving something tangible.

Aims and Procedures of Experiments

1. Experiments done in laboratory should stimulate critical and scientific thinking in the students.
2. They should also cater to the needs and requirements of individual students.

3. The teacher should be considered as a friend and philosopher.
4. All the apparatus required for the experiment should be verified and kept ready in advance on the table.
5. Difficult experiments should be repeated by the students

Instruction for the Students

In order to enable the students to do experiments some guidelines should be given to the students. The guidelines can be given in different forms. They are:

- a. Laboratory manuals
- b. Laboratory instructions
- c. Instruction card.

Laboratory Manuals

These manuals are more useful to the new teachers who are not much experienced in doing the experiments. These are also useful to the students who want to do their experiments by themselves and to the students who were absent to the class by some reason or the other. Teachers need not give procedures for each experiment. These manuals contain the correct result of the experiments so that time is not wasted on the experiments.

These manuals should contain the following points:

- i. Procedure for doing the experiment and precaution to be taken for the experiment.
- ii. The method of entering the observation in the record.
- iii. An example should be given in the beginning
- iv. The places where reference should be made to the textbook.
- v. The points left out in the textbook should be included in them.

Laboratory Instruction

These are useful to the students when they do experiments in laboratories. The instructions for experiments should be in simple and clear language. This will contain the procedure for doing the experiment in brief and order. This will also contain the precautions to be taken, method of observation recording, number of times to be repeated and calculations to be done. These instructions will help the students to do experiments very easily.

Instruction Cards

These cards are given to the students in the laboratory in order to enable them to do the experiments using the procedure given in the cards. 15 cm x10 cm. One card will be used for one

experiment. The instructions regarding the experiment will not be too long or too short. They will be brief and clear. Each instruction card will bear the following information.

1. Experiment number
2. Aim of the experiment
3. Apparatus required
4. Procedure
5. Precautions to be taken
6. Tabular column to be adopted
7. Conclusion

Categorization of Laboratory Method

Laboratory method can be divided into two types. They are;

1. Multiple or group systems and
2. Individual system

Multiple or Group System

In this system students do the experiments in groups. Arrangements will be made in the laboratory in such a way that the students, in groups, do the experiment.

Individual Laboratory System

Individual laboratory system is a system in which the students are doing the experiments individually. This method is further divided into Even Front System and Rotation Method.

(i) Even Front System

This is system in which all the students will be doing the same experiment simultaneously and individually. In this method supervision will be easy for the teacher. Students can compare the results. They can rectify the mistake if at all any, happens in the course of the experiments. It is easy for the teacher to give the procedure for the experiment. The apparatus can be kept ready since they are the same. The time required for the experiment can be fixed very easily.

This is the most expensive method since it requires more number of apparatus. The space required for storing so many sets of apparatus will be enormous. The experiments are not based on the interest and aptitude of the students. Lazy students may copy the results from other students without actually doing the experiment.

(ii) Rotation Method

Different experiments as per the syllabus are arranged and the students are asked to do the experiments one after the other in rotation.

Merits

1. The apparatus required for the experiment can be left in the place ready for doing the experiment.
2. The apparatus are cleaned immediately after the experiment.
3. This method avoids repetition of experiments by the students.
4. It is easy to pay individual attention to the student.
5. It requires only 4 or 5 sets of apparatus for each of the experiment and hence storage-space required is comparatively small.

Demerits

1. It is very difficult for the teacher to supervise the laboratory work.
2. It is not possible to dictate procedure for all the experiments at the same time.
3. Duration for the experiment cannot be fixed because it differs from experiment to experiment.

Conclusion

Both even front system and rotation method have some merits and demerits. The demerits can be eliminated when even front system is followed for chemistry and biology and rotation method for physics. Normally in biology even front system is followed as it has all the advantages.

II. PROJECT METHOD

This method was devised by **Kilpatrick** and was given a project shape by **Stevenson**. This is based on the philosophy of pragmatism. **John Dewey** wanted that education should be for life and through life. School should be a miniature society. In this method connected facts are developed round a central theme which may be any matter of scientific interest, a scientific principal or a topic of immediate interest to the students.

Definitions

The term project has been defined by a number of educationists in their own way. According to **Kilpatrick**, “A project is a wholehearted purposeful activity proceeding in a social environment.” According to **Stevenson** “A project is a problematic act carried to completion in its natural setting.” According to **Ballard** “A project is a bit of real life that has been imparted into the school.”

This method is based on the following principals:

1. Students learn better through association, co-operation and activity.
2. Learning by doing

3. Learning by living.

A project is a kind of life experience which is the outcome of a desire of the students and teaching by this method is therefore, based upon the use of this desire. “Learning by living” is the better meaning of project method, because life is actually full of projects and we try to carry out these projects every day.

Projects work out best with small groups or classes. Biology can be best taught through projects. Students can gain interesting information if they are made to investigate the same locality at different seasons of the year for flora and fauna. They may note down the ways in which living things may adapt themselves to dry and wet seasons, the different times of flowering and fruiting of plants, and of breeding of birds and the presence or absence of various species of animal life.

Suitable planning and organization is essential for any investigation. Students should be classified into groups with a leader for each group. Every student should be assigned a definite task the leader being responsible for collecting all the information together at the end. Students should take down notes as and when observations are made

Steps in a project

1. Providing a situation

The teacher should always be on the look out to find out situations that arise and discuss them with their students to discover their interests. Situations may be provided by different methods. The teacher can talk to the students on the topics of common interests, for example about their hobby, how do they spend the leisure time and holidays. By talk and discussion with the students the teacher should provide situations for the students to tell about a project, which can be completed by project method.

2. Choosing and Proposing

The project should be chosen and proposed by the students. The teacher should not choose the project himself and compel the students directly or indirectly to accept the proposal. The teacher should tempt the students and the proposal should finally come from the students. The teacher should continue his discussion till the students propose the project. When a project has been proposed the teacher should see that the proposal of the teacher is clearly defined and understood. In case the students make an unwise choice the teacher should carefully guide them for a better project by providing some other situation.

3. Planning

The success of a project depends on the planning. This planning is to be done by the students. All the details of the project are to be planned well in advance. The teacher should guide the students in planning by giving some suggestions. The teacher should not impose his plan on the students. Everything should be told by the students.

4. Executing

It is the most important and longest step in the project method and therefore needs a great deal of patience on the part of the teacher and the students. The project must be executed by the students because they have chosen and planned parts among the students. The work of the project is to be assigned to the students according to their tasks, interests, aptitudes and capabilities. All the work of the project cannot be done by every member of the group. Every students should get a chance to do something. Those who are backward in one subject, may be excellent in others, and therefore can contribute their might towards the execution of the project. The teacher is simply to keep a close watch, and encourage and guide the students wherever necessary.

5. Evaluating

It is very valuable to review the whole project, after the project has been completed and find out the mistakes, if any. Students should evaluate their own work and they should be able to look their own failures and findings.

6. Recording

The students should keep a complete record of the project. They should record the discussion, the proposal, and the plan, allotment of duties, books referred, places visited, maps drawn, places surveyed, specimens collected and lessons learnt.

Criteria of a Good Project

1. The project selected should be purposeful it should be useful and practicable to the students in their daily life.
2. The experience gained should be fruitful. The students should learnt to co-operate and share their interests and should develop into a democratic individual.
3. The project should cater for the activities of the students.
4. Students should be given full freedom to work on their own accord.
5. The project should be selected by the active participation of both students and teacher.
6. The project should be economical and the purpose of the project should be achieved without any waste of time or money.

7. It should be timely and drawn in relationship with seasons of the year and the interest and needs of the community.
8. It should be challenging.
9. It should be feasible.
10. It should help individuals to see and understand life in its unity.

Role of the Teacher in Project Method

1. The teacher is a friend, guide, and a working partner.
2. He should provide opportunities for shy students to contribute something for the success of the project.
3. He should try to learn more along with the students.
4. He should help the students in developing character and personality by allowing them to accept the responsibilities and discharge them efficiently.
5. He should move freely with the students so that democratic atmosphere prevails in the class.
6. He should be alert and active all the time to see that the project runs in the right line.
7. He should have a thorough knowledge of the students so as to allot them work according to their interest and ability.
8. He should be well experienced and should have initiative, tactics and taste for learning.

Merits

1. This method is based upon the laws of learning. They are as follows:

a. Law of readiness

The students are made ready to learn by creating interest, purpose and life situations.

b. Law of exercise

The student's carry out activities in the real life situations, the experiences gained thus are very useful in the later life of the students.

c. Law of effect

The sense of success and satisfaction should follow the learning process. This law makes it essential for the teacher to make the student satisfy and feel happy in what he is learning.

- d. It promotes co-operation and group interaction.
- e. It is a democratic way of learning. The students choose, plan and execute the project themselves.
- f. It teaches dignity of labour.

- g. The correlation of subject is best sought. There is no division of subjects into watertight compartments.
- h. It gives opportunity to develop keenness and accuracy of observation and to experience the joy of discovery.
- i. It calls for wholehearted purposeful activity.
- j. It sets up a challenge to solve a problem and this stimulates constructive and creative thinking.
- k. It helps to widen the mental horizons of students.
- l. Students learn the matter very easily because the subject is associated with activities.

Demerits

- 1. The project method absorbs a lot of time.
- 2. It gives the students superficial knowledge of so many things but leaves an insufficient basis of sound fundamental principles.
- 3. It requires much work on the part of teacher for planning and carrying out projects.
- 4. It presumes that the teacher is the master of all subjects and has an all-round knowledge of everything to impart correction.
- 5. The books written on these lines are not available.
- 6. It is more expensive because the students have to bear the expenses of excursions, outdoor activities, purchase of material and do experiments.
- 7. In this method, the teaching is not well organized, regularized and continuous. The timetable is almost upset.

Suggestions

- 1. This method is suitable for teaching to primary and middle school students. This can also be used for secondary school students with some modifications.
- 2. There is no need for text books and materials. The red project can be carried out in its natural setting and so local material can be made use of.
- 3. The problem of expenditure can be easily solved by taking some such projects in which we can earn something. Vegetable gardening and staging a play will fetch some money.

The time table may be so arranged that in the forenoons subjects may be taught and in afternoons project will be carried out.

III. PEER TUTORING/TEACHING BY STUDENTS

Introduction

Peer tutoring is an instructional strategy that consists of student partnerships, linking high achieving students with lower achieving students or those with comparable achievement, for structured reading and math study sessions. According to Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller (2003), peer tutoring is "systematic, peer-mediated teaching strategies". Peer teaching is not a new concept. It can be traced back to Aristotle's use of *archons*, or student leaders, and to the letters of Seneca the Younger. It was first organized as a theory by Scotsman Andrew Bell in 1795, and later implemented into French and English schools in the 19th century. Over the past 30-40 years, peer teaching has become increasingly popular in conjunction with mixed ability grouping in K-12 public schools and an interest in more financially efficient methods of teaching.

Not to be confused with peer instruction—a relatively new concept designed by Harvard professor Eric Mazur in the early 1990s—peer teaching is a method by which one student instructs another student in material on which the first is an expert and the second is a novice.

What is peer tutoring?

Peer tutoring is a flexible, peer-mediated strategy that involves students serving as academic tutors and tutees. Typically, a higher performing student is paired with a lower performing student to review critical academic or behavioral concepts.

Why choose peer tutoring?

1. It is a widely-researched practice across ages, grade levels, and subject areas
2. The intervention allows students to receive one-to-one assistance
3. Students have increased opportunities to respond in smaller groups
4. It promotes academic and social development for both the tutor and tutee
5. Student engagement and time on task increases
6. Peer tutoring increases self-confidence and self-efficacy (Spencer, 2006)
7. The strategy is supported by a strong research base (e.g., Calhoon, Al Otaiba, Cihak, King, & Avalos, 2007; Kunsch, Jitendra, & Sood, 2007; Vasquez & Slocum, 2012)

What are the most frequently used peer tutoring models?

Classwide Peer Tutoring (CWPT): Classwide peer tutoring involves dividing the entire class into groups of two to five students with differing ability levels. Students then act as tutors, tutees, or both tutors and tutees. Typically, CWPT involves highly structured procedures, direct

rehearsal, competitive teams, and posting of scores (Maheady, Harper, & Mallette, 2001). The entire class participates in structured peer tutoring activities two or more times per week for approximately 30 minutes (Harper & Maheady, 2007). While the procedures and routines in CWPT remain the same, student pairings or groups may change weekly or biweekly. In CWPT, student pairings are fluid and may be based on achievement levels or student compatibility. Students may

Cross-age Peer Tutoring: Older students are paired with younger students to teach or review a skill. The positions of tutor and tutee do not change. The older student serves as the tutor and the younger student is the tutee. The older student and younger student can have similar or differing skill levels, with the relationship being one of a cooperative or expert interaction. Tutors serve to model appropriate behavior, ask questions, and encourage better study habits. This arrangement is also beneficial for students with disabilities as they may serve as tutors for younger students.

Peer Assisted Learning Strategies (PALS): PALS, a version of the CWPT model, involves a teacher pairing students who need additional instruction or help with a peer who can assist (Fuchs, Fuchs, & Burish, 2000). Groups are flexible and change often across a variety of subject areas or skills. Cue cards, small pieces of cardstock upon which are printed a list of tutoring steps, may be provided to help students remember PALS steps (Spencer, Scruggs, & Mastropieri, 2003). All students have the opportunity to function as a tutor or tutee at differing times. Students are typically paired with other students who are at the same skill level, without a large discrepancy between abilities.

Reciprocal Peer Tutoring (RPT): Two or more students alternate between acting as the tutor and tutee during each session, with equitable time in each role. Often, higher performing students are paired with lower performing students. RPT utilizes a structured format that encourages teaching material, monitoring answers, and evaluating and encouraging peers. Both group and individual rewards may be earned to motivate and maximize learning. Students in RPT may prepare the instructional materials and are responsible for monitoring and evaluating their peers once they have selected a goal and reward as outlined by their teacher.

Same-age Peer Tutoring: Peers who are within one or two years of age are paired to review key concepts. Students may have similar ability levels or a more advanced student can be paired with a less advanced student. Students who have similar abilities should have an equal understanding of the content material and concepts. When pairing students with differing levels, the roles of tutor and

tutee may be alternated, allowing the lower performing student to quiz the higher performing student. Answers should be provided to the student who is lower achieving when acting as a tutor in order to assist with any deficits in content knowledge. Same-age peer tutoring, like classwide peer tutoring, can be completed within the students' classroom or tutoring can be completed across differing classes. Procedures are more flexible than traditional classwide peer tutoring configurations.

How to pull off Peer Teaching

1. be sure your tutors are trained.

Existing research identifies adequate tutor training as an essential component of peer tutoring programs.

One after-school peer tutoring program implemented in a middle school in California, called Student-2-Student, offers tutoring in a variety of subjects to students with the help of high-achieving eighth graders. Student-2-Student is selective in its recruitment of tutors. Qualified eighth graders meeting a minimum GPA requirement and demonstrating high citizenship must complete an application process and obtain approval from their teachers before being paired with struggling students. The program advisor then matches tutors to students based on who seems to be a good match academically and socially. Tutors receive quality training in effective ways to work with their tutees.

This program led to a significant improvement in core subject letter grades for all participants. In an evaluation of the program, participants also demonstrated increased responsibility, completion of homework assignments, and significantly improved work habits.

2. Use a reward system.

In another peer teaching program, sixth grade students enrolled in general reading education classes in a Midwestern, urban middle school were assigned to tutoring pairs of either equal ability or pairs in which high-achieving students modeled successful learning with lower-achieving students. Similar to Student-2-Student, the students received training prior to tutoring.

What sets this peer tutoring program apart from common peer tutoring practices is the inclusion of a reward system for students to encourage participation and on-task behavior. During the sessions, the teacher supervised all activities and passed out raffle tickets to students exhibiting good tutoring or on-task behavior. Students wrote their names on earned tickets and placed them in a collection throughout each week. At the end of each week, the teacher would draw several names of students who could each choose a small prize from a box of inexpensive toys.

Evaluation of the class-wide peer tutoring model with rewards for good behavior showed substantial letter grade improvements for the students. The lottery system for reinforcing participation and on-task behavior was shown to overcome challenges to student motivation.

3. Emphasize confidentiality, positive reinforcement, and adequate response time.

The tutors at Student-2-Student are taught to demonstrate three important things during any given tutoring session: confidentiality, positive reinforcement, and adequate response time when asking questions. The training process also instructed tutors on explaining directions, designing work for extra practice, watching for and correcting mistakes, and providing positive feedback and encouragement.

4. Choose the learning exercise and the appropriate vehicle for it.

Simply placing students in groups or pairs and telling them to “work together” is not going to automatically yield results. You must consciously orchestrate the learning exercise and choose the appropriate vehicle for it. Only then will students in fact engage in peer learning and reap the benefits of peer teaching.

5. Use group strategies:

To facilitate successful peer learning, teachers may choose from an array of strategies:

- **Buzz Groups:**

A large group of students is subdivided into smaller groups of 4–5 students to consider the issues surrounding a problem. After about 20 minutes of discussion, one member of each sub-group presents the findings of the sub-group to the whole group.

- **Affinity Groups:**

Groups of 4–5 students are each assigned particular tasks to work on outside of formal contact time. At the next formal meeting with the teacher, the sub-group, or a group representative, presents the sub-group’s findings to the whole tutorial group.

- **Solution and Critic Groups:**

One sub-group is assigned a discussion topic for a tutorial and the other groups constitute “critics” who observe, offer comments and evaluate the sub-group’s presentation.

- **“Teach-Write-Discuss”:**

At the end of a unit of instruction, students have to answer short questions and justify their answers. After working on the questions individually, students compare their answers with each other’s. A whole-class discussion subsequently examines the array of answers that still seem justifiable and the reasons for their validity.

6. Use role playing and modeling.

During the first week of the sixth grade reading program, project staff explained the tutoring procedures and the lottery, modeled each component of the program, and used role-playing to effectively demonstrate ways to praise and correct their peers.

7. Emphasize the importance of active learning.

Many institutions of learning now promote instructional methods involving “active” learning that present opportunities for students to formulate their own questions, discuss issues, explain their viewpoints, and engage in cooperative learning by working in teams on problems and projects. Critique sessions, role-play, debates, case studies and integrated projects are other exciting and effective teaching strategies that stir students’ enthusiasm and encourage peer learning.

8. Teach instructional scaffolding.

To reap the benefits of peer teaching, tutees must reach a point when they are practicing a new task on their own. Tutors can help prepare students for independent demonstration by providing instructional scaffolding, a method by which the tutor gradually reduces her influence on a tutee’s comprehension. See our guide on instructional scaffolding here for further explanation.

9. Explain directive versus nondirective tutoring.

A tutor who engages in directive tutoring becomes a surrogate teacher, taking the role of an authority and imparting knowledge. The tutor who takes the non-directive approach is more of a facilitator, helping the student draw out the knowledge he already possesses. Under the directive approach, the tutor imparts knowledge on the tutee and explains or tells the tutee what he should think about a given topic. Under the non-directive approach, the tutor draws knowledge out of the tutee, asking open-ended questions to help the student come to his own conclusions about the topic. Both are valid methods, but different levels of each should be used with different students and in different scenarios.

10. Explain how to provide feedback.

Positive verbal feedback: Teach your tutors the importance of positive verbal feedback. Prompt students to come up with a list of standard statements which they feel may be positively reinforcing. They also need to be taught how much positive feedback to give. Giving feedback after each and every response can take too much time and diminish its effect. Teach tutors to give genuine praise after every third or fourth correct response and after particularly difficult problems. Make sure to have them practice.

Corrective feedback: Teach your tutors how to respond when an incorrect answer is given. When an incorrect answer is given, the tutor should promptly give and explain the correct answer or draw the correct answer out of the tutee without being critical of the tutee, and then give the tutee an opportunity to repeat the correct answer.

It should be noted that the majority of peer-tutoring programs for students are intended to complement, not substitute for, regular classroom instruction. Tutoring should never be a substitute for professional teaching. An ideal learning atmosphere is as a rich blend of peer and adult instructional strategies.

Benefits of Peer Tutoring

The main benefits of peer teaching include, but are not limited to, the following:

- Students receive more time for individualized learning.
- Direct interaction between students promotes active learning.
- Peer teachers reinforce their own learning by instructing others.
- Students feel more comfortable and open when interacting with a peer.
- Peers and students share a similar discourse, allowing for greater understanding.
- Peer teaching is a financially efficient alternative to hiring more staff members.
- Teachers receive more time to focus on the next lesson.
- Research also indicates that peer learning activities typically yield the following results for both tutor and tutee: team-building spirit and more supportive relationships; greater psychological well-being, social competence, communication skills and self-esteem; and higher achievement and greater productivity in terms of enhanced learning outcomes.

IV. INDIVIDUAL ACTIVITIES

The social aspect of activities is just as important as the creative, leisure and learning aspects. Mentors make great efforts to help people join small friendly groups to share experience and skills and support each other in maintaining the group in the long-term.

Some participants are housebound. In these circumstances, mentors encourage activities that people can pursue individually at home. Sometimes, arrangements may be made for an external artist or 'provider' to visit the person for a while. Wherever possible, the participant is introduced to others who might share their interests, by phone or letter or visiting. Some people prefer to pursue interests on their own.

Here are a few examples of individual activities prompted by mentors:

- A lady who had lived an active life but had become isolated in her home started recording her autobiography on tape, with the mentor's encouragement. She was hesitant at first but developed such confidence that she started using the tape to provoke memories from visiting friends and family, developing lively discussions.
- A lady who had withdrawn to her room in a residential home, and had very poor memory, started a 'Day Book' where visitors jotted down what they talked about so the next visitor could pick up the conversation. The lady became more confident in 'joining in' and visitors were encouraged and had more to talk about.
- A participant with severe hearing loss wanted to learn new crafts, including quilling (the craftsperson introduced by the mentor had first to learn quilling herself). The mentor linked the lady with the local church, and she now makes crafts for the church to sell for charity; this provides regular contact outside her home.
- A man aged 90 living in sheltered accommodation had never learned to cook and asked for lessons after his wife died. Within several sessions, he was preparing 3-course meals for his visiting son and was delighted with his new skills.
- A participant in Moretonhampstead with rapidly failing eyesight, who used to write poetry and do some painting, wanted to revive her skills despite her changed circumstances. She experimented with using textures (sand, etc.) instead of paint and collected old and new poems and pictures into a small book that she has distributed with great pride to many friends and family.
- A professional writer has worked with a former poacher and gamekeeper to help him produce a book of lively poaching stories and to give him tips on how to market his work through magazines and articles.
- A participant who had begun to feel very isolated as a result of being restricted to a wheelchair was visited several times by a mentor and introduced to the South West Lakes organization that he was able to help by trialing access along their routes around Roadford Reservoir. His self-confidence grew greatly.

V. EXPERIENTIAL METHOD

Introduction

Learning is the modification of the behavior through experience. The process has continuity and is carried through various years. The perfection in learning in an individual is achieved only through the active interaction between knowledge acquired by the individual in the years and the

variety of experience he has received. In learning mind reacts to external conditions and the reactions are modified with the help of experience the learner gains. The key element behind this view is that no two minds react identically in the same situation because each has a different history. The process of learning takes place at three different levels depending on the prior experience of the learner, his intellectual ability and the presentation of the materials. The learning process can be categorized into three levels viz. association, conceptualization and creative self-direction.

Association

All initial learning consists in the formation of associations. Here the thing which is to be conceived is taken as comprising of two parts are related to each other in such a way that one follows or precedes the other. Most of the knowledge and attitudes are learnt by association. This type of learning is comparatively easy to evaluate.

Conceptualization

Conceptualization is the process of grasping the commonalities or the relationships. It is the process of abstracting the commonality in association meaning that the relevant relationship is grasped. Most of the higher learning in the cognitive as well as affective domains takes place by conceptualization.

Creative Self-Direction

In creative self-direction is achieved as people progress from association and move on to conceptualization. This is a kind of learning that characterizes the creative artist. This part has got its strength from emotional or affective dimension of learning. When a student has reached to this level of learning, he can work independently on his own initiative.

Some of the important psychological theories of learning are Piaget's stages of intellectual growth, Ausubel's theory cognitive subsumption, Gagne's model of sequential learning and Bruner's concept learning. Learning can be categorized as a process occurring purely psychological in nature and is continuous over years.

Learning experience

Children learn by feeling, thinking, and acting. Learning results from the active participation of children in the stimulus situation which the teacher provides in the class. Learning experience is not a part of syllabus but it is the interaction of the learner and the situation provided by the teacher. Selecting appropriate learning experience suitable for educational goals must be purposeful, continuous, interactive and integrating. Learning experience should be based on facts, concepts,

principles, generalization, curricular and co-curricular activities for making learning experience more functional and effective in teaching learning process.

Types of learning experience

1. Direct experience
2. Indirect experience

Direct Experience

Firsthand experiences with various objects are termed as direct experience. These experiences are more than perceptual learning in the sense that they include experience with symbols. Perceptual learning arise out of experience dependent on seeing, learning, smelling, tasting, touching, feeling, handling and manipulating objects in various ways and we get meanings of terms like sweet, sour, soft-hard, pulling, pushing through perceptual learning.

Indirect Experience

The experiences which are not received as real are termed as indirect experience. It is very difficult to have direct experience in all classroom situations. Every student cannot get a direct experience in matters like earth quake, feelings of travelling by air or sea. Students can appreciate such experience through imagination only. Some of the experience like nuclear reactions and chain reactions will not be therefore the teacher also, even though teachers teach this topics well.

Characteristics of Good Learning experience

- The learning experience should be directly related to the instructional objectives
- It should satisfy the psychological needs of the learner
- It should be meaningful
- It should be appreciate for the maturity level of the learner
- It should be related to the life situations, so that they may be more effective, more meaningful and satisfying to the learner
- It should be reinforced
- It should be intensive. AV aids play an important role in this
- It should be varied, rich in content and novel
- It should be related to the availability of material and time

Sources of Learning Experience

Sources of learning experience can be grouped into some common heads. They are home, society, peer groups, school, mass media etc.

VI. TEACHER GUIDED LEARNING

Introduction

You have heard the chestnut: “Those who can, do. Those who can’t teach.” It’s catchy, but like so many popular notions about teaching and learning, it’s wrong. The best teachers are also doers, and they help their students become doers, too.

Most teachers bring a wealth of practical experience with them to the classroom, serving as role models of what can be achieved and mentoring students through the steps to success. Like a wise parent or a supportive boss, a versatile teacher who is both mentor and role model can inspire, coach, and motivate the next generation. Teachers with practical experience and willingness to explore are especially motivating to future entrepreneurs and innovators: people who take ideas and put them into action.

The Guided Learning Method of Teaching is good because students are provided with structured guidelines for assignments but allowed to discover details on their own. Students are given a set of guidelines to follow and then collect information and data on their own. Guided teaching can be limiting though because some students need to come up with their own topic. It is especially limiting for students who think outside the box and need to discover things on their own.

The importance of guided practice in the classroom:

"Most of all, a man tends to imitate himself. The fact that he has done a thing once, in a certain way, makes it easier for him to do it again in the same way. The oftener this is repeated, the more fixed does the habit become. At last he cannot do the thing in a different way without great effort. Finally it may become almost impossible for him to do it in a different way."

— Charles Carroll Everett from "Ethics for Young People" (1891)

From our life experiences, we all know the importance of practice in order to get better at something. Consider something you do well: a sport, an activity, a skill. How did you learn to do it? How did you get better at it, or master it?

There is an old saying we are all familiar with: Practice makes perfect. In the classroom, students must practice the skills we are teaching for it to become internalized. As Everett pointed out in 1891, students need to practice something for it to become habit.

It is important for us as educators, then, to not only provide opportunities for students to practice, but to practice correctly. As some have pointed out, perfect practice makes perfect.

This is not to say that we cannot allow students to make mistakes. Errors and mistakes are an integral part of the learning process. Through practice with feedback, students learn to correct errors or mistakes and master a skill or concept. Players of any given sport play practice games, tournaments or races, and the coach provides feedback to participants. So must teachers provide opportunities for students to practice a skill and provide targeted feedback to students so that they can progress.

Madeline Hunter spoke of the importance of guided practice in the 1980s. It has since been entrenched in lesson plans and discussions about teaching. We know that practice builds fluency; in order for students to learn to read or write, they must participate in the act of reading and writing. Reading and writing must be incorporated often in each of the content areas we are teaching so that students can learn about the topic and express their thinking. Similarly, by adding student discourse, we help students to solidify their thinking, gain ideas and thoughts from others and become more articulate.

What does guided practice look like in the classroom? Many teachers are familiar with the phrase "I do, we do, you do," or the gradual release of responsibility.

The idea here is that the learning and cognitive load should be shifted to students over time through teacher modeling, collaborative practice and individual application. The release can occur over a short time frame, such as within a class period, or over longer periods of time, depending on the complexity of the skill or concept.

At times, however, we see an instant release of responsibility, wherein students are immediately asked to apply a skill or concept independently, sometimes after little or no modeling. Consider the following scenario, all too common in classrooms today: The teacher asks the students to read specific pages in the textbook and take notes on what they are reading. The teacher might point out to students that it is important to pay attention to the headings, bolded words, graphics, italicized portions of the text, etc.

After they have read and taken notes, the students then are asked to answer questions based on the reading, referring back to their notes. The teacher instructs the students that they can either answer the questions independently or in small groups.

This scenario provides little to no practice for students before moving to independent practice. The teacher will not necessarily be able to determine areas of misunderstanding or needed additional instruction until students have turned in the work.

Even when teachers are cognizant of the gradual release and begin to implement it in their lessons, we often see a dominance of teacher-student interactions. For example, the teacher may model solving a math problem, using a whiteboard, interactive whiteboard, overhead or document camera.

From there, the teacher guides the students through a discussion, potentially calling on students to share what the next step is, or having individual students come to the front of the room to help work through the problem. The teacher then has the students independently practice by solving a series of problems that involve the skills and concepts being taught.

These interactions, however, miss a critical learning component: learning through collaboration with peers.

Consider, then, a slight change in the phrase "I do, we do, you do" to "I do, we do together, you do together, you do independently." The amount of time for each of these phases of the gradual release will vary, and teachers need to consider both long-term and short-term implementation.

Modeling, guided practice, collaborative practice and independent practice may be done within one class period, and may also last over a longer time span in order to help students master a more complex skill.

For example, math expert Terry Wardlow recommends the following sequence in a math lesson: the lesson starts off with four different examples done by the teacher of the same type problem with teacher talk. Here the teacher is modeling and sharing her thinking about how the problem is being solved.

From there, the "we do" is similar but includes students coming to the board to write the next step or steps. The teacher might have three or four kids to the board on one problem, or she may call on students to tell you what to do next and why.

This is done for two or three problems so multiple students have the opportunity to work through the problem with teacher guidance. The following step would be to have students work collaboratively, in pairs, triads or potentially groups of up to four students do three or four problems.

Lastly, students would be assigned a few problems to do on their own to practice and/or demonstrate mastery of the skills. All of the problems would need to be similar in terms of the skills being practiced.

Modeling (I do)

In this portion of the lesson, be explicit with students as to how to use a particular skill you are teaching or understand the concept being taught. Include think-alouds as a way to explicitly share

with students what goes on in the mind of a proficient reader, writer, mathematician or professional in the discipline you are teaching.

Provide scaffolds for students by clearly explaining tasks and lead students step-by-step through the processes they will be using. Additionally, consider including color-coding as a scaffold, by changing the color of the pen you are using during each step.

For example, if solving a multiple-step math problem, switch colors when you go to the next step so that each step is clearly marked for students and you can discuss clearly each step with them.

It is important to point out that students should still be actively engaged during the modeling process. Teachers can have students chorally call key vocabulary or next steps, discuss predictions or ideas with a partner, or write down a quick summary of what has been done so far before moving on.

Guided practice (we do together)

As you move toward practicing with students, consider how you will call on students. Begin with selecting some students intentionally. These may be students who have a clear understanding of the step you are practicing, or students that have a common misconception that needs to be addressed with the class.

Next move to calling on students randomly. This can be done using a cooperative structure like numbered heads, or through other methods such as using a computer program. Calling on random students holds all students to be accountable to work through the skill and demonstrate where they are in the process. Successes or errors can be addressed at this time.

Finally, call on volunteers. At times the students who always volunteer to share or practice will have something additional to add that has not come up with other students. This practice flips what we often see in classrooms, where teachers first call on volunteers. The problem there is that often the same group of students gets called on time and again, and leave other students disengaged or lacking an opportunity to practice with direct guidance from the teacher. Of course, the students who are helping you or sharing ideas should not be the only students engaged in the instruction.

Just as in the modeling section, other students can stay engaged by chorally calling out vocabulary or steps, helping the student through "phone-a-friend" or by assisting each other, writing down information, making predictions, discussing with partners, etc.

Collaborative peer practice (you do together)

During the interactive peer-collaboration guided-practice phase, students work together in small groups to practice the skill or concept. Teachers can incorporate cooperative learning structures at this point to maximize student participation and practice of the skills or concepts.

Having students seated in pairs, triads or small groups will be helpful during this time, and structures such as having a talking stick and explicit roles within a group can keep students on task and provide an opportunity for all students to be equally involved.

The teacher, during this time, walks around monitoring student practice and assisting students as needed to clarify any misconceptions. The teacher can remind students of key points, and assesses if particular students or if the entire class needs additional instruction.

During this peer collaboration time, teachers can also pull together a small group of student that may need additional modeling or instruction, thereby differentiating for students based on need.

Independent practice (you do independently)

The last stage requires students to practice and apply the task independently. In many ways this can be said to be the purpose of education: to have students be able to apply the skills and information they have learned on their own, without the help and support of a teacher or peer.

There are multiple ways that teachers have implemented and continue to implement independent practice and application in the classroom. Students do projects, keep portfolios, do homework and do in-class practice each day in classrooms around the world.

Providing Guided Practice & Models in Instruction

Teachers spend a lot of time with students throughout the day. Not all of it is used for direct instruction. This lesson shows how to use methods of guided practice and modeling when teaching and offers examples of how each is used.

Quality Instruction

When Dan decided to become a teacher, he didn't realize he'd spend so much time talking. Most of the day, he's either talking to his whole class, small groups, or individual students. The more seasoned teachers on his floor don't seem to spend nearly as much time instructing their students. In fact, when Dan walks by their rooms, he often sees students working on material.

It looks like Dan is making a rookie mistake. Veteran teachers know that quality instruction uses several components:

- Direct instruction time - used to teach students new concepts.
- Guided practice - the time students spend practicing new material with teacher support.
- Independent practice - such as homework, is time students spend practicing without teacher support.

In other words, this model is the 'I do, we do, you do' method of instruction. Dan uses most of his class time instructing, in the 'I do', and allows little time for his students to practice the new concepts he teaches. Let's see how he can change things to improve the flow of his day and increase student success.

Guiding Student Practice - We Do

We all know the benefits of practicing. The more we work on a new skill, like dribbling, the better we get at it. Especially important is the guidance we receive from an expert. When a coach is nearby, showing us how to move our hand in a different way, we get better at dribbling. The same is true for education and learning.

Dan is great at the 'I do' part of his job. He's a top-notch teacher who explains things well to the students. The next step he needs to incorporate is the 'we do', also known as guided practice. Just like a coach standing nearby to help with dribbling skills, the teacher monitors and scaffolds students during guided practice. Guided practice can take a few shapes:

Whole Class

Dan just taught his students how to multiply two digit numbers - now it's time for guided practice. This 'we do' part of the process requires him to support students while they take their first stab at a new concept. He can support all his students while they practice together by giving them some problems to work on and then choosing students to do them on the board. During this time, Dan will walk around the room to check on students as they work. He can also have them work a few problems with partners on whiteboards at seats, or play a game using the new concepts.

Small Group

Another way Dan can guide student practice is to form small guided learning groups. After direct instruction time, Dan can pull these students together to practice skills while other students are working independently. Using guided learning groups gives Dan a chance to zoom in on specific students with common struggles. Today, he may pull a group who didn't quite understand single digit multiplication and help them practice.

Individual

Dan can also scaffold and support guided learning by meeting with individual students and teaching one-on-one. If Dan notices a student who struggles during guided whole group practice, he can make sure to spend time with the student when they go off to practice independently. This way

Dan corrects the misunderstanding of the concept before the student is expected to apply skills without help.

VII. PROBLEM-SOLVING METHOD

It is a method in which a specific problem is given to the students and they are required to find out the solution through objective reasoning and thinking. This method is also highly suitable for teaching of science. In this method, the teacher is going to act as a guide and will be in the background and the students should take active participation in finding out the solution to the problem in hand.

The students should know what he is doing and why he is doing. The problem should be of educational importance and should have educational value and must be selected from the real life situation. Also the problem chosen should be worthwhile and should have practical value. The problem should be chosen in such a way that it can be fitted well in the present curriculum organization in the school to avoid various administrative difficulties.

Steps in problem-solving method

The following steps are involved in the problem solving method.

- A. Recognizing the problem
- B. Defining and interpreting the problem
- C. Collecting data related to the problem
- D. Organizing and evaluating the data of problem
- E. Arriving at final conclusion
- F. Verifying the result

A. Recognizing the problem

In this step, the teacher should organize a discussion of a problem or problems with the students and based on the discussion, the teacher should create a problem in such a way that the students should feel that it is their own problem and they should solve it. The teacher should organize the problem in such a manner that it should arouse student's interest to study and solve it.

B. Defining and interpreting the problem

The teacher should explain the problem given to the students in detail or may be interpreted by the students themselves through discussion. All the attributes constituting the problem must be made clear to the students and the problem must be defined in a systematic manner.

C. Collection of data related to the problem

In this method, the teacher should suggest the available resources like books, journals, periodicals, etc. with respect to the problem given to the students. Also he must encourage the students to collect data from different sources.

D. Organizing and evaluating the data of problem

The data collected must be well organized by the students and all the unwanted superfluous matter should be deleted. In this stage, the teacher can help the students in arranging and classifying the materials collected in a scientific way.

E. Arriving at final conclusion

After analyzing all the important points with respect to the problem, a tentative solution may be discussed among the students and finally they will arrive at a conclusion collectively.

F. Verification of the result

Finally the solution to the problem must be verified by applying this result in a new situation to detect the discrepancies if any, in the facts already discovered.

Merits

- The students will get training in the art of solving a problem in actual life situations
- Reflective thinking and the power of reasoning can be developed with this method
- Self-confidence among the students can be developed through this method.
- It helps the students in developing the power of critical judgement as they have to think a lot to arrive at correct solution to the problem through practice
- It inculcates the habit of open-mindedness and tolerance.

Demerits

- It is difficult for the teachers to organize the content of science according to the need of the students and therefore, he cannot always give real life problems.
- It is a time-consuming process
- Textbooks and other written materials are not available as per the guidelines of the problem-solving method.
- This method is useful only for the students studying higher classes and for those who have higher level of thinking.
- All the lesson or topics cannot be taught by his method.

VIII. SMALL GROUP/WHOLECLASS INTERACTIVE LEARNING

Small group teaching has become more popular as a means of encouraging student learning. While beneficial the tutor needs a different set of skills for those used in lecturing, and more pertinently, small group work is an often luxury many lecturers cannot afford. A further consideration with small group teaching is the subjective perspective of what constitutes a small group. A lecturer used to taking 400 in a lecture would define 50 as a small group, while a lecturer used to a group of 50 would define 5-10 as a small group. In a discussion, where participation is assessed some students may not speak up in a group that begins to be get bigger than 10 participants and in addition tutors would find it hard to assess participation by individual students in groups with numbers greater than this.

Regardless of the group size the learning environment should provide an opportunity for students to obtain a deep understanding of the material. Biggs (1989) notes that in order to gain a deeper learning the following four components are important:

- **Motivational Context:** Intrinsic motivation, students need to see both learning goals and learning process as relevant to them, to feel some ownership of course and subject.
- **Learner Activity:** Students need to be active not passive, deep learning is associated with doing rather than passively receiving.
- **Interaction with Others:** Discussion with peers requires students to explain their thinking, this, in turn, can improve their thinking.
- **Well Structured Knowledge Base:** The starting point for new learning should be existing knowledge and experience. Learning programmes should have a clearly displayed structure and should related to other knowledge and not presented in isolation.

General Techniques for Use in Small & Large Group Teaching

The following methods can be adapted for either large or small group teaching. Provided below are a selection of common flexible methods one may use in both large and small group teaching. These are open to adaption and interpretation to suit your individual needs, and were originally listed by Brown (1997).

1. Silent Reflection
2. Rounds
3. Three Minutes Each way
4. Buzz Groups
5. Brain storms

6. Syndicates
7. Snowballing/Pyramiding
8. Fishbowls
9. Crossovers

1. Silent reflection

This is where you give students a few minutes to think about a problem or issue. Ask them to write down their thoughts or ideas on a note pad. Keep the task specific. For example, ask them to write down the three most important, or positive, or expensive etc. aspects of a scientific issue. It is often useful to ask them to write on post-its and then post them on, say, a notice board or the wall. Alternatively, ask them to share their ideas with their neighbour before moving into a discussion phase. This technique suits quieter students and ensures that everyone has the opportunity to provide feedback.

2. Rounds

Where groups are not too large (20 or so) go around everyone in the group and ask them to respond. People often use rounds as icebreakers or as part of the winding-up of a session. Try not to make the round too daunting by giving students guidance on what is expected of them. Keep it short. For example try and avoid questions like. “I want everyone to give their name and then identify one aspect of the course that they know nothing about but are looking forward to learning about”. In big rounds, students can be quite nervous, so make it clear that it’s OK to pass and if people at the beginning have made your point, that concurrence is sufficient.

3. Three minutes each way

Ask students in pairs to speak for three minutes on a given topic. Be strict with timekeeping. Your students might find this quite difficult at first, but it is an excellent way of getting students to articulate their ideas, and also means that the quieter students are given opportunities to speak and be heard. The art of listening without interrupting (other than with brief prompts to get the speaker back on target if they wander off the topic) is one that many students will need to foster. This pair-work can feed into other activities.

4. Buzz Groups

Give pairs, threes, fours or fives small timed tasks which involve them talking to each other, creating a hubbub of noise as they work. Their outcomes can then be shared with the whole group through feedback, on a flip chart sheet poster, on an overhead projector transparency or otherwise as appropriate.

5. Brain Storms

This can be valuable way of stimulating creative freethinking and is particularly useful when looking for a solution to a problem or in generating diverse ideas. Start with a question like “How can we..? or “What do we know about...?” and encourage the group to call out ideas as fast as you can write them up (perhaps use two scribes on separate boards if the brainstorm flows well). Make it clear that this is supposed to be an exploratory process, establish some ground-rules in advance for example:

A large quantity of ideas is desirable, so everyone should be encouraged to contribute at whatever level they feel comfortable.

6. Syndicates

This is the term used to describe activities undertaken by groups of students working to a brief under their own direction. They can be asked to undertake internet or literature searches, debate an issue, explore a piece of text, prepare an argument, design an artifact or many other tasks. To achieve productively, they will need an expect brief, appropriate resources and clear outcomes.

Specialist accommodation is not always necessary; syndicates can work in groups spread out in a large room, or, where facilities permit, go away and use other classrooms etc. if the task is substantial, the tutor may wish to move from group to group, or may be available on a ‘help desk’ at a central location. Outcomes may be in the form of assessed work from the group or produced at a plenary as described above.

7. Snow balling/Pyramiding

Start by giving students an individual task of a fairly simple nature such as listing features, nothing questions, identifying problems, summarizing the main points of their last lecture.

Then ask them to work in pairs on a slightly more complex task, such as prioritizing issues or suggesting strategies. Thirdly, ask them to come together in larger groups, fours or sixes for example and undertake a task involving, perhaps, synthesis, assimilation or evaluation.

Ask them to draw up guidelines, perhaps, or produce an action plan or to assess the impact of a particular course of action. They can then feed back to the whole group if required. You may also wish to try ‘reverse pyramiding’!

8. Fishbowls

Ask for a small group of up to half a dozen or so volunteers to sit in the middle of a larger circle comprising the rest of the group. Give them a task to undertake that involves discussion, with the group around the outside acting as observers. Make the task you give the inner circle sufficiently

simple in the first instance to give them the confidence to get started. This can be enhanced once students have had practice and become more confident.

This method can be useful for managing students who are dominating a group, because it gives them permission to be the centre of attention for a period of time.

After a suitable interval, you can ask others from the outer circle to replace them, thus giving the less vocal ones the opportunity for undisturbed “air-time”. Fishbowls can also be useful ways of getting representatives from buzz groups to feedback to the whole groups to feedback to the whole group.

Some students will find it difficult to be the focus of all eyes and ears, so it may be necessary to avoid coercing anyone to take centre stage (although gentle prompting can be valuable).

9. Crossovers

Often we want to mix students up in a systematic way so they work in small groups of different compositions. You can use crossovers with large groups of students, but the following example shows how this method would work with twenty seven students.

- Prepare as many pieces of paper as you have students, marking on them A1, A2, A3, B1, B2, B3 and so on (this combination is for creating triads – groups of three).

When you are ready to have the students go into smaller groups, get them to group themselves with students who have the same letter as themselves: AAA, BBB, CCC and so on for one group exercise. For a second exercise, ask the students to work with people who have the same number as themselves; 111, 222, 333. A third exercise will have students in triads where none of the students can have a matching letter or number: e.g. A1, D2 F3.

- This will allow you to get students to crossover within groups, so they work with different people on each task in a structured way.
- This technique also cuts down on the need to get a lot of feedback from the groups because each individual will create rapport on the outcomes of their previous task in the last configuration. As with snowballing or pyramids, you can make the task at each stage slightly more difficult and ask for a product from the final configuration if desired. Crossovers are useful in making sure everyone in the group is active and also help to mix students outside their normal friendship, ethnic or gender groups.

It takes a little forethought to get the numbers right for the cohort you are working with (for example, you can use initial configurations of four rather than three, so that in stage two they will work as fours rather than triads).

If you have one person left over, you can just pair them with one other person and ask them to shadow that person wherever they go.

IX. STUDENT SEMINAR

This is the best technique for some situations. This is mostly used alone. When the topics are easy the teacher can ask the students to prepare an essay on the topic and present it to the class. The topics may be assigned for all the students. The papers may be read in the class one after the other. After the presentation the students can ask questions and raise doubts. The paper reader will answer these questions. The teacher will be the chairman or leader. The size of the class will be small containing a maximum of 20 to 25 students. The class teacher acts as a resource person too.

In a typical seminar the strength may range from 6 to 25 and it usually has an appointed chairman and one or more resource persons. It is a common of discussion group and is ideally suited for the study and analysis of difficult problems over a period of time. The group increases in its effectiveness when members become acquainted with each other, and not to feel threatened by each other and are willing to express ideas frankly.

A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It has the function of bringing together small groups for recurring meetings, focusing each time on some particular subject, in which everyone present is requested to actively participate. This is often accomplished through an ongoing Socratic dialogue with a seminar leader or instructor, or through a more formal presentation of research. It is essentially a place where assigned readings are discussed, questions can be raised and debates can be conducted. Student seminars are the open presentations done by the students before their peers and teachers. The word seminar is derived from the Latin word *seminarium*, meaning “seed plot”

Some Tips for Seminar Preparation

- Choose a Good topic: Choose a topic which will sustain your interest and will allow you to exhibit enthusiasm during your presentation
- Keep your Audience in Mind: The primary objective in giving a talk should be a communicate an interesting idea to students who attend the seminar. This means that the talk should be delivered in a way that students in attendance understand what you are saying, so be mindful of their background.

- Tell a story/ anecdote: Begin with solid motivation for your problem and plenty of illuminating examples. Only after your audience understands what your topic is and why they should care about it should you spend time working carefully through the relevant science.
- Keep timing in mind: Choose a topic that you can motivate and explicate comfortably in this window of time.

Scoring Indicators for Evaluation of Seminar

1. Ability to Collect Data: Sufficient, Relevant, Accuracy of facts
2. Ability to Prepare Seminar Paper: Introduction, Content Organization, Conclusion
3. Presentation: Communication, Competence, Fluency, Spontaneity
4. Understanding the Subject: Involvement in the Discussion, Responding suitably, Capacity to handle differences of opinion

Advantages

1. Students develop the habit of reading more books.
2. They develop the ability to collect relevant information from different sources.
3. They are able to remove shyness and contribute something in the class.
4. They develop a high degree of participation.
5. They are able to face the students and answer the questions boldly.

Disadvantages

1. It requires more time, more space and more personnel.
2. Sometimes only a few students will participate in seminar.
3. Unless the chairman is skilful, the seminar easily degenerates into a question and answer session or a lecture.

X. GROUP DISCUSSION

Managing Group Learning in Classroom

Classroom management is the most vital skill that the teacher should demonstrate. The factors of classroom management depend on the teacher's knowledge of structuring his presentation, knowledge about the psychology of the learner rapport between the students, rule making capacity etc. the efficiency for managing the group learning techniques depends on teacher's efficiency in handling human resources. The teacher should not be a dictator for the execution of the task but he should be dictator of ideas. He should plan the activities in such a way that effective utilization and involvement pupil participation should be maintained. To be an effective classroom manager teacher must learn to exercise, the least amount of power necessary to accomplish the desired result.

Tips for managing group learning

Teachers can use some techniques for producing better efficiency in group learning techniques.

1. Change group composition frequently so that students of different backgrounds, academic achievement levels, and social skills learn to work together. This capacity is build to familiarity, insights, and trust.
2. Organize the work so that each team member contributes to the achievement of the team goals.
3. Use teacher observations, tests, checklists, and individual assignments to measure each student's achievement.
4. Promote group responsibility by holding groups accountable for completing specific tasks or project steps during work sessions.
5. Tech, model, and assess the social skills you expect teams to demonstrate: Listening, taking turns, encouraging, and supporting each other, staying on task, cleaning up the work area, etc.
6. Pick the right sized task. Bit must be challenging enough to keep students interested, but easy enough for students to achieve success (with effort) in the time allotted.
7. Include a very specific assignment or menu of options for teams to work on. "every meeting results in a product "-a list to create, a diagram to draw , an outline to display, a form to fill out.
8. Anticipate that not every group will finish at the same time. Have a classroom poster or handout with a list of "what to do if you finish early" items on it.
9. Teach teams how to assess how well they work together. Encourage "team reflection" as part of every activity.

Small Group discussions

Active learning can be implemented by organizing the class into small groups of students who can work together, foster their own learning strategy and create an atmosphere in which information sharing can takes place. Instructional techniques involving group controlled learning experiences provide room for the learner's self-development and active participation in the teaching learning process. A discussion is a teaching technique that involves exchange of ideas with active learning and participation by all concerned. Discussion is an active process of teacher-pupil involvement in the classroom environment. This allows a student present its own perspective about something freely. Four basic concepts are to be considered for initiating small group discussion.

- Process – the interactions that takes place within the group

- Roles – each group member’s specific responsibilities within the group
- Leadership – the capacity to guide and direct others in a group setting
- Cohesion- group members support for one another
- Different Types of Small Group Discussions
- Brain Storming
- Tutorials
- Buzz session
- Task-directed discussion
- Role playing
- Simulation
- Inquiry centered discussion

XI. MIXED ABILITY GROUPING

“Mixed ability grouping”, refers to grouping together students of different abilities. Usually this kind of grouping occurs when the group consists of students with different ages with one or two years span. The term “mixed age grouping” or “heterogeneous grouping”. But there is distinction between mixed age groupings and mixed ability grouping, the second one is done only based on the ability, since the basic criterion for grouping is ability and not necessarily age. In mixed ability groups there are some students that are more mature and experienced than other ones and thus they have more advanced ability to acquire knowledge. The main aim of setting up mixed ability groups is not to produce homogeneity of ability in a group as this is the case in ability grouping, but to increase interaction across students with different abilities. In other words the purpose of mixed ability grouping is for children to benefit by their intellectual and social interaction with other students of their group that have different social behaviour and ability to learn. The former reveals the main difference of mixed ability grouping with ability grouping. While grouping children with same ability the goal is to achieve homogeneity of the group and homogenize instruction for students of the group on basis different of grades are ages but based on ability. Age may not be an exclusive criterion for indicating different levels of ability of children but it is the first factor that you take into account when you set up mixed ability groups. Putting together students with one or two grades difference you can make a mixed ability group. It is believed that this interaction and cooperation of children with different intellectual level and social behavior, experience and skills can have worth mentioning educational benefits. Research is much more favorable for mixed ability grouping than ability

grouping and stress on certain important skills that acquired or improved in mixed ability groups. In mixed ability group of students of different grades indicates the following:

The older, more intellectually and socially matured children benefit:

- By helping their group mates since they are becoming their mentors, they are developing healthy leadership skills and enhancing their self - esteem.
- By improving cognitive skills since they have the chance to consolidate knowledge by sharing it or instructing their younger group mates.
- The younger, less intellectually and socially matured children benefit:
- By being exposed on cooperation activities with more matured students in a spirit of collaboration and team working
- By being stimulated by students with stronger personalities, better abilities with wider range of interests
- By belonging to a team where they feel security, trust and well guided by their group mates.

However as always there are not only beneficial outcomes by mixed ability grouping. Just putting some students together with different abilities doesn't mean that one can guarantee satisfactory results on social and cognitive level for the students. The success of the attempt depends on taking into account several parameters like the appropriate age difference to have the appropriate range of abilities, the allocation of time to activities, the modification of the curriculum and good detailed planning by the teacher. There not enough data available indicating in detail the educational principles and the implementation strategies that mixed ability grouping should be governed by. However it is strongly believed that good planning and monitoring by experienced teachers could reveal the benefits of the technique easily. Mixed ability grouping is believed to be a valuable tool for the multi grade teacher and safeguard good levels of quality in multi grade education. Moreover if the techniques like “peer – tutoring” or the “activity centers approach” along with utilization of ICT in multi grade classrooms are combined together with grouping techniques the results can be even more remarkable.

RECENT TRENDS

Constructivist learning: Constructivism is a learning theory found in psychology which explains how people might acquire knowledge and learn. It therefore has direct application to education. The theory suggests that humans construct knowledge and meaning from their

experiences. Constructivism is not a specific pedagogy. Piaget's theory of Constructivist learning has had wide ranging impact on learning theories and teaching methods in education and is an underlying theme of many education reform movements. Research support for constructivist teaching techniques has been mixed, with some research supporting these techniques and other research contradicting those results.

Problem-based learning: Problem-based learning is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem found in trigger material. Problem based learning is similar to project based learning, in that it is a student focused approach to learning based on solving open-ended problems, but tends to be more knowledge focused and to operate in loops of inquiry, analysis and articulation. Small group learning is an educational approach. Small group learning allows students to develop problem solving, interpersonal, presentational and communication skills, all beneficial to life outside the classroom. Whole group instruction is direct instruction using traditional textbooks or supplemental materials with minimal differentiation in either content or assessment. It is sometimes referred to as whole class instruction. It is typically provided through teacher-led direct instruction.

Brain-based learning: Brain-based learning is refers to teaching methods, lesson designs, and school programs that are based on the latest scientific research about how the brain learns, including such factors as cognitive development how students learn differently as they age, grow, and mature socially, emotionally, and cognitively.

Collaborative learning: Collaborative learning is an educational approach to teaching and learning that involves groups of students working together to solve a problem, complete a task, or create a product. During this intellectual gymnastics, the learner creates a framework and meaning to the discourse. Thus, collaborative learning is commonly illustrated when groups of students work together to search for understanding, meaning, or solutions or to create an artifact or product of their learning.

The flipped classroom: The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. Flipped learning is a learner-centered curriculum that changes the traditional roles of teacher and student. In these instructional approaches, faculty creates active learning opportunities for students to

engage with the content on a deeper level. Flipped Learning is an approach that allows teachers to implement a methodology, or various methodologies, in their classrooms. These Flipped Learning leaders also distinguish between a Flipped Classroom and Flipped Learning. These terms are not interchangeable. Flipping a class can, but does not necessarily, lead to Flipped Learning. Many teachers may already flip their classes by having students read text outside of class, watch supplemental videos, or solve additional problems, but to engage in Flipped Learning, teachers must incorporate the following four pillars into their practice.

Blended learning: Blended learning is a formal education program that involves combining Internet and digital media with traditional classroom methods that require the physical presence of both a teacher and students, with some element of student control over time, place, path, or pace. Blended learning is a term increasingly used to describe the way e-learning is being combined with traditional classroom methods and independent study to create a new, hybrid teaching methodology. It represents a much greater change in basic technique than simply adding computers to classrooms; it represents, in many cases, a fundamental change in the way teachers and students approach the learning experience. Blended learning is a combination of offline (face-to-face, traditional learning) and online learning in a way that the one compliments the other. It provides individuals with the opportunity to enjoy the best of both worlds. For example, a student might attend classes in a real-world classroom setting, and then supplement the lesson plan by completing online multimedia coursework. As such, the student would only have to physically attend class once a week and would be free to go at their own pace

E-learning: E-learning is electronic learning, and typically this means using a computer to deliver part, or all of a course whether it's in a school, part of your mandatory business training or a full distance learning course. In the early days it received a bad press, as many people thought bringing computers into the classroom would remove that human element that some learners need, but as time has progressed technology has developed, and now we embrace smart phones and tablets in the classroom and office, as well as using a wealth of interactive designs that makes distance learning not only engaging for the users, but valuable as a lesson delivery medium. Building partnerships with quality training providers, and combining this with a dedicated experienced technical team and support staff, Virtual College provides the perfect blended learning environment, offering anyone the chance to take their online training to the next level. Some of the most important developments in education have happened since the launch of the internet. These days' learners are

well versed in the use of smart phones, text messaging and using the internet so participating in and running an online course has become a simple affair. Message boards, social media and various other means of online communication allow learners to keep in touch and discuss course related matters, whilst providing for a sense of community.

Videoconferencing

Video conferencing is the conduct of a videoconference (also known as a video conference or video teleconference) by a set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions. A video conference is a live, visual connection between two or more people residing in separate locations for the purpose of communication. At its simplest, video conferencing provides transmission of static images and text between two locations. At its most sophisticated, it provides transmission of full-motion video images and high-quality audio between multiple locations.

Questions for Discussion and Reflection

1. What is 'lecture method' of teaching? When the lecture method can be effectively used?
2. Explain the features of 'demonstration' method of teaching and its merits and demerits.
3. What is team-teaching? How could it be organized in schools?
4. Explain the concept of flipped classroom?
5. What are the different ways of organizing the laboratory method of teaching? State their relative merits and demerits.
6. Define 'Project Method' of teaching. Explain briefly the various steps involved in it. Mention its merits and demerits.
7. What are the different ways of organizing the problem-solving method of teaching?
8. How a seminar is conducted? Mention its advantages and limitations.
9. Define 'Group Discussion' of teaching. Explain briefly the various steps involved in it
10. What are the different ways of the problem-based learning?

Unit V: Resources for Teaching Biological Science

Objectives:

- To obtain knowledge on the Print resources in teaching of biological science.
- To understand the audio resources in teaching of biological science.
- To analyse the visual resources in teaching of biological science.
- To explore the ICT resources in teaching of biological science

PRINT RESOURCES:

Newspaper: A newspaper is a serial publication containing news, other informative articles (listed below), and advertising. A newspaper is usually but not exclusively printed on relatively inexpensive, low-grade paper such as newsprint. Newspapers are typically published daily or weekly.

Magazines: Magazines are publications; usually periodical publications that are printed or electronically published they are generally published on a regular schedule and contain a variety of content. In the case of written publication, it is a collection of written articles. A "magazine" is a periodical with a popular focus, i.e. aimed at the general public, and containing news, personal narratives, and opinion. Articles are often written by professional writers with or without expertise in the subject; they contain "secondary" discussion of events, usually with little documentation.

Journal: A "journal" is a scholarly periodical aimed at specialists and researchers. Articles are generally written by experts in the subject, using more technical language. They contain original research, conclusions based on data, footnotes or endnotes, and often an abstract or bibliography. The Journal of Physical Chemistry, The Chaucer Review, The Milbank Quarterly, and Labor History are examples of journals.

Science Encyclopedias: Science Encyclopedias is, any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation. In general, a science involves a pursuit of knowledge covering general truths or the operations of fundamental laws. An encyclopedia or encyclopaedia is a type of reference or compendium holding a comprehensive summary of information from either all branches of knowledge or a particular branch of knowledge. Encyclopedias are divided into articles or entries, which are usually accessed alphabetically by article name. Encyclopedia entries are longer and more detailed than those in most dictionaries. Generally speaking, unlike dictionary entries, which focus

on linguistic information about words, encyclopedia articles focus on factual information concerning the subject for which the article is named.

AUDIO RESOURCES: An audio tape recorder, tape deck or tape machine is an analog audio storage device that records and plays back sounds, including articulated voices, usually using magnetic tape, either wound on a reel or in a cassette, for storage. In its present-day form, it records a fluctuating signal by moving the tape across a tape head that polarizes the magnetic in the tape in proportion to the audio signal. Tape-recording devices include reel-to-reel tape deck and the cassette deck. Talk radio is a radio format containing discussion about topical issues. Most shows are regularly hosted by a single individual, and often feature interviews with a number of different guests. A talk show or chat show is a television programming or radio programming genre in which one person discusses various topics put forth by a talk show host.

DVDs/CDs: A compact disc (**CD**) is a small, portable, round medium made of molded polymer (close in size to the floppy disk) for electronically recording, storing, and playing back audio, video, text, and other information in digital form. Tape cartridges and CDs generally replaced the phonograph record for playing back music. At home, CDs have tended to replace the tape cartridge although the latter is still widely used in cars and portable playback devices.

DVD is an optical disc technology with a 4.7 gigabyte storage capacity on a single-sided, one-layered disk, which is enough for a 133-minute movie. DVDs can be single- or double-sided, and can have two layers on each side; a double-sided, two-layered DVD will hold up to 17 gigabytes of video, audio, or other information. This compares to 650 megabytes (.65 gigabyte) of storage for a CD-ROM disk.

VISUAL RESOURCES

Pictures: Pictures are kinds of visual instruction materials might be used more effectively to develop and sustain motivation in producing positive attitudes towards English and to teach or reinforce language skills. Pictures attract children and motivate them like to learn English so pictures are unlikable things to teach and learn English. Picture is visual presentation of human, places, or things. The use pictures are more effective than the use words because they are easier to remember and retell. Children can see pictures, recall and retell or describe a human, a place, a thing or a specific situation that is shown in picture. It is much clearer than remembering boring words.

Flashcard: A flashcard or flash card is a set of cards bearing information, as words or numbers, on either or both sides, used in classroom drills or in private study. One writes a question on a card and an answer overleaf. Flashcards can bear vocabulary, historical dates, formulas or any subject matter that can be learned via a question-and-answer format. Flashcards are widely used as a learning drill to aid memorization by way of spaced repetition. Flashcards exercise the mental process of active recall: given a prompt, one produces the answer. Beyond the content of cards, which are collected index, there is the question of *use* – how does one use the cards, in particular, how frequently does one and how does one react to errors, either complete failures to recall or mistakes? Various systems have been developed, with the main principle being spaced repetition increasing the review interval whenever a card is recalled correctly.

Charts : A chart, also called a graph, is a graphical representation of data, in which "the data is represented by symbols, such as bars in a bar chart, lines in a line chart, or slices in a pie chart". A chart can represent tabular numeric data, functions or some kinds of qualitative structure and provides different info. The term "chart" as a graphical representation of data has multiple meanings. Charts are often used to ease understanding of large quantities of data and the relationships between parts of the data. Charts can usually be read more quickly than the raw data. They are used in a wide variety of fields, and can be created by hand or by computer using a charting application. Certain types of charts are more useful for presenting a given data set than others. For example, data that presents percentages in different groups are often displayed in a pie chart, but may be more easily understood when presented in a horizontal bar chart. On the other hand, data that represents numbers that change over a period of time might be best shown as a line chart.

Posters: There are many teaching aids available to help improve your student's learning. Educational posters are an excellent teaching aid that can help children with spelling & comprehension, mathematics, language, geography, science, history and many more subjects. Educational posters are an excellent source for students to read and learn from when focusing on a specific subject. It is proven that visual learning is one of the most popular methods of learning that people find most effective. At Teach Starter, we have used this knowledge and developed a number of educational posters that help children learn through the use of visual aids. Educational posters are eye catching and visually appealing. The use of bright colours and bold text is helpful for getting the attention of children and adults. There are many benefits of having educational posters in your

classroom or at home. Posters can be interactive as laminating certain posters means that students can write on them and then reuse them in the future.

Photograph: A Photograph is worth a thousand words through which a complex idea can be conveyed with just a single still image. Pictures make it possible to absorb large amounts of data quickly. Using photographs for explaining complex phenomena is one of the teaching aids of modern education system all over the world. As the world is changing day by day so are the methods of instructions as the modern curriculum requires conceptual elaborations. Visual aids have the tendency to materialize the thoughts of students in the form of graphics to give thoughts a concrete frame of reference. Use of photographs is important for students because they are more likely to believe findings when the findings are paired with colored images describing complex situations during learning as opposed to other representational data such as complex book text.

Models: Many researchers have tried to put together classroom- or school-based models that describe the teaching-learning process. A model is a visual aid or picture which highlights the main ideas and variables in a process or a system.

ICT RESOURCES:

Radio: Radio is a powerful mass medium used in education for disseminating information, imparting instruction and giving entertainment. It serves with equal ease in both developed and developing countries. It spreads information to a greater group of population thereby saving time, energy, money and man-power in an effective way. Radio is a simple and cheap medium readily available as a small toy. Now small and handy transistors are available with even poorest of people. A small transistor can carry the message to any place on - the earth. It needs very little for maintenance and cheaper production can be taken up with more and more resources. Radio speaks to an individual so also to millions at a time. Hence, any listener can think the broadcast is meant for him whereas when listened in group all think the message directed towards them. Each student takes the broadcast as very intimate to him. Due to its portability and easy accessibility radio could find its place everywhere whether it was a field, a school, a kitchen or a study room. Radio is a blind man's medium and is meant for ears only. It plays with sound and silence where the sound can be anything like voice or word, music and effect. When one hears radio, simultaneously one can imagine happenings in his/her mind. So it is called as theatre of blind or a stage for the mind. Radio can be listened to simultaneously along with another work like reading also.

Television: Television or Learning show is the use of television programs in the field of distance education. It may be in the form of individual television programs or dedicated specialty channels that is often associated with cable television in the United States as Public, educational, and government access (PEG) channel providers. There are also adult education programs for an older audience; many of these are instructional television or "tele course" services that can be taken for college credit. Many children's television series are educational, ranging from dedicated learning programs to those that indirectly teach the viewers. Some series are written to have a specific moral behind every episode, often explained at the end by the character that learned the lesson. In the social aspects of television, several studies have found that educational television has many advantages.

Internet: Teachers whose lesson plans were discussed here engage students in meaningful learning activities that are of high relevance to students. The Internet is serving as a solution to engage students and teachers as equal partners in an educational journey in these electronic settings. Computers and the Internet are a great resource for classroom teachers! Teachers can find suggestions, lesson plans, practical support, information, and materials through the Internet. In fact, using a computer can make a teacher's life easier and more efficient. The LEADERS website provides an extensive list of Internet links designed to help teachers of reading and writing. This list of links covers most of the types of websites discussed below. Here are some of the many ways in which teachers can make computer and Internet technology work for them.

Multimedia: Multimedia is content that uses a combination of different content forms such as text, audio, images, animations, video and interactive content. Multimedia contrasts with media that use only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material. Multimedia can be recorded and played, displayed, interacted with or accessed by information content processing devices, such as computerized and electronic devices, but can also be part of a live performance. Multimedia devices are electronic media devices used to store and experience multimedia content. Multimedia is distinguished from mixed media in fine art; by including audio, for example, it has a broader scope. The term "rich media" is synonymous for multimedia. Hypermedia scales up the amount of media content in multimedia application.

Interactive whiteboard : An interactive whiteboard is a large interactive display in the form factor of a whiteboard. It can either be a standalone touch screen computer used independently to perform tasks and operations, or a connectable apparatus used as a touchpad to control computers

from a projector. They are used in a variety of settings, including classrooms at all levels of education, in corporate board rooms and work groups, in training rooms for professional sports coaching, in broadcasting studios, and others. The first interactive whiteboards were designed and manufactured for use in the office. This board was used in small group meetings and round-tables.

COMMUNITY RESOURCES

Zoological gardens: A zoo (short for zoological garden or zoological park, and also called an animal park or menagerie) is a facility in which animals are confined within enclosures, displayed to the public, and in which they may also breed. The term "zoological garden" refers to zoology, the study of animals, and a term deriving from the Greek word. . The abbreviation 'zoo' was first used of the *London Zoological Gardens*, which was opened for scientific study in 1828 and to the public in 1857.

Botanical garden: A botanical garden or botanic garden is a garden dedicated to the collection, cultivation and display of a wide range of plants labeled with their botanical names. It may contain specialist plant collections such as cacti and other plants, herb, plants from particular parts of the world, and so on; there may be greenhouses, shade houses, again with special collections such as tropical plants, alpine plants, or other exotic plants. Visitor services at a botanical garden might include tours, educational displays, art exhibitions, book rooms, open-air theatrical and musical performances, and other entertainment. Botanical gardens are often run by universities or other scientific research organizations, and often have associated herbaria and research programmes in plant taxonomy or some other aspect of botanical science. In principle, their role is to maintain documented collections of living plants for the purposes of scientific research, conservation, display, and education, although this will depend on the resources available and the special interests pursued at each particular garden.

Eco-Park: Eco-park is an eco-industrial park or estate is a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues. By working together, the community of businesses seeks a collective benefit that is greater than the sum of individual benefits each company would realize by only optimizing its individual performance. The goal of an EIP is to improve the economic performance of the participating companies while minimizing their environmental impacts. Components of this approach

include green design of park infrastructure and plants cleaner production, pollution prevention; energy efficiency; and inter-company partnering.

Aquarium: An aquarium (plural: aquariums or aquaria) is a vivarium of any size having at least one transparent side in which water-dwelling plants or animals are kept and displayed. Fish keepers use aquaria to keep fish, invertebrates, amphibians, aquatic reptiles such as turtles, and aquatic plants. The term, coined by English naturalist Philip Henry Gosse, combines the Latin root aqua, meaning water, with the suffix -arium, meaning "a place for relating to". An aquarist owns fish or maintains an aquarium, typically constructed of glass or high-strength acrylic. Cuboid aquaria are also known as fish tanks or simply tanks, while bowl-shaped aquaria are also known as fish bowls. Size can range from a small glass bowl to immense public aquaria. Specialized equipment maintains appropriate water quality and other characteristics suitable for the aquarium's residents.

Science exhibition/fair: A science fair experiment is generally a competition where contestants present their science project, results in the form of a report, display board, and/or models that they have created. Science fairs allow students in elementary, middle and high schools to compete in science and/or technology activities. A science fair experiment is generally a competition where contestants present their science project, results in the form of a report, display board, and/or models that they have created. Science fairs allow students in elementary, middle and high schools to compete in science and or technology activities. The main motive of a science fair is for students to answer a question or task, not from a textbook but found out themselves by conducting a range of experiments and ongoing research in the short amount of time allocated to them. In order that the questions or tasks spark a true interest in the student they should be able to have an interesting, eye catching project. Science fairs also provide a mechanism for students with intense interest in the sciences to be paired with mentors from nearby colleges and universities, so that they can access to instruction and equipment that the local schools cannot provide.

Fieldtrip: A field trip or excursion is a journey by a group of people to a place away from their normal environment. The purpose of the trip is usually observation for education, non-experimental research or to provide students with experiences outside their everyday activities, such as going camping with teachers and their classmates. The aim of this research is to observe the subject in its natural state and possibly collect samples. Field trips are also used to produce civilized young men and women who appreciate culture and the arts. It is seen that more-advantaged children may have already experienced cultural institutions outside of school, and field trips provide a

common ground with more-advantaged and less-advantaged children to have some of the same cultural experiences in the arts.

Qualities of a good biology textbook: Text books are the most widely used of all instructional materials. Now a day's text book has become a course of study. A set of unit plans and a learning guide as well. A text book should really design for the pupils rather than the teacher. Text book should stimulate reflective thinking and cultivate in students the scientific attitude. In the teaching-learning process, the text-book occupies an important place. There is a saying "As is the text-book, so is the teaching and learning". A good text-book can even replace class-room teaching. The science text-book should aim at aiding the pupils in the development of their personalities, in developing open mindedness, developing appreciation and understanding of nature and not merely stuffing their minds with facts.

The opportunity of this analysis has been offered to students, future teachers of biology, around the time when they will directly use the textbooks for preparing and teaching the lessons. The main objective of this coordinated exercise of exploring the quality of the alternative biology textbooks is the development of the students' abilities to critically analyze the textbooks which they will use in the near future and for which they will have to express alternative options. The interests of the authors are also focused on the role of the textbooks in the learning process, on the analysis of their contribution to the students' progress in the scientific knowledge but also to their personal development. The textbook, as a source of the basic knowledge of biology as a school subject, but also as a collector of methodological ideas, is a „territory" that is insufficiently explored by students in the initial teaching preparation.

Qualities of a Biology teacher: Biology teachers need characteristics that are common to all good teachers, but, in addition, they need additional qualities specific to their chosen subject area. General Characteristics. Good teachers are dynamic, patient, understanding and caring. Knowledge, Personality and Physical Attributes.

Teaching Style/Approach:

An excellent Biology teacher:

1. Enthusiastic about teaching students the subject matter
2. Treats students with respect and designs curricula to meet the needs of all students, regardless of level of instruction

3. Relates subject matter to students' lives, explaining how they are an integral part of the entire ecosystem
4. Sets an example of integrity inside and outside the classroom and teaches students responsibility and high standards
5. Plans lessons well in advance, gives adequate time for each topic, and integrates subjects
6. Teaches well organized concepts in a conceptually concise fashion
7. Stresses concept learning rather than rote memory
8. Continually reassesses approaches, lectures and tests to insure a fresh, relevant curriculum
9. Exhibits inquiring behavior typical of scientists.

Subject Expertise/Teaching Techniques

An excellent teacher:

1. Teaches students how to learn, analyze and think critically, emphasizing good scientific methodology and problem solving skills
2. Prepares lessons that will enhance problem solving ability
3. Develops hands-on activities to illustrate concepts and uses a variety of approaches to assist the learning processes lectures, discussions, laboratories, demonstrations, field trips, guest speakers, student presentations, films and slide shows
4. keeps up-to-date in the subject matter
5. Maintains competence in the life science fields
6. Teaches useful lab techniques and lab safety
7. Stresses the fragility of life on the planet and the importance of maintaining well managed ecosystems.

Teaching Environment

An excellent teacher:

1. Creates an exciting classroom atmosphere with as many living things as possible to enhance learning (e.g. well maintained plants and animals, which may include fish tanks, gerbils/mice, and reptiles/amphibians)
2. Acquires up-to-date equipment for laboratory work
3. Joins committees to improve the school, department, himself/herself
4. Generates new and exciting ideas for students to think about
5. Encourages students to ask questions about the lesson

6. Maintains a safe and clean classroom laboratory
7. Knows how to administer first aid in case of accidents.

Community Involvement

An excellent teacher:

1. Will use the community resources by inviting guest speakers from nearby institutions
And conduct field trips to laboratories, nature reserves, museums, local water plants, etc.
2. Develops and promotes advanced and/or continuing education courses in the school district, if possible
3. Attends other activities in which students are involved such as musicals, sports, art exhibits, etc.
4. Takes an interest in and gets involved in community activities
5. Solicits support from community businesses to improve facilities and programs in the schools.

Professional Development

An excellent teacher:

1. Continually updates his/her knowledge by
 - ❖ Reading the literature (e.g. journals such as The American Biology Teacher, Scientific American, Science, Science News, etc.)
 - ❖ Attending conferences, conventions, workshops and seminars
 - ❖ Taking college or in-service courses
 - ❖ Visiting local laboratories, nature reserves, etc.
2. Becomes active in a professional organization and encourages colleagues to join as well
3. Seeks grant support to purchase equipment, to organize or attend meetings or conferences, and to fund special educational projects.

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Questions for Discussion and Reflection

11. Write short notes on the audio resources in teaching of biological science.
12. Give the need for professional development of a biology teacher.
13. Write an essay on the ICT resources for teaching of biological science in detail.
14. Enumerate the qualities of good biology textbook.
15. Critically analyse the community resources for teaching of biological science.