TAMILNADU TEACHERS EDUCATION UNIVERSITY

CHENNAI-97

B.Ed-TWO YEARS COURSE

(From the Academic Year 2016-2017 onwards)

PADAGOGY OF SCHOOL SUBJECT

PART-I-MATHEMATICS

FIRST YEAR

Dr P.S.Shanmugaboopathi

Principal

Maruthi College of Education

M.V.South, Salem-636121, Tamilnadu

Published by
Vandana Publications
UG-4, Avadh Tower, Naval Kishor Road,
Hazratganj, Lucknow – 226001, INDIA

ISBN: 978-81-942515-8-3

All disputes are subject to Lucknow jurisdiction only.

Printed At:
Vandana Publication Press
UG-17, Avadh Tower, Naval Kishor Road, Hazratganj, Lucknow – 226001, INDIA.
Ph: +91-9696045327

Preface

The main goal of mathematics education in schools is the mathematisation of the child's thinking. Clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise. There are many ways of thinking, and the kind of thinking one learns in mathematics is an ability to handle abstractions, and an approach to problem solving.

In this book, we will discuss various approaches, strategies and techniques of teaching-learning of Mathematics. We will also discuss the shift with paradigm of learning Mathematics from traditional behaviorist approach of rote learning and drill to constructive approach, where learner constructs his/her own knowledge.

It concludes that the main goal of Mathematics education is the development of children's ability of mathematization of their prior existing ideas & this can successfully be achieved by the use of innovative activities/projects & experiments.

Dr P.S.Shanmugaboopathi

CONTENT

4.1.2 Peer Tutoring

4.1.3 Individual Activities

4.1.4 Experiential Learning

4.1.5 Teacher-Guided Learning

4.1.6 Problem-Solving Method

4.1.7 Small Group/Whole-Class Interactive Learning

4.1.8 Student Seminar

4.1.9 Group Discussion

4.1.10 Mixed-Ability Grouping

4.1.11 Math's through Games and Puzzles

4.2 RECENT TRENDS IN TEACHING MATHEMATICS

4.2.1 Constructivist Learning

4.2.2 Problem-Based Learning

4.2.3 Brain-Based Learning

4.2.4 Collaborative Learning

4.2.5 Flipped Learning

4.2.6 Blended Learning

4.2.7 E-Learning Trends

4.2.8 Video Conferencing

UNIT V RESOURCES FOR TEACHING MATHEMATICS

5.0 Print Resources

5.1 Newspapers

5.2 Journals

5.3 Magazines

5.4 Encyclopedia

5.5 Audio Resources

5.6 DVD's/CD's

5.7 Visual Resources

5.8 Models

UNIT I AIMS AND OBJECTIVES OF TEACHING MATHEMATICS

1.0 INTRODUCTION

Mathematics is the most international of all curriculum subjects, and mathematical understanding influences decision making in all areas of life private, social, and civil. Mathematics education is a key to increasing the post-school and citizenship opportunities of young people, but today, as in the past, many students struggle with mathematics and become disaffected as they continually encounter obstacles to engagement. It is imperative, therefore, that we understand what effective mathematics teaching looks like and what teachers can do to break this pattern.

Teaching of mathematics in the class is not only concerned with the computational knowledge of the subject but is also concerned with the selection of the mathematical content and communication leading to its understanding and application. So while teaching mathematics one should use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate responses from the students than we have ever had in the past. We know that the teaching and learning of mathematics is a complex activity and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics.

1.1 MEANING

The term ‘Mathematics’ is derived from two Greek words ‘mathanein’ which means ‘learning’ and ‘Techne ‘which means ‘ an art ‘.It means the art of learning related to disciplines.

The dictionary meaning of mathematics is that ‘ it is either the science of number and space or the science of measurement, quantity and magnitude’. Mathematics is thus defined as the science of quantity, measurement and relations. It is a systematized, organized and exact branch of science. It deals with quantitative facts, relationships as well as with problems involving space and form. It is a logical study of shape and arrangement, and quantity.

1.2 NATURE AND SCOPE OF MATHEMATICS EDUCATION

Mathematics, like everything else that man has created, exists to fulfill certain human needs and desires. It is very difficult to say at what point of time in the history of mankind, and in which part of the world, mathematics had its birth. The fact that it has been steadily pursued for so many centuries, that it has attracted ever increasing attention and that it is now the dominant intellectual interest of mankind shows that it appeals very powerfully, to mankind. This conclusion is borne out by everything that we know about the origin of mathematics. More than 2,000 years before the beginning of the Christian era, both the Babylonians and the Egyptians were in possession of systematic methods of measuring space and time. They had the knowledge of rudimentary geometry and rudimentary astronomy. This rudimentary mathematics was formulated to meet the practical needs of an agricultural population. Their geometry resulted from the measurements made necessary by problems of land surveying Units of measurement; originally a stone or a vessel of water for weight, eventually became uniform over considerable areas under names which are now almost forgotten. Undoubtedly, similar efforts occurred in early times in the southern part of Central Asia along the Indus and Ganges rivers and in Eastern Asia Projects related to engineering, financing, irrigation, flood control, and navigation required mathematics. Again a usable calendar had to be developed to serve agricultural needs. *Zero* was defined and this at once led to positional notations for whole numbers and later to the same notation for fractions**.** The place value system which eventually developed was a gift of this period. These achievements and many more of a similar nature are the triumph of the human spirit. They responded to the needs of human society as it became more complex. Primitive men can hardly be said to have invented or discovered their arithmetic; they actually lived it. The men who shaped the stones in erecting the Temple of Mathematics were widely scattered, a few in Egypt, a few in India, and yet others in Babylon and China. These workmen confronted nature and worked in harmony with it. Their products, therefore though scattered in time and space, partook of the unity of nature.

Mathematics is something that the man has himself created to meet the cultural demands of time. Nearly every primitive tribe invented words to represent numbers. But it was only when ancient civilizations such as the Sumerian, Babylonian, the Chinese and the Mayan developed trade, architecture, taxation and other civilized contracts that the number systems were developed. Thus, mathematics has grown into one of the most important cultural components of our society.

Our modern way of life would hardly have been possible without mathematics. Imagine trying to get through the day without using a number in some manner or the other. If a person lacks the ability to compute, he is as good as crippled. For instance, we need to know the time and tell the same. Telling the time is difficult and yet nearly everyone learns it. Soon, we shall lose an important experience of looking at the old fashioned clock with rotating hands, as we shall all be using digital readings to read time. A degree of estimation, not only in money but in 'weights and measures, is very important. Many of our daily routine chores involve sorting, ordering and organizing processes. We handle many mechanized devices which require geometrical or spatial skills. For travel, reading of maps, diagrams, interpreting scales becomes an essential part of our intellectual equipment. A knowledge of mathematics is useful to understand and interpret matters such as income tax and read information presented to us by the mass media in numerical form or in the form of graphs and understand the use of phrases such as rising prices, index, per capita income, inflation, stock market index etc. in ordinary day to day language. It is not necessary to provide an exhaustive list to prove the case in favour of "mathematics for survival" or "useful mathematics".

1.2.1 LATE 19th AND EARLY 20th CENTURY VIEWS

New investigations in mathematics, freed from reliance on experimentation and perception, soon encountered new problems with the appearance of paradoxes in the real number system and the theory of sets. At this point, three new views of mathematics arose to deal with the perceived problems. The first was the school of logicism, founded by the German mathematician Gottlob Frege in 1884. This school, an outgrowth of the Platonic school, set out to show that ideas of mathematics could be viewed as a subset of the ideas of logic. The proponents of logicism set out to show that mathematical propositions could be expressed as completely general propositions whose truth followed from their form rather than from their interpretation in a specific contextual setting. A N. Whitehead and Bertrand Russell set out to show this in their landmark work, *Principia Mathematica.* This attempt was equivalent to trying to establish classical mathematics from the terms of the axioms of the set theory developed by Zermelo and FrankeL This approach, as that of Frege, was built on the acceptance of an externally existing mathematics, and hence was a direct outgrowth of the Platonic school Whitehead and Russell's approach failed through its inability to establish the axioms of infinity and choice in a state of complete generality

devoid of context. This Platonic approach also failed because of the paradoxes in the system.

The followers of the Dutch mathematician L. E. J. Brouwer, on the other hand, did not accept the existence of any idea of classical mathematics unless it could be constructed via a combination of clear inductive steps from first principles. The members of Brouwer's school of thought, called the intuitionists, were greatly concerned with the appearance of paradoxes in set theory and their possible ramifications for all of classical mathematics. Unlike the logicists, who accepted the contents of classical mathematics, the intuitionists accepted only the mathematics that could be developed from the natural numbers forward through the mental activities of constructive proofs. This approach did not allow the use of the law of the excluded middle. This logical form asserts that the statement *PV -P* is true and makes proof by contradiction possible. In many ways, the ideas put forth by Brouwer were based on a foundation not unlike that professed by Kant. Brouwer did not argue for the "inspection of external objects, but [for] 'close introspection'". This conception portrayed mathematics as the objects resulting from "valid" demonstrations. Mathematical ideas existed only insofar as they were constructible by the human mind. The insistence on construction placed the mathematics of the intuitionists within the Aristotelian tradition. This view took logic to be a subset of mathematics. The intuitionists' labors resulted in a set of theorems and conceptions different from those of classical mathematics. Under their criteria for existence and validity, it is possible to show that every real-valued function defined for all real numbers is continuous. Needless to say, this and other differences from classical mathematics have not attracted a large number of converts to intuitionism. The third conception of mathematics to emerge near the beginning of the 20^{th} century was that of formalism. This school was molded by the German mathematician David Hilbert. Hilbert's views, like those of Brouwer, were more in line with the Aristotelian tradition than with Platonism. Hilbert did not accept the Kantian notion that the structure of arithmetic and geometry existed as descriptions of a priori knowledge to the same degree that Brouwer did. However, he did see mathematics as arising from intuition based on objects that could at least be considered as having concrete representations in the mind. Formalism was grounded in the attempts to characterize mathematical ideas in terms of formal axiomatic systems. This attempt to free mathematics from contradictions was built around the construction of a set of axioms for a branch of mathematics that allowed for the topic to be discussed in a first-order language. Considerable progress was made in several areas under the aegis of formalism before its demise as a result of Kurt Godel's 1931

landmark paper. Godel (1931) established that it is impossible in axiomatic systems of the type Hilbert proposed to prove formally that the system is free of contradictions. G6del also demonstrated that it is impossible to establish the consistency of a system employing the usual logic and number theory if one uses only the major concepts and methods from traditional number theory. These findings ended the attempt to so formalize all of mathematics, though the formalist school has continued to have a strong impact on the development of mathematics. The three major schools of thought created in the early 1900s to deal with the paradoxes discovered in the late 19th century advanced the discussion of the nature of mathematics, yet none of them provided a widely adopted foundation for the nature of mathematics. All three of them tended to view the contents of mathematics as products. In logicism, the contents were the elements of the body of classical mathematics, its definitions, its postulates, and its theorems. In intuitionism, the contents were the theorems that had been constructed from first principles via "valid" patterns of reasoning. In formalism, mathematics was made up of the formal axiomatic structures developed to rid classical mathematics of its shortcomings. The influence of the Platonic and Aristotelian notions still ran as a strong undercurrent through these theories. The origin of the "product" -either as a pre-existing external object or as an object created through experience from sense perceptions or experimentation - remained an issue.

1.2.2 MODERN VIEWS AND MATHEMATICS

The use of a product orientation to characterize the nature of mathematics is not a settled issue among mathematicians. They tend to carry strong Platonic views about the existence of mathematical concepts outside the human mind. When pushed to make clear their conceptions of mathematics, most retreat to a formalist, or Aristotelian, position of mathematics as a game played with symbol systems according to a fixed set of socially accepted rules (Davis & Hersh, 1980). In reality, however, most professional mathematicians think little about the nature of their subject as they work within it. The formalist tradition retains a strong influence on the development of mathematics (Benacerraf &Putnam, 1964; Tymoczko, 1986). Hersh (1986) argues that the search for the foundations of mathematics is misguided. He suggests that the focus be shifted to the study of the contemporary practice of mathematics, with the notion that current practice is inherently fallible and, at the same time, a very public activity (Tymoczko, 1986). To do this, Hersh begins by describing the plight of the working mathematician. During the creation of new mathematics, the mathematician works as if the discipline describes an

externally existing objective reality: But when discussing the nature of mathematics, the mathematician often rejects this notion and describes it as a meaningless game played with symbols. This lack of a commonly accepted view of the nature of mathematics among mathematicians has serious ramifications for the practice of mathematics education, as well as for mathematics itself.

The conception of mathematics held by the teacher has a strong impact on the way in which mathematics is approached in the classroom (Cooney, 1985). A teacher who has a formalist philosophy will present content in a structural format, calling on set theoretic language and conceptions (Hersh, 1986). Such a formalistic approach may be a good retreat for the individual who does not understand the material well enough to provide an insightful constructive view. Yet, if such formalism is *not* the notion carried by mathematicians, why should it dominate the presentation of mathematics in the classroom? To confront this issue, a discussion of the nature of mathematics must come to the foreground in mathematics education. Tymoczko and Hersh argue that what is needed is a new philosophy of mathematics, one that will serve as a basis for the working mathematician and the working mathematics educator.

According to Hersh, the working mathematician is not controlled by constant attention to validating every step with an accepted formal argument. Rather, the mathematician proceeds, guided by intuition, in exploring concepts and their interactions. Such a path places the focus on understanding as a guide, not long, formal derivations of carefully quantified results in a formal language.

This shift calls for a major change. Mathematics must be accepted as a human activity, an activity not strictly governed by anyone school of thought (logicist, formalist, or constructivist). Such an approach would answer the question of what mathematics is by saying that: Mathematics deals with ideas. Not pencil marks or chalk marks, not physical triangles or physical sets, but ideas (which may be represented or suggested by physical objects). What are the main properties of mathematical activity or mathematical knowledge, as known to all of us from daily experience?

1. Mathematical objects are invented or created by humans.
2. They are created, not arbitrarily, but arise from activity with already existing mathematical objects, and from the needs of science and daily life.
3. Once created, mathematical objects have properties which are well determined, which we may have great difficulty in discovering, but which are possessed independently of our knowledge of them.(Hersh, 1986, p. 22)

The development and acceptance of a philosophy of mathematics carries with it challenges for mathematics and mathematics education. A philosophy should call for experiences that help mathematician, teacher, and student to experience the invention of mathematics. It should call for experiences that allow for the mathematization, or modeling, of ideas and events. Developing a new philosophy of mathematics requires discussion and communication of alternative views of mathematics to determine a valid and workable characterization of the discipline.

1.2.3 PURE AND APPLIED MATHEMATICS

The study of the history of mathematics does not answer the question "what is mathematics"? However, it provides a valuable perspective to understand the nature of mathematics. Mathematics has a cumulative growth from prehistoric times. This growth has been of two kinds: extrinsic in the form of primary discoveries and intrinsic development of the subject. The primary discoveries have been those of essential basic ideas, most of them gained by trial and error. Primarily, they were responses to human needs consistent with the body of knowledge already, existing before the emergence of the new ideas. They are true accretions. Secondly, in addition to accretions motivated by human needs, the cumulative development of mathematics has been due to its inner growth.

As Nunn has so well said, "Mathematical truths always have two sides or aspects. With the one they face and have contact with the world of outer realities lying in time and space, with the other they face and have contact with each other. Thus, the fact that equiangular triangles have proportional sides enables me to determine by draining or by calculation the height of a Un scalable mountain peak twenty miles away. This is the first or the outer aspect of that mathematical truth. On the other hand, I can deduce the truth itself with complete certainty from the assumed properties of congruent triangles. This is its second or inner aspect."

In brief, historically mathematics has grown largely as a result of

i) social needs, as shown in everyday life, commerce, science and technology,

ii) the intellectual need to connect together existing mathematics into a single logical framework or proof structure.

Thus, the word mathematics can be used in two distinct and different senses, i.e.,

i) the truths that are discovered, and

ii) the methods used to discover truths.

This distinction leads us to explore the question of pure and applied mathematics. In a classroom much of the mathematics we teach is applied mathematics in the sense that it relates directly to life's activities connected with buying, selling, trade, business, consumer applications, weighing, measuring etc. These applications of mathematics to the world around us can be extended to more technical ones. Mathematics has helped in analysing motion and in doing so, Newton created the calculus which became known as applied mathematics. More recently mathematical growth has been in areas such as operational research, linear programming, system analysis, statistics, all involving processes to handle numerical information in an increasingly technologically advanced world. The mathematical ideas we teach in schools develop over many years of study and become associated in our minds with all the applications and illustrations presented to explain them. It is always easier to explain what we can do with a concept in mathematics than to say what it is. A teacher has to answer questions such as "what is the use of this to us this?', or "why do we have to learn this?'If he/she fails to do so there will be many children who will not be able to see the point.

In pure mathematics we start from certain rules of inference, by which we call infer that if one proposition is true, then some other proposition is also true. These rules or inference constitute the major part of the principles of formal logic. For instance, we all know the axiom that in real numbers if $a > b$ and $b > c$, then $a > c$. Thus, from given propositions we conclude that some other proposition is true. We then take any hypothesis that seems amusing, and deduce its consequences. If our hypothesis is about anything, and not about some (one or more) particular person or thing, then our deductions constitute mathematics. Thus, mathematics may be defined as "the subject in which we never know what we are talking about, nor whether what we are saying is me" - *Bertrund Russell*

These ideas point out the abstract nature of mathematics. Mathematics deals with the application of arbitrary rules in an arbitrary situation which may or may not have significance in the world outside. It is a network of logical relationships. In school mathematics Euclidean geometry is essentially pure mathematics. A set of axioms and postulates are given and from them a body of definitions, theorems and propositions are derived. All pure mathematics is built up by combinations of primitive ideas of logic; its propositions are deduced from the general axioms of logic, such as the syllogism and the other rules of inference.

As a theoretical discipline, mathematics explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the real

world. The abstractions can be anything from strings of numbers to geometric figures to sets of equations. In addressing, say, "Does the interval between prime numbers form a pattern?" as a theoretical question, mathematicians are interested only in finding a pattern or proving that there is none, but not in what use such knowledge might have. In deriving, for instance, an expression for the change in the surface area of any regular solid as its volume approaches zero, mathematicians have no interest in any correspondence between geometric solids and physical objects in the real world.

A central line of investigation in theoretical mathematics is identifying in each field of study a small set of basic ideas and rules from which all other interesting ideas and rules in that field can be logically deduced. Mathematicians, like other scientists, are particularly pleased when previously unrelated parts of mathematics are found to be derivable from one another, or from some more general theory. Part of the sense of beauty that many people have perceived in mathematics lies not in finding the greatest elaborateness or complexity but on the contrary, in finding the greatest economy and simplicity of representation and proof. As mathematics has progressed, more and more relationships have been found between parts of it that have been developed separately—for example, between the symbolic representations of algebra and the spatial representations of geometry. These cross-connections enable insights to be developed into the various parts; together, they strengthen belief in the correctness and underlying unity of the whole structure.

Mathematics is also an applied science. Many mathematicians focus their attention on solving problems that originate in the world of experience. They too search for patterns and relationships, and in the process they use techniques that are similar to those used in doing purely theoretical mathematics. The difference is largely one of intent. In contrast to theoretical mathematicians, applied mathematicians, in the examples given above, might study the interval pattern of prime numbers to develop a new system for coding numerical information, rather than as an abstract problem. Or they might tackle the area/volume problem as a step in producing a model for the study of crystal behavior.

The results of theoretical and applied mathematics often influence each other. The discoveries of theoretical mathematicians frequently turn out sometimes decades later to have unanticipated practical value. Studies on the mathematical properties of random events, for example, led to knowledge that later made it possible to improve the design of experiments in the social and natural sciences. Conversely, in trying to solve the problem of billing long-distance telephone users fairly, mathematicians made fundamental

discoveries about the mathematics of complex networks. Theoretical mathematics, unlike the other sciences, is not constrained by the real world, but in the long run it contributes to a better understanding of that world.

There is a very thin line dividing pure and applied concepts. On the one hand concepts of pure mathematics are formulated because of the need to apply them and on the other, every discovery or formulation has some application somewhere.

1.3 AIMS OF TEACHING MATHEMATICS IN SCHOOLS

Before we start the teaching of a subject, it is important for us to know as to why we are going to teach it. The process of teaching can be kept on right lines only with the help of clear cut aims. Aimlessness in teaching would result in the wastage of time, energy and other resources.

What would be the aims of teaching mathematics in our schools? The answer requires the knowledge of all the advantages that can be drawn from the teaching of mathematics. These aims will be based on the educational values of the subject. Aims and values are interrelated and interdependent. Aims help in to realization of the values possessed by a subject. Education is imparted for achieving certain ends and goals. Various subjects of the school curriculum are different means to achieve these goals. The term aims of teaching mathematics stands for the goals, targets or broader purposes that may be fulfilled by the teaching of mathematics in the general scheme of education. Aims are like ideals. Their attainment needs a long-term planning. Their realization is not easy task. Therefore, they are divided into some definite, functional and workable units named as objectives. The objectives are those short-term, immediate goals or purposes that may be achieved within the specified classroom situations. The aims are broken into specified objectives to provide definite learning experiences for bringing about desirable behavioural changes.

1.3.1 OBJECTIVES OF TEACHING MATHEMATICS AT ENTIRE SCHOOL STAGE

Aims of teaching mathematics are to be framed in the light of the educational values of the subject. Value is the spring-board of aim. We know that mathematics has wide applications in our daily life. It has great cultural and disciplinary values. Thus we may mention the aims of teaching mathematics as under:

Aims

1. To enable the students to solve mathematical problems of daily life. We have to select the content and methods of teaching so that the students are able to make use of their learning of mathematics in daily life.

2. To enable the students to understand the contribution of mathematics to the development of culture and civilisation.

3. To develop thinking and reasoning power of the students.

4. To prepare a sound foundation needed for various vocations. Mathematics is needed in various professions such as those of engineers, bankers, scientists, accountants, statisticians etc.

5. To prepare the child for further learning in mathematics and the related fields. School mathematics should also aim at preparing him for higher learning in mathematics.

6. To develop in the child desirable habits and attitudes like habit of hard work, self-reliance, concentration and discovery.

7. To give the child an insight into the relationship of different topics and branches of the subject.

8. To enable the child to understand popular literature. He should be so prepared that he finds no handicap in understanding mathematical terms and concepts used in various journals, magazines, newspapers etc.

9. To teach the child the art of economic and creative living.

10. To develop in the child rational and scientific attitude towards life.

Objectives

Aims of teaching mathematics are genially scope whereas objectives of the subject are specific goals leading ultimately to the general aims of the subject. The objectives of teaching mathematics in school can be described as under:

A. Knowledge and Understanding Objectives

Through mathematics, a pupil acquires the knowledge of the following:

(i) He learns mathematical language, for example, mathematical symbols, formulae figures, diagrams, definitions etc.

(ii) He understands and uses mathematical concepts like concept o area, volume, number, direction etc.

(iii) He learns the fundamental mathematical ideas, processes, rules and relationships.

(iv) He understands the historical background of various topics and contribution of mathematicians.

(v) He understands the significance and use of the units of measurement.

B. Skill Objectives

Mathematics develops the following skills:

(i) The child learns to express thoughts clearly and accurately.

(ii) He learns to perform calculations orally.

(iii) He develops the ability to organise and interpret the given data

(iv) He learns to reach accurate conclusions by accurate and logic reasoning.

(v) He learns to analyse problems and discover fundamental relationships.

(vi) He develops speed and accuracy in solving problems.

(vii) He develops the skill to draw accurate geometrical figures,

(viii) He develops the ability to use mathematical apparatuses and tools skillfully.

C. Application Objectives

The students will be able to develop the following application objectives

(i) He is able to solve mathematical problems independently.

(ii) He makes use of mathematical concepts and processes in everyday life.

(iii) He develops ability to analyse, to draw inferences, and to generalise from the collected data and evidences.

(iv) He can think and express precisely, exactly, and systematically by making proper use of mathematical language.

(v) He develops the ability to use mathematical knowledge in the learning of other subjects especially sciences.

(vi) He develops the students' ability to apply mathematics in his future vocational life.

D. Appreciation and Interest Objectives

The child learns to appreciate:

(i) The contribution of mathematics to the development of various subjects and occupations.

(ii) The role played by mathematics in modern life.

(iii) The mathematical type of thought which serves as model for scientific thinking in other fields.

(iv) The rigor and power of mathematical processes and accrue of results.

(u) The cultural value of mathematics.

(vi) The value of mathematics as leisure time activity.

E. Attitude Objectives

Mathematics helps in the development of following attitudes:

(i) The child develops the attitude of systematically pursuing a task to completion.

(ii) He develops heuristic attitude. He tries to make independent discoveries. (Hi)' He develops the habit of logical reasoning.

(iv) He is brief and precise in expressing statements and results,

(v)He develops the habit of verification.

(vi) He develops power concentration and independent thinking. (vii) He develops habit of self-reliance.

We have discussed the aims and objectives of teaching mathematics in general. The teacher should carefully choose the objectives regarding a particular topic. The nature of students will also be kept in view. The aims of teaching and learning mathematics are to encourage and enable students to:

- recognize that mathematics permeates the world around us
- appreciate the usefulness, power and beauty of mathematics
- enjoy mathematics and develop patience and persistence when solving problems
- understand and be able to use the language, symbols and notation of mathematics
- develop mathematical curiosity and use inductive and deductive reasoning when solving problems
- develop a positive attitude towards learning Mathematics
- perform mathematical operations and manipulations with confidence, speed and accuracy
- think and reason precisely, logically and critically in any given situation
- develop investigative skills in Mathematics
- identify, concretise, symbolise and use mathematical relationships in everyday life
- comprehend, analyse, synthesise, evaluate, and make generalizations so as to solve mathematical problems
- Collect, organize, represent, analyse, interpret data and make conclusions and predictions from its results

- apply mathematical knowledge and skills to familiar and unfamiliar situations
- appreciate the role, value and use of Mathematics in society
- develop willingness to work collaboratively
- acquire knowledge and skills for further education and training
- communicate mathematical ideas
- become confident in using mathematics to analyse and solve problems both in school and in real-life situations
- develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics
- develop abstract, logical and critical thinking and the ability to reflect critically upon their work and the work of others
- develop a critical appreciation of the use of information and communication technology in mathematics
- appreciate the international dimension of mathematics and its multicultural and historical perspectives.

1.3.2 OBJECTIVES OF TEACHING MATHEMATICS AT ELEMENTARY STAGE

The objectives at the elementary stage can be supplemented as given:

A. Knowledge and understanding objectives

1. Develops the knowledge and understanding of mathematical concepts like number, units of measurement, size, shape, direction, distance, grouping sub-grouping and fractions.

2. Develops the knowledge and understanding of mathematical facts and processes like place value of numbers, meaning and significance of zero, four fundamental operations, percentage, unitary method, menstruation, etc.

3. Develops the knowledge and understanding of mathematical terms and symbols like digits, fractions, percentage, etc.

4. Develops the knowledge and understanding of fundamental mathematical relationships.

B. Skills objectives

The students develops the following skills :

1. Ability in counting, reading and writing of numbers.

2. Skill in four fundamental operations dealing with integral numbers and fractions.

3. A reasonable speed, accuracy and neatness in oral and written computational work.

4. Technique of solving problems which involve elementary mathematical processes and simple calculations.

5. Skill in the use of mathematical tables.

6. Proficiency in making quantitative estimate of size and distance.

C Application objectives

1. He is able to solve both oral and written mathematical problems independently.

2. He applies elementary mathematical concepts and processes in every day life.

D Attitude objectives

1. Develops self-confidence for solving elementary mathematical problems.

2. While solving mathematical problems, he tries to read it carefully, analyses it, collects all the known evidences and then draw proper inferences.

3. Develops the habits of neatness, regularity, honesty and truthfulness.

4. Develops the habits of logical thinking and objective reasoning.

E Appreciation and interest objectives

1. Develops interest in the learning of mathematics.

2. Appreciate the contribution of mathematicians and gets inspiration from their work.

3. Appreciates the power of computational skills.

4. Appreciates and takes interest in using his knowledge of mathematics in solving problems of daily life.

5. Appreciates the recreational value of mathematics and learns to utilize his leisure time properly.

1.3.3 OBJECTIVES OF TEACHING MATHEMATICS AT SECONDARY STAGE

The objectives of teaching mathematics at secondary stage are as follows and are very similar to the objectives at the entire school stage

A. Knowledge and understanding objectives

1. He develops the knowledge and understanding of mathematical facts, concept and abstractions.

2. He develops the knowledge and understanding complex geometrical figures.

3. He develops the knowledge and understanding of polynomials, linear equations, and factorization.

4. He develops the knowledge and understanding of similarity, congruency and trigonometry

B. Skill objectives

1. He develops the skills of solving mathematical problems of secondary stage

2. He develops the skills of problem solving to deal with the word problems involving one or more variable.

3. He develops skills of inductive and deductive reasoning in solving geometrical problems.

4. Skills in finding out different trigonometric ratios values of fundamental angles.

C. Application objectives

1. He learns the application of mathematics in his day to day life problems.

2. He is able to apply mathematical ability to his social situation, vocational, occupational and recreational life.

D. Attitude objectives

1. He gains confidence and competence in the learning of mathematics.

2. Develops the habit of analytical thinking in day to day life situation.

E. Appreciation and interest objectives

1. He enjoys mathematical problem of every type.

2. He appreciates the use of mathematics in the entire daily life situation.

3. He justifies every one with the importance of mathematics in daily life.

4. He appreciates the utilitarian value of mathematics in life.

1.4 NEED OF TEACHING MATHEMATICS

Mathematics is a way of organising our experience of the world. It enriches our understanding and enables us to communicate and make sense of our experiences. It also gives us enjoyment. By doing mathematics we can solve a range of practical tasks and real-life problems. We use it in many areas of our lives.

Mathematics is regarded as the mother of all sciences. If our students are to function effectively in this era of rapid technological advancement and globalization, they must be mathematically literate. Those who understand and can do mathematics have significantly enhanced opportunities and options that will open doors to productivity.

The Kothari Commission (1964-66) emphasizes the significance of mathematics in the school curriculum by stating “One of the outstanding characteristics of scientific culture is quantification. The advent of automation and cybernetics, in this century, marks the beginning of the scientific industrial revolution and makes it all the more imperative to devote special attention to the study of mathematics. Proper foundation to the knowledge of the subject should be laid in the school”.

In the words of Young “It (mathematics) is the only subject that encourages and develops logical thinking. It enables the student to discriminate between essential and non-essentials. It helps them to sift facts, to draw conclusions tersely and without ambiguity and that is the subject by which they may learn what is meant by rigid reasoning”. Therefore, Knowledge of mathematics is very essential for training rational, trustworthy and useful citizens in a democratic society.

Mathematics for Life: Knowing mathematics can be personally satisfying and empowering. The underpinnings of everyday life are increasingly mathematical and technological. For instance, making purchasing decisions, choosing insurance or health plans, and voting knowledgeably all call for quantitative sophistication.

Mathematics as a part of Cultural Heritage: Mathematics is one of the greatest cultural and Intellectual achievements of human-kind, and citizens should develop an appreciation and Understanding of that achievement, including its aesthetic and even recreational aspects.

Mathematicsfor the Workplace: Just as the level of mathematics needed for intelligent citizenship has increased dramatically, so too has the level of mathematical thinking and problem solving needed in the workplace, in professional areas ranging from health care to graphic design.

Mathematics for the Scientific and Technical Community. Although all careers require a foundation of mathematical knowledge, some are mathematics intensive. More students must pursue an educational path that will prepare them for lifelong work as mathematicians, statisticians, engineers, and scientists. In this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures. A lack of mathematical competence keeps those doors closed. Generally it is an assumption that mathematics is only for the select few. On the contrary, everyone needs to understand mathematics. All students should have the opportunity and the support necessary to learn significant mathematics with depth and understanding. There is no conflict between equity and excellence. Principles and Standards call for a common foundation of mathematics to be learned by all students. This approach, however, does not imply that all students are alike. Students exhibit different talents, abilities, achievements, needs, and interests in mathematics. A society in which only a few have the mathematical knowledge needed to fill crucial economic, political, and scientific roles is not consistent with the values of a just democratic system or its economic needs.

1.5 SIGNIFICANCE OF TEACHING MATHEMATICS

- A good mathematical background with the knowledge of concepts and theories is essential for meeting the challenges of the modern technological society.
- Mathematics learning helps to apply mathematical concepts and theorems to new situation.
- The study of mathematics develops the ability to transfer the mathematical type of thinking and reasoning to daily life situations.
- Mathematics provides a clear understanding of laws of nature.
- Mathematics helps in clear understanding of the culture and development of our civilization.
- Mathematics helps to appreciate the applications of mathematics for the scientific and technological advancement.
- The study of mathematics provides sufficient mathematical skills to meet the demands of daily life.
- Mathematics learning helps in a better understanding of the world around us.
- The study of mathematics develops ability to make independent decisions in societal issues.
- Mathematics learning inculcates a good deal of self-reliance, self-confidence, tolerance and open-mindedness.
- Mathematics provides a framework for solving problems.
- Learning of mathematics develops ability to transfer the knowledge and skills learned through mathematics lessons to other context in the work place and in everyday life.
- Mathematics is an essential element of communications.
- Mathematics is a powerful tool in the hands of the learners.
- The study of mathematics develops logical thinking and reasoning, critical mind and creative imagination.
- Mathematics learning develops ability to apply mathematics and make meaningful connections to life's experiences.
- The study of mathematics enhances the ability to communicate mathematical ideas coherently and clearly to peers, teachers and others.
- Mathematics learning helps to think alternative methods of solving problems.
- The study of mathematics enhances the ability to apply mathematical ideas and relationships to areas outside classroom such as art, science and other curricular areas and in everyday life, especially physical phenomena.

1.6 VALUES OF MATHEMATICS EDUCATION

Knowledge of educational values helps the teacher to avoid aimlessness in teaching. Value is the springboard of aim and vice-versa. There is nothing controversial about the two. One aims at a thing, because one values it: or by aiming at a thing, one shall taste it value. “We aim at teaching mathematics in the light of its aims; we shall realize its values.” Aimless teaching will realize no values. Broadly speaking there are three main considerations for which a child is sent to school. Education must contribute to the acquirement of these values:

i) Knowledge and skill

ii) Intellectual habits and power

iii) Desirable attitude and ideals

Mathematics has got many educational values which determine the need of teaching the subject in schools. These values can be studied under the following heads:

1.6.1 PRACTICAL VALUE

Mathematics has great practical value. Everyone uses some mathematics in every form of life.A common man sometimes can do without reading or writing but he cannot do without counting and calculating. Any person who is ignorant of mathematics can be easily cheated. He will always be at the mercy of others. We have to make purchases daily. We buy cloth, food items, fruit, vegetables, grocery etc.

We have to calculate how much we have to pay for everything. A house-wife also needs mathematics for looking after her house, preparing family budgets and estimates, writing various expenses and noting down various household transactions.

Mathematics is needed by all of us whether rich or poor, high or low. Not to speak of engineers, bankers, accountants, businessmen, planners etc., even petty shopkeepers, humble coolies, carpenters and labourers need mathematics not only for earning their livelihood but also to spend wisely and save for future. Whoever earns and spends uses mathematics.

We are living in a world of measurements. We have to measure lengths, areas, volumes and weights. We have to fix timings, prices, wages, rates, percentages, targets, exchanges etc. In the absence of these fixations, the life in the present complex society will come to a standstill.

There will be utter confusion and chaos. Just think if a fairy descends on earth and removes all mathematics. There will be no calendar, no maps, no accounts, no fixations or measurements, no industrial activity, no plans or projects.

Thus we see that mathematics has tremendous value or application in our daily life. It is essential for leading a successful social life.

1.6.2. CULTURAL VALUE

Mathematics has got a great cultural value which is steadily increasing day by day. Mathematics has made a major contribution to our cultural advancement. The progress of our civilisation has been mainly due to the progress of various occupations such as agriculture, engineering, industry, medicine, navigation, rail road building etc.

These occupations build up culture. Mathematics makes direct or indirect contribution to the development of all occupations. Hogben says, "Mathematics is the mirror of civilisation".

The history of mathematics shows how mathematics has influenced civilisation and culture at a particular time. Progress in mathematics, of Greeks and Egyptians in the past led to their cultural advancement and the progress of their civilisation.

Mathematics is a pivot for cultural arts such as music, fine arts, poetry and painting. Perhaps that is why the Greeks, who were the greatest geometers of their times, were quite adept in fine arts.

1.6. 3. DISCIPLINARY VALUE

Mathematics trains or disciplines the mind also. It develops thinking and reasoning power. According to Locke, "Mathematics is a way to settle in the mind a habit of reasoning." Mathematics is 'an exact and definite science'. Every student of mathematics has to reason properly without any prejudices or unnecessary biases. Reasoning in mathematics has the characteristics of simplicity, accuracy, objectivity, originality etc.

Besides reasoning, mathematics has the following disciplinary values also.

(a) Development of the power of concentration. The faculty to concentrate one's mind can only be learnt by the study of mathematics.

(b) Development of inventive faculty. The study of mathematics develops inventive faculty of the students. The solving of a difficult problem in mathematics is just like making a discovery.

(c) Will power. Mathematics develops patience and perseverance in the students. It strengths their will power

In addition to practical, cultural and disciplinary values, mathematics has so many other values. Mathematics teaches the art of economical living. It teaches economy in time, speech, thought and money.

Thus we see that mathematics has many educational values which show the increasing importance of the subject in schools and in social life.

QUESTIONS

1. Describe the meaning of mathematics?
2. Explain the nature and scope of mathematics?
3. What are the values of teaching mathematics? Explain it?
4. State the Aims and objectives of teaching Mathematics in schools?
5. Explain the Need of teaching Mathematics?
6. State the significance of teaching Mathematics?
7. “Aims and values of teaching mathematics are overlapping” Discuss?
8. Describe the disciplinary and social aims of teaching mathematics?

UNIT II PLANNING FOR INSTRUCTION

2.0 LESSON PLAN-INTRODUCTION

A lesson plan is the systematic preparation done in a scientific manner. Effective and successful teaching mainly depends on perfect lesson planning. A lesson plan represents a single teaching unit meant for a class period. Generally a lesson plan is teacher's mental and emotional visualization of classroom activities.

2.0.1 STEPS IN PLANNING A LESSON

A lesson plan is the instructor's road map of what students need to learn and how it will be done effectively during the class time. Before planning the lesson, it is needed to identify the learning objectives and then design appropriate learning activities and develop strategies to obtain feedback on student learning.

2.0.2 HERBARTIAN STEPS

The formal steps involved in the approach as below

- Introduction / Motivation
- Presentation
- Comparison and association
- Generalization
- Application
- Recapitulation

INTRODUCTION / MOTIVATION

This step is concerned with the task of preparing the students for receiving new knowledge. In preparation, nothing new is taught to students. Relevant to the topic in hand he teacher should make himself sure of what the pupils already know, by putting a few questions, based on the pupils previous knowledge. In general, with the help of this step, the teacher can check the students entering behavior before he starts teaching the lesson. Thus, testing previous knowledge, developing interest in the minds of students and maintaining curiosity of the students can be achieved with the help of this step.

The following activities involved in this step

- The assumption about the previous knowledge of the students in relevance to the lesson

- The testing of the previous knowledge
- Utilizing the previous knowledge for introducing the lesson
- Motivating the students for studying the present lesson

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 simple language is used. 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. The teacher should carefully and skillfully arrange his material so that his pupils may clearly and readily grasp it. The teacher should make proper use of questions, charts, graphs, pictures, models and other illustrative for demonstration and explanation. At the end of each section a few questions concerning that section only should be asked to whether the pupils are now ready for the acquisition of new knowledge.

COMPARISON OF ASSOCIATION

More importance should be given in this stage to compare the facts observed by the students with another concept by way of giving examples. By making use of this comparison, the students can derive definitions or theories. The students are encouraged to give new suitable examples for the concept instead of the examples given in the book to make them think in an innovative manner.

GENERALIZATION

This step is concerned with arriving at some general ideas or drawing out the necessary conclusions by the students on the basis of the different comparisons, contracts and associated observed in the learning material present by the teacher. As far as possible the task of formulation should be left to students. The teacher at this stage should try to remain in the background for providing only necessary guidance and correction.

APPLICATION

In this stage, the teacher makes the students to use the understood knowledge in an unfamiliar situation. Unless the knowledge of science is applied in new situations or in our day-to-day life, the study of science will become meaningless. This application of scientific principles will strengthen learning and will make the learning permanent.

RECAPITULATION

This stage is meant for the teachers to know whether students have grasped by reviewing a lesson or by giving assignments to the students. Only through this step achieving closure (in teaching) is possible.

2.1 UNIT PLAN

Different meaning has been assigned to the term unit. They are

1. The lesson of the day
2. As a Chapter in a text book etc.

Syllabus contains many topics/ units such as Mensuration, Algebra, Triangles trigonometry, Statistics etc. A unit plan involves planning a teaching a unit, teaching methods, evaluation of teaching activities, diagnosing and remedial steps all together is called unit planning.

S.NO	Sub Division of content	No. of Period required	Teaching Method	Resource Materials	Evaluation

2.1.0 DESIGNING A LESSON PLAN

Planning of a lesson is an important equipment of a teacher in a school or in a college. A lesson plan is strictly individual; it is indeed the creation of the teacher who plans out lesson plan. A plan is a work or is involving much imagination and study. The

plan is an unfolding of the teacher's soul; it contains the life-blood of the teacher. Lesson plan is a kind of discipline, which has to be learnt in the training college.

2.2 BLOOMS TAXONOMY OF EDUCATIONAL OBJECTIVES

Bloom's Taxonomy, a educational tool developed by Benjamin S. Bloom (1913-1999) that ranks the relative cognitive complexity of various educational objectives. This taxonomy is often used as an aid when create test questions and assignments and objectives of a subject. Following the description, you will find Lindsey Shorser's interpretation of Bloom's Taxonomy in the context of mathematical understanding with examples drawn from school level topics.

Educational Objectives

1. **Cognitive Domain**
2. **Affective Domain**
3. **Psychomotor Domain**

BLOOM'S TAXONOMY OF COGNITIVE SKILLS:

2.2.1 COGNITIVE DOMAIN (Bloom)

Level	Definition	Sample Verbs
Knowledge	Recall and remember information.	defines, describes, identifies, knows,labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states, memorizes, tells, repeats, reproduces
Comprehension	Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. Establish relationships between dates, principles, generalizations or values	comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives examples, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates, shows relationship of, characterizes, associates, differentiates, classifies, compares distinguishes
Application	Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. Facilitate transfer of knowledge to new or unique situations.	applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, solves, uses, systematizes, experiments, practices, exercises, utilizes, organizes
Analysis	Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines,

		relates, selects, separates, investigates, discovers, determines, observes, examines
Synthesis	Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. Originality and creativity.	categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes, synthesizes, imagines, conceives, concludes, invents theorizes, constructs, creates
Evaluation	Make judgments about the value of ideas or materials.	appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, ummarizes, supports, calculates, estimates, consults, judges, criticizes, measures, decides, discusses, values, decides, accepts/rejects

2.2.2 AFFECTIVE DOMAIN (BLOOM)

Level	Definition	Sample Verbs
Receiving phenomena	Awareness, willingness to hear, selected attention.	asks, chooses, describes, follows, gives, holds, identifies, locates, names, points to, selects, sits, erects, replies, uses.
Responding to	Active participation on the part of	answers, assists, aids,

phenomena	the learners. Attends and reacts to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).	complies, conforms, discusses, greets, helps, labels, performs, practices, presents, reads, recites, reports, selects, tells, writes.
Valuing	The worth or value a person attaches to a particular object, phenomenon, or behavior. This ranges from simple acceptance to the more complex state of commitment.	completes, demonstrates, differentiates, explains, follows,forms, initiates, invites, joins, justifies, proposes, reads, reports, selects, shares, studies, works.
Organization	Organizes values into priorities by contrasting different values, resolving conflicts between them, and creating a unique value system. The emphasis is on comparing, relating, and synthesizing values.	adheres, alters, arranges, combines, compares, completes, defends, explains, formulates, generalizes, identifies, integrates, modifies, orders, organizes, prepares, relates, synthesizes.
Internalizing values	Has a value system that controls their behavior. The behavior is pervasive, consistent, predictable, and most importantly, characteristic of the learner.	acts, discriminates, displays, influences, listens, modifies, performs, practices, proposes, qualifies, questions, revises, serves, solves, verifies.

2.2.3 PSYCHOMOTOR DOMAIN (DAVE)

Level	Definition	Sample Verbs
Imitation	Includes repeating an act that has been demonstrated or explained, and it includes trial and error until an appropriate response is achieved.	begin, assemble, attempt, carry out, copy, calibrate, construct, dissect, duplicate, follow, mimic, move, practice, proceed, repeat, reproduce, respond, organize, sketch, start
Manipulation	Includes repeating an act that has been demonstrated or explained, and it includes trial and error until an appropriate response is	(similar to imitation), acquire, assemble, complete, conduct, do, execute, improve, maintain, make,

	achieved.	manipulate, operate, pace, perform, produce, progress, use.
Precision	Response is complex and performed without hesitation.	achieve, accomplish, advance, exceed, excel, master, reach, refine, succeed, surpass, transcend
Articulation	Skills are so well developed that the individual can modify movement patterns to fit special requirements or to meet a problem situation.	adapt, alter, change, excel, rearrange, reorganize, revise, surpass
Naturalization	Response is automatic. One acts "without thinking."	arrange, combine, compose, construct, create, design, refine, originate, transcend

2.3 INSTRUCTIONAL OBJECTIVES AT DIFFERENT LEVELS

Though Bloom's Taxonomy of educational objectives in the cognitive domain as six levels of remembering, understanding , applying, analysing, evaluating and creating, as adapted to mathematics, it has only three, levels, namely, remarkably, understanding and applying . Here routine exercises and applications are included under knowledge and understanding depending on the complexity and applying level objectives, include non-routine application, analysis, creating and evaluation.

In view of the above, for writing instructional objectives we have employed following levels in the cognitive, affective and psychomotor domains: (1) Remembering, (2) Understanding, (3) Applying, (4) Skills, (5) Appreciation, (6) Interest, and (7) Attitudes.

2.3.1 INSTRUCTIONAL OBJECTIVES AT ELEMENTARY LEVEL

1. Remembering Objectives: To remember terms, facts, concepts, symbols, definitions, principles, and formulae of mathematics and also applications which are routine in nature requiring probably only substitution in a formula.

Specifications: To demonstrate the achievement of above objectives, the pupil:

1.1 Recall the terms, facts, definitions, formulae, concepts, processes, etc.

1.2 Recognize formulae, figure, concepts, procedures and processes, etc.

1.3 Solves routine types of problems using a formula

2. Understanding Objectives: To develop understanding of concepts, principles and processes of mathematics, to apply principles and processes in routine situations.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

2.1 Gives illustrations and detect errors in statement, formulae or figure and correct them

2.2 Explain concepts, principles and configuration

2.3 Discriminate between closely related concepts and principles

2.4 Classifies as per given criteria

2.5 Identifies relationship among the given data

2.6 Translate variable statement in to symbolic relationships and vice-versa

2.7 Estimate the result

2.8 Interpret the given charts, graphs and data

2.9 Verify properties

2.10 Solves routine types of problem using concepts and processes

3. Applying Objectives: To apply the acquired knowledge and understanding of mathematics in unfamiliar situation or new situations.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

3.1 Analyses and solves non-routine types of problems

3.2 Finds out the adequacy and relevance of the given data

3.3 Establishes relationship among the given data

3.4 Selects the appropriate method for solving a problem

3.5 Suggests alternative methods of solutions

3.6 Gives justification to the method of solution

4. Skill Objectives: To acquire different skills (a) computing (b) drawing geometrical figure and graphs (c) reading tables graphs, charts, etc.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

4.1 Carries out oral calculations with ease and speed

4.2 Does written calculations with ease and speed

4.3 Handles geometrical instruments with ease and proficiency

4.4 Measures accurately

4.5 Draws free hand diagrams with ease

4.6 Draws figure accurately

4.7 Draws figure according to scale

5. Appreciation Objectives: To appreciate the use of mathematics in day-to day life and in other disciplines.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

5.1 Appreciates the use of mathematics in other disciplines

5.2 Appreciates the symmetry of figures and patterns

5.3 Appreciates qualities like brevity and exactness through the study of mathematics

6. Interest Objectives: To develop interest in mathematics.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

6.1 Solve mathematical puzzles

6.2 Participates in the activities of mathematical club

6.3 Reads additional material in mathematics

6.4 Formulates additional problems.

7. Attitude Objectives: To develop scientific attitude trough the study of mathematics.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

7.1 Examines all the aspects of a problem

7.2 Point out errors boldly if convinced

7.3 Accepts errors without hesitation

7.4 Respects the opinion of others.

2.3.2 INSTRUCTIONAL OBJECTIVES AT SECONDARY LEVEL

1. Remembering Objectives: To acquire the knowledge of terms, facts, concepts, symbols, definitions, principles, and formulae of mathematics.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

1.1 Recall the terms, facts, definitions, formulae, concepts, processes

1.2 Recognise formulae, figure, concepts, procedures and processes

2. Understanding Objectives: To develop understanding of concepts, principles and processes of mathematics.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

2.1 Gives illustration

2.2 detects errors in statement, formulae or figure and correct them

2.3 Explains concepts, principles and configuration

2.4 Discriminate between closely related concepts and principles

2.5 Classifies as per given criteria

2.6 Identifies relationship among the given data

2.7 Translate variable statement in to symbolic relationships and vice-versa

2.8 Estimate the result

2.9 Reads and interpret the given chart, graphs and data

2.10 Verify properties, indicates hypothesis

2.11 Solves routine types of problem using concepts, principles, etc.

2.12 Reads and interprets data from a given table

2.13 Uses calculator and computer

3. Applying Objectives: To apply the acquired knowledge and understanding of mathematics in unfamiliar situation or new situations.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

3.1 Analyses and solves non-routine types of problems

3.2 Finds out the adequacy and relevance of the given data

3.3 Establishes relationship among the given data

3.4 Selects the appropriate method for solving a problem

3.5 Suggests alternative methods of solutions

3.6 Gives justification to the method of solution

4. Skill Objectives: To acquire different skills (a) computing (b) drawing geometrical figure and graphs (c) reading tables graphs, charts, etc.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

4.1 Does written calculations with ease and speed

4.2 Handles geometrical instruments with ease and proficiency

4.3 Measures accurately

4.4 Draws free hand diagrams with ease

4.5 Draws figure accurately and according to the scale

4.6 Reads data/ table with speed and accuracy

5. Appreciation Objectives: To appreciate the use of mathematics in day-to day life and in other disciplines.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

5.1 Appreciates the use of mathematics in other curricular areas

5.2 Appreciates the symmetry of figures and patterns

5.3 Appreciates qualities like brevity and exactness

5.4 Appreciates the contributions of mathematicians in general and Indian mathematicians in particular.

6. Interest Objectives: To develop interest in mathematics.

Specifications: To demonstrate the achievements of the above objectives, the pupil:

6.1 Solve mathematical puzzles

6.2 Participates in the activities of mathematical club

6.3 Reads additional material in mathematics

6.4 Formulates additional problems.

7. Attitude Objectives: To develop scientific attitude through the study of mathematics. Specifications: To demonstrate the achievements of the above objectives, the pupil:

7.1 Examines all the aspects of a problem

7.2 Point out errors boldly if convinced

7.3 Accepts errors without hesitation

7.4 Respects the opinion of others.

Example 1

Topic: Perimeter

Objectives

- To reinforce the idea of perimeter as boundary of the figure among learners using different activities.
- To enable learners to calculate perimeter of closed figures (using Geoboard).
- To enable the learner to use the formulae to calculate/ solve problems related to perimeter

Example 2

Topic: Circumference of a circle

Objectives

- To enable the students to understand the concept of circle.
- To enable learners to find the relationship between the circumference and the diameter of a circle.
- To enable learners to solve problems related to circumference of the circle using its formula
- To enable learners to differentiate between area and perimeter of a circle.

Example 3

Topic: Algebraic expressions

Objectives

- To enable learners to identify a variable in an algebraic expression.

- To enable learners to state the meaning of term ‘variable’ and ‘constant’
- To enable learners to define an algebraic expression.
- To enable learners to state the components of an algebraic expression.
- To enable learners to translate a given statement into an algebraic expression
- To enable learners to identify terms of an algebraic expression.
- To enable learners to differentiate between like and unlike terms.
- To enable learners to state the meaning of coefficient of a term and hence, enable them to write coefficients of the terms in an algebraic expression.
- To enable learners to classify algebraic expressions into monomials, binomials and trinomials, etc.

MODEL LESSON PLAN

Name of the student teacher :

Class/section and session :

Name of the school :

Instructional objectives: The pupil

1. Identifies the different mathematical shapes.

2. Recalls the formulae on area and volume of the cube

3. Explains the relationship between the area and the volume of the cube.

4. Computes the problems with speed and accuracy.

5. Formulates the problems on their own.

Instructional resources:

1. Model of a cube

2. Solid objects

3. Pictures depicting cube

Previous knowledge of learners

The Teacher asks the below questions to check the previous knowledge of the students.

1. How many sides are there in a cube?

2. Name some of the cube shape objects.

3. What is the area of the square?

Concept/Content	Specification of behavioral objectives	Learning Experiences(Teacher/Learner activities)	Evaluation

2.4 TYPES OF TEST-ITEMS

OVERVIEW

Evaluation can be one of the most threatening steps for the inexperienced teacher. Planning for student evaluation is an integral part of planning for teaching, not just the final step of the instructional process. As someone who has had to maintain a high GPA in order to gain admittance to your graduate program, you are most familiar with summative evaluation--an assignment or set of assignments that result in a letter grade that is supposed to reflect your overall grasp of course material at the end of a period of time. Without question, assessing your students with grades is one of the most important tasks you may be asked to do as a teaching assistant. However, just as important as summative evaluation--determined through quizzes, tests, term papers, mid-terms, and final exams--is the formative evaluation that you can do throughout the semester in order to assess how well your students are learning as they prepare for summative evaluation.

Formative evaluation can pre-empt poor student performance on summative evaluation projects; at the same time, formative evaluation can communicate to both teachers and students whether or not course content is effectively being communicated and learned, information that can lead to refinement of instruction on the part of the teacher

and refinement of studying techniques on the part of the students. For a few examples of formative evaluation, refer to page 17 of this handbook; for a comprehensive study of formative evaluation techniques, refer to Angelo and Cross's Classroom Assessment Techniques. The remainder of this section focuses on some important aspect of summative evaluation.

2.4.1 TESTING

Testing serves three main purposes. Tests are diagnostic tools that help you establish what students already know. Tests are formative because they give students feedback as well as help you to improve your instruction. Finally, tests are summative in that they evaluate student performance for the purpose of assigning a final grade.

Tell your students in advance, preferably at the beginning of the term, what kinds of tests will given in the course. The nature of the course test format will directly influence how students will prepare, study, and learn. In most introductory courses at the University of Georgia, professors assign several tests during the course of the semester, in addition to the final examination.

2.4.2 TEST DEVELOPMENT

Test development should generally begin with the delineation of what you will expect students to know at various points in the course. Having first defined the scope of the test, next decide what kind of test will best measure student progress. The nature of the subject and the personal teaching philosophy of the course instructor will usually determine which format will work best. If the course has focused on facts, data, and procedures that the student will need to recall, then an objective test will probably be most appropriate. On the other hand, if your students have been organizing, synthesizing, and applying knowledge in class on a regular basis, then perhaps an essay test, problem solving project, or written assignment will be a more suitable test.

2.4.3 FORMAT

To decide upon a format, it may be helpful to write down all the topics you wish to test under each course objective and then classify the topics according to importance. Next, outline the questions you want to ask on each topic, keeping in mind that the more

important topics deserve the most attention. Beside each question, indicate whether it will require the students to recall facts, understand or explain a concept, or apply knowledge. Your choice of an exam format should be based on the learning outcomes you want to test. Listed below are some possible exam formats. You can combine several of these to create a well-balanced test.

- **Essay** tests give students a chance to organize, evaluate, and think, and therefore often are very effective for measuring how well students have learned. They are, unfortunately, the most difficult and time consuming to grade. It is a good idea to establish the criteria for grading an essay or discussion question ahead of time to insure that the test question is written clearly, and to insure that students understand what kind of answers are expected.
- **Short Answer** questions allow for greater specificity in testing while still providing some opportunity for student creativity. Some short answer questions test recall, but can be more challenging than multiple choice, which allows students to recognize correct answers. Depending upon construction, other short answer questions test students' analytical skill, and can test more material than an essay test. In a typical test period, most students cannot address more than two or three essay questions adequately. During the same period, students can respond to eight or ten short answer questions, which could cover a broader range of topics. By only allowing a limited space for short answers, students are encouraged to be precise.
- **Multiple Choice** questions are very versatile and may be especially useful for testing the ability to interpret diagrams, sketches, tables, graphs, and related material. These questions are very easy to grade, and are frequently used in large classes. Unfortunately, it is difficult and time consuming to write good multiple choice questions. If you are teaching a small class, you may want to consider less time consuming test construction. Teachers' manuals, which often accompany textbooks, usually contain some multiple choice questions already prepared.

  Each multiple choice question should contain a stem (consisting of a clear, complete thought or problem, which may be presented as a sentence, a question, or a statement missing a few words) and a set of optional answers. Like the stem, the options should be clear and concise, and the distracters (incorrect answers)

generally should include common misperceptions, true statements that are in the wrong context for the question, and incorrect answers that might sound plausible to naive students. Write out three to five optional answers per question, and hide the correct answer randomly among the distracters. Write options that are nearly equal in length and style. Make certain that there are no verb tense changes and that subject and verb agree from the stem to the options. Try not to use "all of the above" or "none of the above" answers, as these tend to confuse and frustrate students.

- **Completion** questions test for recall of key terms and concepts. These questions usually consist of sentences in which one or more key words have been left blank for students to complete. Make sure that all completion question blanks are of the same length. If the completion blank follows an indefinite article, make sure to write "a/an." Since completion questions that merely copy glossary terms do not assess higher level thinking skills, it is advisable to create original statements that will test a student's ability to apply key terms.
- **Matching** questions are useful for testing recognition of the relationships between pairs of words or between words and definitions. Matching questions are usually composed of a list of stems and an equal or greater list of optional answers to be matched to the stems. The stems may be complete sentences, definitions, short phrases, or single words, such as the name of a major concept, geographical location, or philosophic or scientific principle. The options may be single words or definitions. All options and stems should be of the same length. Supply enough answer choices so that students cannot simply guess by process of elimination. Matching questions are more effective when used in sets of at least five to ten related items.
- **True-False** questions are easy to write and grade, but are not recommended as a dependable means for measuring student learning, except for testing factual recall. If you choose to use true-false questions, avoid creating double negatives, and avoid ambiguity in your statements.

2.4.4 SHORT-ANSWER TESTS

Depending on your objectives, short-answer questions can call for one or two sentences or a long paragraph. Short-answer tests are easier to write, though they take longer to score, than multiple-choice tests. They also give you some opportunity to see

how well students can express their thoughts, though they are not as useful as longer essay responses for this purpose. See "Short-Answer and Essay Tests" for detailed guidelines.

2.4.5 PROBLEM SETS

In courses in mathematics and the sciences, your tests can include problem sets. As a rule of thumb, allow students ten minutes to solve a problem you can do in two minutes. See "Homework: Problem Sets" for advice on creating and grading problem sets.

2.4.6 ORAL EXAMS

Though common at the graduate level, oral exams are rarely used for undergraduates except in foreign language classes. In other classes they are usually time-consuming, too anxiety provoking for students, and difficult to score unless the instructor tape-records the answers. However, a math professor has experimented with individual thirty-minute oral tests in a small seminar class. Students receive the questions in advance and are allowed to drop one of their choosing. During the oral exam, the professor probes students' level of understanding of the theory and principles behind the theorems. He reports that about eight students per day can be tested.

2.4.7 PERFORMANCE TESTS

Performance tests ask students to demonstrate proficiency in conducting an experiment, executing a series of steps in a reasonable amount of time, following instructions, creating drawings, manipulating materials or equipment, or reacting to real or simulated situations. Performance tests can be administered individually or in groups. They are seldom used in colleges and universities because they are logistically difficult to set up, hard to score, and the content of most courses does not necessarily lend itself to this type of testing. However, performance tests can be useful in classes that require students to demonstrate their skills (for example, health fields, the sciences, education). If you use performance tests, Anderson (1987, p. 43) recommends that you do the following (I have slightly modified her list):

- Specify the criteria to be used for rating or scoring (for example, the level of accuracy in performing the steps in sequence or completing the task within a specified time limit).
- State the problem so that students know exactly what they are supposed to do (if possible, conditions of a performance test should mirror a real-life situation).

- Give students a chance to perform the task more than once or to perform several task samples.

2.4.8 "CREATE-A-GAME" EXAMS

For one midterm, ask students to create a board game, word game, or trivia game that covers the range of information relevant to your course. Students must include the rules, game board, game pieces, and whatever else is needed to play. For example, students in a history of psychology class created "Freud's Inner Circle," in which students move tokens such as small cigars and toilet seats around a board each time they answer a question correctly, and "Psychologies," a card game in which players select and discard cards until they have a full hand of theoretically compatible psychological theories, beliefs, or assumptions.

2.4.9 CONSTRUCTING TEST-ITEMS FOR FORMATIVE EVALUATION IN CLASS

General steps

- Identify and define the learning outcomes to be measured
- Prepare test specifications
- Construct relevant test items
- Review and edit the items
- Arrange the items in the test
- Prepare directions

Step 1*: *Identify and define learning objectives

1. State the general objectives.
2. Develop 5 to 15 general objectives.
3. Begin each general objective with one of the six cognitive domain headings of Bloom's Taxonomy
4. State the specific objectives.
5. For each G.O., develop 3-5 specific objectives.
6. Begin each S.O with an action verb.

Step 2: Preparing Test specifications

1. Select the specific outcomes to be tested
2. Outline the subject matter by listing topic and subtopic areas in the lesson plan
3. Make a two-way table of specifications

Step 3: Construct Relevant Test Items and Consider:

1. Selecting the type of test items to use

2. Selecting type items (e.g, multiple choice, true-false, matching, interpretive exercises)

3. Supply type items(e.g, short answer, essay(restricted response), essay (extended response)

4. Matching items to Specific Objectives

5. For each S.O., write one or more related items, Parts of an Item:

i. Stem-the question or incomplete sentence.

ii. Alternatives-the choices

iii. Distractors-the incorrect choices

Step 4: Review and edit the items

1. Does each test item measure an important learning-outcome included in the table of specifications?

2. Is each item type appropriate for the particular learning outcome to be measured?

3. Does each item present a clearly formulated task?

4. Is the item stated in simple, clear language?

5. Is the item free from extraneous clues?

6. Is the difficulty of the item appropriate for the students to be tested?

7. Is each test item independent and are the items, as a group, free from overlapping?

8. Do the items to be included in the test provide adequate coverage of the table of specifications?

Step 5: Arrange the items in the test

1. The items should be arranged so that all items of the same type are grouped together.

2. The items should be arranged in order of increasing difficulty.

3. For some purposes, it may be desirable to group together items which measure the same learning outcomes or the same subject-matter content.

Step 6: Prepare directions

1. Purpose of the test.

2. Time allowed to complete the test.

3. How to record the answers.

4. Whether to guess when in doubt about the answer.

QUESTIONS

1. Explain Bloom's Taxonomy of Educational Objectives.

2. Prepare a model Lesson Plan for any one of the topic in 9th standard Mathematics Text book.

3. Briefly explain the significance of Lesson Plan in teaching Mathematics.

4. Briefly explain the structure and steps involved in the four fold Lesson Plan.

5. Explain the types of test-items and construct test-items for formative evaluation in a class room.

UNIT III PRACTISING THE TEACHING SKILLS IN MATHEMATICS

3.0 MEANING OF TEACHING

The main aim of teaching is to bring about socially desirable behavior change in the students and this can only be achieved if the teaching is effective and based on the principles of teaching. How the pupils will learn effectively, depends on the methods the teacher adopts. There is the great world outside and the mind within and it is the duty of the teacher to bring the two together. This process of interpreting the world of knowledge to the child's mind is called the 'Method of teaching'. It is just a way of teaching. Method is the style of presentation of the content to the classroom.

3.0.1 DEFINITION OF TEACHING SKILL

* A teaching skill is that behaviour of the teacher which facilitates pupils' learning directly or indirectly.

* A teaching skill includes all arts and behaviour of the teacher which maximizes pupils' learning.

*A teaching skill is that art of the teacher which makes communication between the teacher and pupils sufficiently.

3.1 MAJOR TEACHING SKILLS

S.No	List of Skills	Component of the Skill
1	INTRODUCING	1a) Preliminary Attention Gaining 1b) Use of previous knowledge. 1c) Use of appropriate Device. 1d) Link with a new topic **Attention Gaining** i) Use of voice to focus interest ii) Use of audio-visual aids iii) Use of gestures/eye contact iv) Introducing something unusual

		• **Motivation Stimulation** i) To arouse curiosity ii) Use of storytelling technique iii) Able to involve students
2	**EXPLAINING**	1.Beginning statement; 2.Explaining links; 3.Concluding statement; 4.Questions to test pupils' understanding; 5.Irrelevant statement, 6.Lacking in continuity, 7.Vague words and phrases.
3	**QUESTIONING**	**1.** Lower Order Questions 2 Middle Order Questions 3 Higher Order Questions
4	**VARYING THE STIMULUS**	1. Movements. 2. Gestures. 3. Change in Speech Pattern. 4. Change in Interactions Style. 5. Focusing. 6. Pausing. 7. Oral-visual Switching.
5	**NON-VERBAL CUES**	Kinesics (body language) Proxemics (proximity) Haptics Touch Oculesics Eye contact Chronemics Use of time, waiting, pausing Olfactics Smell Vocalics Tone of voice, timbre, volume, speed **Sound symbols** **Silence** Pausing, waiting, secrecy **Posture** Position of the body, stance **Adornment** Clothing, jewellery, hairstyle **Locomotion** Walking, running, staggering,

		limping
6	**REINFORCEMENT**	1. Positive Verbal Reinforcement. 2. Positive Non-Verbal Reinforcement. 3. Negative Verbal Reinforcement. 4. Negative Non-Verbal Reinforcement. 5. Wrong use of Reinforcement. 6.Inappropriate use of Reinforcement
7	**CLOSURE**	Closure is the act of reviewing and clarifying the points of a lesson, tying them together into a coherent whole, and ensuring their utility in application by securing them in the student's conceptual network.
8	**FLUENCY IN COMMUNICATION**	**Slow Down Your Speaking Speed** Give Yourself Time to Think Learn Sentences, Not Only Words **Learn to Listen** Practise Your Interrogatives Produce, Produce, Produce

3.1.1 INTRODUCTION SKILL

This is the pre-instructional technique when you begin a lesson you have to give a brief introduction. Such introduction influences the students attitude and secures attention.

COMPONENTS

- Preliminary Attention Gaining
- Use of previous knowledge.
- Use of appropriate Device.
- Link with a new topic
- Attention Gaining
- i) Use of voice to focus interest

- ii) Use of audio-visual aids
- iii) Use of gestures/eye contact
- iv) Introducing something unusual
- • Motivation Stimulation
- i) To arouse curiosity
- ii) Use of storytelling technique
- iii) Able to involve students

PRELIMINARY ATTENTION GAINING

It has been mostly seen that at the beginning of the lesson, the learners are found not to be attentive and mentally prepared for learning in such a situation the primary duty of a teacher is to create a desire for learning among the learners.

USE OF PREVIOUS KNOWLEDGE

Previous knowledge refers to the learner's level of achievement before instruction begins. Use of previous knowledge helps the establish integration between the pre-existed knowledge of the learners and the new knowledge that the teacher wants to impart.

USE OF APPROPRIATE DEVICE

In order to motivate the learners, the teacher should make use of appropriate device or technique while introducing a lesson.

E.g. dramatization, models, audio-visual aids, flash cards, flip cards, etc..,

LINK WITH NEW TOPICS

After preliminary questions and introduction, teacher should establish a link of the previous knowledge with present topic.

3.1.2 SKILL OF EXPLANATION

Explanation is the set of inter-related statement to make students understand ideas, concept, formulas, principles, laws, etc..,

COMPONENTS

- Beginning statement;

- Explaining links;
- Concluding statement;
- Questions to test pupils' understanding;
- Irrelevant statement,
- Lacking in continuity,
- Vague words and phrases.

BEGINNING STATEMENT

The purpose of this statement is to create readiness among the pupils to pay attention to the point being explained. It is the introductory statement to begin explanation.

EXPLAINING LINKS

These words and phrases which are mostly conjunctions and prepositions and are generally used by the teachers to make his explanation effective.

- These are : the result of, the cause, therefore, in order to, before, hence, since, next, etc..,

CONCLUDING STATEMENT

This is the statement made at the end of the explanation. It includes the summary of all the main results of the explanation.

QUESTIONS TO TEST PUPILS' UNDERSTANDING

These are short questions put to the pupils to test their understanding of the concept after the explanation. The main purpose is simply to judge whether the pupils have understood or not.

Don'ts - IRRELEVANT STATEMENTS

These statements sometimes made by the teacher during explanation which have nothing to do with the present concept. These statements do not contribute to understanding rather create confusion in the minds of the students.

LACKING IN CONTINUITY

- It happens when the sentences remain incomplete or are reformulated in the middle of the statement and there are other causes also like :
- a statement is not logically related to the previous statement.
- when a topic of previously taught content is referred without showing the relationship to what is being explained.

- when there is no sequence of space or place.
- use of inappropriate vocabulary of technical terms which are quite unknown to pupils.

VAGUE WORDS AND PHRASES

- Do not give explicit idea about concept.
- Hinders students understanding.
- For eg. May, actually, you know, somewhat.

3.1.3 SKILL OF 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 though 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.

3.1.4 SKILL OF STIMULUS VARIATION

The deliberate change of behaviours of the teacher in the class room teaching to arrest and maintain pupils attention towards the lesson is called stimulus variation.

COMPONENTS

- Movements.
- Gestures.
- Change in Speech Pattern.
- Change in Interactions Style.
- Focusing.
- Pausing.
- Oral-visual Switching.

MOVEMENTS

Making movements from one place to another with some purpose. (For writing on the black board; to conduct experiment; to explain the chart or model; to pay attention to the pupil who is responding to some question etc.)

GESTURES

These include movements of head, hand and body parts to arrest attention, to express emotions or to indicate shapes, sizes and movements. All these acts are performed to become more expressive.

CHANGE IN SPEECH PATTERN

When the teacher wants show emotions or to put emphasis on a particular point, sudden or radical changes in tone, volume or speed of the verbal presentation are brought out. The change in the speech pattern makes the pupils attentive and creates interest in the lesson.

CHANGE IN INTERACTION STYLE

- When two or more persons communicate their views with each other, they are said to be interacting.
- In the classroom the following three styles of interaction are possible :

1. Teacher ↔ class (Teacher talks to class and vice versa)
2. Teacher ↔ Pupil (Teacher talks to pupil and vice versa)
3. Pupil ↔ pupil (Pupil talks to pupil)

All types of interaction should go side by side to secure and sustain pupils' attention.

FOCUSING

The teacher draws the attention of the pupils to the particular point in the lesson either by using verbal or gestural focusing.

In verbal focusing the teacher makes statements like, “look here” “listen to me” “note it carefully”. In gestural focusing pointing towards some object with fingers or underlining the important words on the black board.

PAUSING

This means “stop talking” by the teacher for a moment. When the teacher becomes silent during teaching, it at once draws the attention of the pupils with curiosity towards the teacher. The message given at this point is easily received by the pupils.

ORAL-VISUAL SWITCHING

The teacher gives information to the class verbally about something. This is called oral medium. When the teacher is showing maps, charts and object without saying something. This is called visual medium. If the teacher is giving information to the pupils through any one medium (oral, visual, oral visual) for a long time., it is possible that the students may lose attention to what the teacher is conveying to them. Therefore it is essential for the teacher to change medium rapidly in order to secure and sustain pupils’ attention to what he says.

- Oral ⇄ oral –visual :- when the teacher while speaking shows objects, charts and models and explains their various parts. It is switching from oral to oral-visual.
- Oral ⇄ visual :- when the teacher while speaking, shows objects, maps, charts, globe etc. It is switching form oral to visual.
- Visual ⇄ oral – visual when the teacher demonstrates the experiment silently and then explains the phenomenon with the help of charts, maps, diagram etc. It is visual-oral switching.

3.1.5 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.

COMPONENTS

Kinesics (body language)

Proxemics (proximity)

Haptics Touch

Oculesics Eye contact

Chronemics Use of time, waiting, pausing

Olfactics Smell

Vocalics Tone of voice, timbre, volume, speed

Sound symbols

Silence Pausing, waiting, secrecy

Posture Position of the body, stance

Adornment Clothing, jewellery, hairstyle

Locomotion Walking, running, staggering, limping

3.1.6 SKILL OF REINFORCEMENT

Every responding pupil of the class needs social approval of his behaviour. To satisfy his need, he is always eager to answer each question known to him. If the teacher is encouraging the pupils by statements like, "good"; that is very good and certain non-verbal expressions, as smiling, nodding the head; and paying attention to the responding pupil, the pupil participation in the class is maximized.

COMPONENTS

- Positive Verbal Reinforcement.
- Positive Non-Verbal Reinforcement.
- Negative Verbal Reinforcement.
- Negative Non-Verbal Reinforcement.
- Wrong use of Reinforcement.
- Inappropriate use of Reinforcement.
-

POSITIVE -VERBAL REINFORCEMENT

These are the positive comments given by the teacher on the correct response of the pupil. They are:

- Using words and phrases like, “good”, “very good” and excellent.
- Repeating and rephrasing pupil’s response.
- Using pupils idea in the development of the lesson.
- Using extra-verbal cues, like “um”, “um”, “aha” to encourage pupils.
- Using prompts like carry on, think again etc. to help the pupil give correct response.
-

POSITIVE NON -VERBAL REINFORCEMENT

The teacher gives comments to pupils on their correct response without using words : This he does by : nodding the head, smiling, patting, looking attentively at the responding pupil, writing pupil’s answer on the black boards. The teacher encourages the pupils to participate maximally in the development of the lesson.

NEGATIVE VERBAL REINFORCEMENT

The teacher gives comments on the incorrect or partially incorrect response by telling that the pupil’s response is incorrect or making sarcastic remarks like “idiots”, “stupid” etc. Such behaviour of the teacher discourages pupil-participation and should not be used.

NEGATIVE NON -VERBAL REINFORCEMENT

The teacher shows his disapproval without using words. This involves, frowning, staring, looking angrily at the responding pupil, when he gives wrong response. This type of behaviour of the teacher creates fear in the minds of the pupil and decreases pupil-participation.

WRONG USE OF REINFORCEMENT

This is the situation, where the teacher does not give reinforcement when the situation is demanding encouragement.

INAPPROPRIATE USE OF REINFORCEMENT

This is the situation when the teacher does not encourage the pupil with respect to quality of his response. He uses same type of comment for every response**.**

3.1.7 SKILL OF 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.

COMPONENTS

Slow Down Your Speaking Speed

Give Yourself Time to Think

Learn Sentences, Not Only Words

Learn to Listen

Practise Your Interrogatives

Produce, Produce, Produce

3.1.8 SKILL OF CLOSURE

Closure is the act of reviewing and clarifying the points of a lesson, tying them together into a coherent whole, and ensuring their utility in application by securing them in the student's conceptual network.

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.

3.2 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 shold 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.

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.

MINI LESSON

Name of the student teacher	: ----------
Subject	: MATHEMATICS
Topic	: WORK
Focus	: Scalar, Vector Quantity
Date	:
Time	: 10 - 10.20 AM

OBJECTIVES

1. Acquires knowledge of the scientific meaning of work.
2. Understands the knowledge of the use of scalar product to represent quantity of work done.
3. Develops an understanding of activities where work is done and not done.
4. Application of knowledge in day-to -day activities of life.

MATERIALS

1. Chart illustrating different activities
2. Hammer
3. Saw
4. Rubber band
5. Pinwheel
6. Attached to string

7. Magnet

CONTENT OUTLINE

1. Meaning of work
2. Scalar product to represent quantity of work
3. Description of where work is done and not done
4. Procedure to find how scalar product is used to define work
5. Identification of work in day-to-day life

TEACHING SKILLS

1. Skill of Introduction
2. Skill of Explaining
3. Skill of Questioning
4. Skill of Stimulus Variation
5. Skill of Closure

INSTRUCTIONAL PROCEDURES AND ACTIVITIES:

MOTIVATION (Skill of Introduction – use of previous knowledge)

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

1. What do you know about work?
2. Do you work every day?
3. Would you call every activity 'work'?
4. How would you define work?
5. In science, when we use the term 'work' what do you mean?

PRESENTATION

The teacher announces the topic as "work done as a scalar product" and writes it on the black board. **(Skill of Explaining – Cognitive link)**

1. Work is done by a force or against the direction of a force when the point of application of the force moves in or against the direction of the loree.
2. Forces such as muscles, objects lifted, objects stretched, wind, water, laminar objects.
3. The teacher uses aids like a lifted hammer or saw, a stretched rubber band that lifts weights, a pinwheel, magnet etc,.. to demonstrate these**3** forces**. (skill of Explaining – uses of Illustrations)**
4. Could you name some of the forces man has at his disposal to overcome friction, gravity, inertia?

5. Objects, magnets, electric current ***(Recalls)***

6. The teacher writes on the board scalar product.

7. Students as you all know that work involves force and distance. These both are vectors but work is a scalar. How is this possible? **(Skill of Questioning – Relevancy)**

8. The teacher expresses scalar product of **2** vectors : As the scalar quantity that we find when we multiply the magnitude of one vector by the component of a second vector along the direction of the first.

9. The scalar product gives the quantity of work alone. It is the product of the magnitude of force and the component of distance parallel with force. ***(Recognizes)***

INTERACTION: (Skill of Questioning – Specificity)

1. When will the scalar product be zero?

2. When will it be maximum?

3. What will happen if Ø =180 0?

4. What am I doing? Is the work done here positive or negative?

i. The teacher points out by lifting an object form floor to table. Here the produce is positive since the vectors re in same direction.

ii. When the two factors are in opposite direction product is negative.

5. Whe n is "no work" done?

i. The teacher whirls a ball around to demonstrate no work.

REFLECTION: (Skill of Stimulus Variation – Audiovisual Switching)

The teacher now shows the chart illustrating different activities and asks pupils to identify cases where positive work, negative work and no work is done.

SUMMING UP: (Skill of Closure – Consolidation of major points)

1. Work is done when a force is exerted or overcome over a distance.

2. When we multiply the magnitude of one vector by the component of a second vector along the direction of the first.

3. When an object is lifted vectors in the same direction work positive.

4. The two factors are in opposite directions product is negative.

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.

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.

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

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 student teacher

OBSERVATION AND FEEDBACK ON INTEGRATION OF TEACHING STEPS

IN MINI-TEACHING

INTEGRATING THE STEPS IN MINI TEACHING
(Assessment by Peers/Teacher Education)

TEACHING STEPS	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				

Range of scores: 8-24

OVERALL ASSESSMENT OF TEACHING STEPS

AVERAGE ____ GOOD ____ VERY GOOD_____

Interpretation of scores

Average : 8 Good : 9-16 Very Good :17-24

Signature of the student teacher

QUESTIONS

1. Briefly explain the major steps in teaching a mini lesson.

2. Write a mini-lesson with multiple teaching skills for class IX .

3. Explain the mini lesson format.

4. Critically analyse the skill of varying the stimulus.

5. Explain the skill of explaining with its components.

UNIT IV METHODS OF TEACHING MATHEMATICS

4.0 TEACHER-CENTERED METHODS

4.0.1 LECTURE METHOD

Lecture is a teaching method where a teacher is the central focus of information transfer. Typically, a teacher will stand before a class and present information for the students to learn. Sometimes, they will write on a board or use an overhead projector to provide visuals for students. Students are expected to take notes while listening to the lecture. Usually, very little exchange occurs between the instructor and the students during a lecture.

PLANNING A LECTURE-INTRODUCTION

The introduction usually is the first three to five minutes of the lecture. This time is crucial in determining how well students learn and retain the information to be presented. The main purpose is to provide a framework for students' learning, providing the structure for the lecture's content information. It is also necessary to gain students' attention. If we fail to capture students' attention during the introduction, it is unlikely that we will retain it during the rest of the lecture. The introduction should do the following:

Gain attention and foster motivation. Relate to students' goals and interests. You might present a meaningful problem to students and describe the lecture as a solution to the problem. In a constitutional law class, for example, the instructor could begin a lecture by discussing popular efforts to place warning labels on rock music and then suggest that a closer examination of the First Amendment and freedom of speech will help students to decide if warning labels are a form of censorship. You might also introduce the lecture by describing how it will help students to be successful in their education and careers or by relating it to your students' inherent curiosity (as in the previous example where rock music was used to address censorship).

Prompt awareness of relevant pre-existing knowledge. Students need to see how the "new" lecture information relates to their existing knowledge or experience. This not only promotes interest and motivation, but also is a first step in cognitive information processing. The instructor of a biology class, for example, might begin a lecture on DNA: "Three weeks ago we spoke about hereditary traits and how certain physical traits are

passed to the next generation. Today we are going to make those abstract laws concrete by looking at how DNA works."

Clarify the purpose of the lecture and describe how it is organized. Research supports a correlation between clarity of objectives and student achievement; students will achieve at higher levels if they know what knowledge and skills they should gain from this instruction. This can be accomplished by doing the following:

Announce the lecture topic as a title.

BODY OF THE LECTURE

The body of the lecture covers the content in an organized way. Since this component is allotted the greatest amount of class time, it includes many more teaching procedures than the introduction and conclusion. This is where you must consult your lecture notes while at the same time maintaining rapport with your students.

Lecture material is a combination of facts, concepts, principles, and generalizations. Concepts represent a class of terms (an idea usually expressed in a word), and principles communicate relationships among concepts. Generalizations are relationships between or among concepts expressed at a higher level of abstraction than a principle. In a lecture, the tendency might be to present one fact after another. This type of information giving is ineffective because students cannot see the relationship or organization of the new ideas. Instead, it is best to present a concept (one idea) by first defining it and then giving many concrete examples of the concept. As you introduce new concepts, link them together into principles, and then into generalizations, each time adding concrete examples as you develop these relationships.

Concepts: Revolution, Economics Principles: If wages are cut, then the likelihood of disgruntled labor supporting a revolution will increase. Generalization: Economic instability can lead to political revolution. Fact: Membership in American communist parties increased substantially during the Great Depression of the 1930s. In addition, a lecture should be organized based on the relationship of the ideas presented. Examples of relationships that can be used to organize lecture information include the following:

Component (part to whole) –shows how a larger idea is composed of several smaller ones. "Before we can begin to talk about how urban planners tackle traffic congestion, we need to look at how psychology, economics and tradition contribute to the present-day layout of cities."

Sequential –deals with chronological or cause/effect relationships. "Although the causes are quite complex, let's look at how mass unionization in the 1930s contributed to prosperity in the 1950s."

Material to purpose –information or a procedure is presented followed by its purpose or use (the "what" followed by the "why"). "Now that we know what Marxism is, let's look at how Marxist theory can be used to address inequality between men and women."

Comparison –comparing two or more things using an explicit basis for comparison. "The recent reintroduction of the gray wolf into Yellowstone National Park once again demonstrates the inherent conflict between environmentalists and business, in this case ranchers. In the next twenty minutes, let us compare the Yellowstone controversy to efforts twenty years ago to clean up Love Canal and see if we can use this comparison to look for ways in which environmental and business interests can learn to work together.

Use transition words as you present. Using transitions or links ("therefore," "because," "as a result") show how pieces of lecture information relate to each other. Verbal or oral cues also alert students to more significant information.

It is especially important to remember. . .
Please note the following . . .
You will need to memorize. . .
I will ask you to recognize . . .
You should be able to apply . . .

Remember to include audiovisual aids while delivering your lecture. Using Power Point slides, transparencies, or even the chalkboard will enliven and strengthen the presentation of ideas and, thus, assist students' learning.

INCLUDE ACTIVE LEARNING

It is crucial to provide opportunities for active learning during any instruction, including a lecture. Active learning allows students opportunity to practice using the lecture information and obtain feedback on the accuracy of their responses. For example, during he lecture, ask questions or give students problem-solving activities that encourage them to use the information they should gain from the lecture. You could encourage

students to think actively during a lecture by announcing at the beginning of the class period that you will interrupt your lecture midway so that students may write a one-minute paper on a topic derived from the lecture. At the end of the lecture, you can use the "minute paper" by asking students to respond in one or two sentences to the following questions:

What stood out as most important in today's lecture?

What ideas from today's lecture are still unclear?

CAPTURE ATTENTION

Maintain Attention throughout your lecture by employing techniques such as the following:

- ✓ Vary student activities–lecture for 15 minutes and then provide an active learning activity.
- ✓ Change the mode of presentation (for example, oral to visual).
- ✓ Employ concept-related humor.
- ✓ Demonstrate enthusiasm about your subject.
- ✓ Encourage note taking by speaking slowly and repeating important information.
- ✓ Provide motivational cues ("On the next exam you will be asked to . . .").

The Conclusion

The conclusion , the most frequently neglected component of the lecture, should be used to reinforce students' learning of the information as well as to clarify any misconceptions regarding their understanding of the concepts presented. Try to do the following in your lecture conclusion:

Repeat and emphasize main points. Signal students that you are going to summarize and reemphasize main points. Or, even better, have several students summarize your main points. This procedure will help you to get feedback as to whether or not students identified the important information. It is also helpful to rephrase information in order to clarify key ideas.

Encourage questions from students. To allow students time to review their notes and thoughts, pause for a few moments after asking for questions. Remember, however, that it is often difficult for students to respond to the vague "Any questions?" Instead, ask specific, leading questions. By doing so, you will encourage your students to review their notes and formulate questions of their own. In this way, any misconceptions can be clarified, and understanding can be reinforced.

Relate content to previous and subsequent topics. The last few statements in the conclusion should provide a connection between this lecture and previous lectures (as well as those to follow). As students see the relationship among major concepts presented in different lectures, they gain a sense of direction.

LECTURE DELIVERY

Nonverbal behaviors play a significant role in effective public speaking: they can enrich or elaborate the spoken message. There are basically two aspects to nonverbal behavior: body Language and voice.

The following four elements make up body language

Speaker-audience distance. The more objects and distance–psychological as well as physical–between speaker and audience, the more formal the atmosphere. If you desire to create a more informal atmosphere, you should reduce these barriers. Move from behind the lectern from time to time and walk in the aisles as you present information or carry on discussions with students.

Body movement and stance. To communicate, you must compensate for distance by employing larger gestures and more volume. Body movement and posture can convey messages to your audience. For example, slouching communicates disinterest or boredom, pacing aimlessly with head down indicates nervousness, and standing stiffly indicates tenseness. Being animated during your lecture helps convey your own enthusiasm and interest to students; they recognize that you are not bored, nervous or tense.

Facial expressions. A significant portion of the emotional impact of a speaker's message is conveyed by facial expressions. Facial expressions tell students how you feel about them and yourself and give students cues to help them interpret the content of the message. Regular eye contact helps you establish credibility. Look directly at different individuals as though you were carrying on a conversation with them.

Gestures. Purposeful movements of the head, arms, hands and shoulders accentuate or dramatize ideas. Three characteristics of effective gestures include relaxation, vigor, and timing. Use your body to indicate a change of topic or transition.

Voice variables allow the speaker to make a message clear and interesting. Some of the vocal characteristics of good speaking are as follows:

Strength. Speak loudly enough so that the audience does not have to strain to hear.

Enunciation. Make an effort to speak crisply, avoiding slurring or skipping parts of words in order to limit the possibility of misunderstanding.

Pronunciation. Meet your audience's expectations in regard to acceptable pronunciation.

Rate of speech. In a large lecture, with students concentrating on note taking, a rate of 120-130 words per minute is comfortable.

Variety. Vary the characteristics of your voice in terms of rate, pitch, stress, pauses, volume and inflection.

Pauses. Pauses can provide emphasis and allow students time to think and take notes. Furthermore, pausing indicates that you are a conscientious speaker who thinks about what you are going to say. However, filling in pauses with sounds like "um," "ah," "well-uh" make a presentation seem disconnected and can be distracting.

MERITS OF LECTURE AS A TEACHING METHOD

- Lectures are a straightforward way to impart knowledge to students quickly.
- Instructors also have a greater control over what is being taught in the classroom because they are the sole source of information.
- Students who are auditory learners find that lectures appeal to their learning style.
- Logistically, a lecture is often easier to create than other methods of instruction.
- Lecture is a method familiar to most teachers because it was typically the way they were taught.
- Because most teachers by default follow lecture-based methods, students gain experience in this predominant instructional delivery method.
- It provides an economical and efficient method for delivering substantial amounts of information to large numbers of student.
- It affords a necessary framework or overview for subsequent learning, e.g., reading assignments, small group activities, discussion.
- It offers current information (more up to date than most texts) from many sources.
- It provides a summary or synthesis of information from different sources.
- It creates interest in a subject as lecturers transmit enthusiasm about their discipline.

DEMERITS OF LECTURE AS A TEACHING METHOD

- Students strong in learning styles other than auditory learning will have a harder time being engaged by lectures.
- Students who are weak in note-taking skills will have trouble understanding what they should remember from lectures.
- Students can find lectures boring causing them to lose interest.
- Students may not feel that they are able to ask questions as they arise during lectures.
- Teachers may not get a real feel for how much students are understanding because there is not that much opportunity for exchanges during lectures.
- It does not afford the instructor with ways to provide students with individual feedback.
- It is difficult to adapt to individual learning differences.
- It may fail to promote active learning unless other teaching strategies, such as questioning and problem-solving activities, are incorporated into the lecture.
- It does not promote independent learning.

FOR A SUCCESSFUL LECTURE

Present an outline of the lecture (use the blackboard, overhead transparency or handout) and refer to it as you move from point to point.

- Repeat points in several different ways. Include examples and concrete ideas.
- Use short sentences.
- Stress important points (through your tone or explicit comments).
- Pause to give listeners time to think and write.
- Use lectures to complement, not simply repeat, the text.
- Learn students' names and make contact with them during the lecture.
- Avoid racing through the last part of the lecture. This is a common error made by instructors wishing to cram too much information into the allotted time.
- Schedule time for discussion in the same or separate class periods as the lecture.

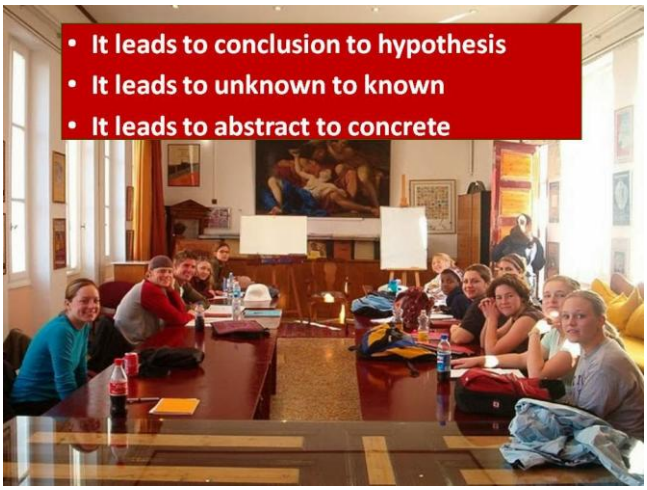
- PREPARE. Preparation reduces stress, frustration, insecurity and consequent ineffectiveness.

Lectures are one tool in a teacher's arsenal of teaching methods. Just as with all the other tools, it should only be used when most appropriate. Instruction should be varied from day to day to help reach the most students possible. Teachers should be cautioned that before heading into numerous classes full of nothing but lectures, they need to provide their students with note taking skills. Only by helping students understand verbal clues and learn methods of organizing and taking notes will they truly help them become successful and get the most out of lectures.

4.0.2 ANALYTICAL METHOD

The word “analytic” is derived from the word “analysis” which means “breaking up” or resolving a thing into its constituent elements. The original meaning of the word analysis is to unloose or to separate things that are together. In this method we **break up** the unknown problem into simpler parts and then see how these can be recombined to find the solution. So we start with what is to be found out and then think of further steps or possibilities the may connect the unknown built the known and find out the desired result. It is believed that all the highest intellectual performance of the mind is Analysis.

- It is derived from the word analysis, its means breaking up.
- It leads to conclusion to hypothesis
- It leads to unknown to known
- It leads to abstract to concrete



Example:

if $a^2+b^2=7ab$ prove that 2log (a+b) = 2log3+loga+logb

Proof:

To prove this using analytic method, begin from the unknown.

The unknown is 2log (a+b) = 2log3+loga+logb

Now, 2log (a+b) = 2log 3+ log a+ log b is true

If $\log (a+b)^2 = \log 3^2 + \log a + \log b$ is true

If $\log (a+b)^2 = \log 9 + \log ab$ is true

If $\log (a+b)^2 = \log 9ab$ is true

If $(a+b)^2 = 9ab$ is true

if $a^2+b^2=7ab$ which is known and true

Thus if $a^2+b^2= 7ab$ prove that 2log (a+b) = 2log3+loga+logb

MERITS

- It develops the power of thinking and reasoning
- It develops originality and creativity amongst the students.
- It helps in a clear understanding of the subject because the students have to go thorough the whole process themselves.
- There is least home work
- Students participation is maximum
- It this method student's participation is encouraged.
- It is a psychological method.
- No cramming is required in this method.
- Teaching by this method, teacher carries the class with him.
- It develops self-confidence and self reliant in the pupil.
- Knowledge gained by this method is more solid and durable.
- It is based on heuristic method.

DEMERITS

- It is time consuming and lengthy method, so it is uneconomical.
- In it, facts are not presented in a neat and systematic order.
- This method is not suitable for all the topics in mathematics.
- This does not find favour with all the students because below average students fail to follow this method.

❖ Every teacher cannot use this method successfully.

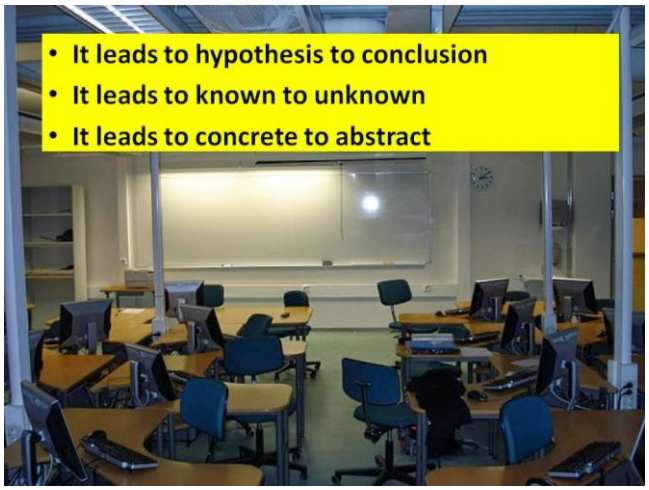
So this method is particularly suitable for teaching of Arithmetic, algebra and Geometry as it analyses the problem into sub-parts and various parts are reorganized and the already learnt facts are used to connect the known with unknown. It puts more stress on reasoning and development of power of reasoning is one of the major aims of teaching of mathematics.

4.0.3 SYNTHETIC METHOD

In this method we proceed from known to unknown. Synthetic is derived form the word "synthesis". Synthesis is the complement of analysis.

To synthesis is to combine the elements to produce something new. Actually it is reverse of analytic method. In this method we proceed "from know to unknown." So in it we combine together a number of facts, perform certain mathematical operations and arrive at a solution. That is we start with the known data and connect it with the unknown part.

- ❖ It leads to hypothesis to conclusion
- ❖ It leads to known to unknown
- ❖ It leads to concrete to abstract



Example :

if $a^2+b^2=7ab$ prove that $2\log (a+b) = 2\log 3+\log a+\log b$

Proof:

To prove this using synthetic method, begin from the known.

The known is $a^2+b^2= 7ab$

Adding 2ab on both sides

$a^2+b^2+2ab=7ab + 2ab$

$(a+b)^2 = 9ab$

Taking log on both sides

$\log (a+b)^2 = \log 9ab$

$2\log (a+b) = \log 9 + \log ab$

$2 \log (a+b) = \log 3^2 + \log a + \log b$

$2\log (a+b) = 2\log 3 + \log a + \log b$

Thus if $a^2+b^2=11ab$ prove that $2\log (a-b) = 2\log3+\log a+\log b$

MERITS

- It saves the time and labour.
- It is short method
- It is a neat method in which we present the facts in a systematic way.
- It suits majority of students.
- It can be applied to majority of topics in teaching of mathematics.
- It glorifies the memory of the child.
- Accuracy is developed by the method

DEMERITS

- It is an un psychological method.
- There is a scope for forgetting.
- It makes the students passive listeners and encourages cramming
- In this method confidence is generally lacking in the student.
- There is no scope of discovery.
- The recall of each step cannot be possible for every child.

DIFFERENCE BETWEEN ANALYTIC AND SYNTHETIC METHOD

ANALYTIC METHOD	SYNTHETIC METHOD
Meaning: Analysis means breaking up into components	***Meaning:*** Synthesis means combining the elements to get something new.
Leads from: Unknown to known Conclusion to	***Leads from:*** Known to unknown Hypothesis to

hypothesis Abstract to concrete Complex to simple	conclusion Concrete to abstract Simple to complex
Method: A method of discovery and thought A psychological method	***Method:*** A method for the presentation of discovered facts. A logical method
Time: Lengthy, laborious and time consuming	***Time:*** Short, concise and elegant.
Sequence: Valid reasons to justify every step in the sequence.	***Sequence:*** No justification for every step in the sequence.
Learning: Encourages meaningful learning. Easy to discover	***Learning:*** Encourages rote learning. Once forgotten not easy to recall
Encourages: Encourages originality of thinking and reasoning	***Encourages:*** Encourages memory work
Learning: Informal and disorganized	***Learning:*** Formal, systematic ad orderly
Thinking: Process of thinking	***Thinking:*** Product of thinking
Participation: Active participation of the learner	***Participation:*** Learner is a passive listener

Though both analytic and synthetic method seems to oppose each other, they complement and support each other. Analysis leads to synthesis and synthesis makes the purpose of analysis clear and complete. The teacher while teaching can use analytic methods and can encourage the student to present them in the synthetic method.

4.0.4 INDUCTIVE METHOD

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

Inductive approach proceeds from

- Particular cases to general rules of formulae
- Concrete instance to abstract rules
- Known to unknown
- Simple to complex

STEPS USING IN THIS METHOD

(a) Presentation of Examples

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

(b) Observation

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

(c) Generalization

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

(d) Testing and verification

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

Example 1:

Square of an odd number is odd and square of an even number is even.

Solution:

Particular concept:

$1^2 = 1$ $3^2 = 9$ $5^2 = 25$ equation 1

$2^2 = 4$ $4^2 = 16$ $6^2 = 36$ Equation 2

General concept:

From equation 1 and 2, we get

Square of an odd number is odd

Square of an even number is even.

Example 2 :

Sum of two odd numbers is even

Solution:

Particular concept:

1+1=2

1+3=4

1+5=6

3+5=8

General concept:

In the above we conclude that sum of two odd numbers is even

Example 3 :

Law of indices $a^m \times a^n = a^{m+n}$

Solution:

We have to start with $a^2 \times a^3 = (a \times a) \times (a \times a \times a)$

$= a^5$

$= a^{2+3}$

$a^3 \times a^4 = (a \times a \times a) \times (a \times a \times a \times a)$

$= a^7$

$= a^{3+4}$

Therefore $a^m \times a^n$ = (axax….m times)x(axa …n times)

$a^m \times a^n = a^{m+n}$

MERITS

- It enhances self confident
- It is a psychological method.
- It is a meaningful learning
- It is a scientific method
- It develops scientific attitude.
- It develops the habit of intelligent hard work.
- It helps in understanding because the student knows how a particular formula has been framed.
- Since it is a logical method so it suits teaching of mathematics.
- It is a natural method of making discoveries, majority of discoveries have been made inductively.
- It does not burden the mind. Formula becomes easy to remember.

This method is found to be suitable in the beginning stages. All teaching in mathematics is conductive in the beginning.

DEMERITS

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

APPLICABILITY OF INDUCTIVE METHOD

Inductive approach is most suitable where

- Rules are to be formulated
- Definitions are be formulated
- Formulae are to be derived
- Generalizations or law are to be arrived at.

4.0.5 DEDUCTIVE METHOD

Deductive method is based on deduction. In this approach we proceed from general to particular and from abstract and concrete. At first the rules are given and then students are asked to apply these rules to solve more problems. This approach is mainly used in Algebra, Geometry and Trigonometry because different relations, laws and formulae are used in these sub branches of mathematics. In this approach, help is taken from assumptions, postulates and axioms of mathematics. It is used for teaching mathematics in higher classes.

Deductive approach proceeds form

- General rule to specific instances
- Unknown to know
- Abstract rule to concrete instance
- Complex to simple

STEPS IN DEDUCTIVE APPROACH

Deductive approach of teaching follows the steps given below for effective teaching

Clear recognition of the problem

Search for a tentative hypothesis

Formulating of a tentative hypothesis

Verification

Example 1:

Find a^2 X a^{10} = ?

Solution:

General : a^m X a^n = a^{m+n}

Particular: a^2 X a^{10} = a^{2+10} = a^{12}

Example 2:

Find $(102)^2$ = ?

Solution:

General: $(a+b)^2 = a^2+b^2+2ab$

Particular: $(100+2)^2 = 100^2 + 2^2 + (2 \times 100 \times 2)$

$= 10000+4+400= 10404$

MERITS

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

DEMERITS

- It is not a psychological method.
- It is not easy to understand

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

APPLICABILITY OF DEDUCTIVE APPROACH

Deductive approach is suitable for giving practice to the student in applying the formula or principles.

DIFFERENCE BETWEEN INDUCTIVE AND DEDUCTIVE METHOD

INDUCTIVE METHOD	**DEDUCTIVE METHOD**
Base:	***Base:***
Inductive reasoning	Deductive reasoning
Proceeds from:	***Proceeds from:***
Particular to general	General to particular
Concrete to abstract	Abstract to concrete
Method:	***Method:***
A psychological method	An unpsychological method
A method of discovery and stimulates intellectual powers	A method of presentation and does not develop originality and creativity.
Learning:	***Learning:***
Emphasis is on reasoning.	Emphasis is on memory
Encourages meaningful learning	Encourages rote learning.
Level:	***Level:***
Most suitable for initial stages of learning	Suitable for practice and application
Class:	***Class:***
Suitable for lower classes	Most suitable for higher classes
Participation:	***Participation:***
Enhances active participation of the	Makes the student passive recipient of

students	knowledge
Time:	***Time:***
Lengthy, time consuming and laborious	Short, concise and elegant
Facilitates discovery of rules and generalizations	Enhances speed, skill and efficiency in solving problems

Induction and deduction are not opposite modes of thought. There can be no induction without deduction and no deduction without induction. Inductive approach is a method for establishing rules and generalization and deriving formulae, whereas deductive approach is a method of applying the deduced results and for improving skill and efficiency in solving problems. Hence a combination of both inductive and deductive approach is known as “inducto-deductive approach” is most effective for realizing the desired goals.

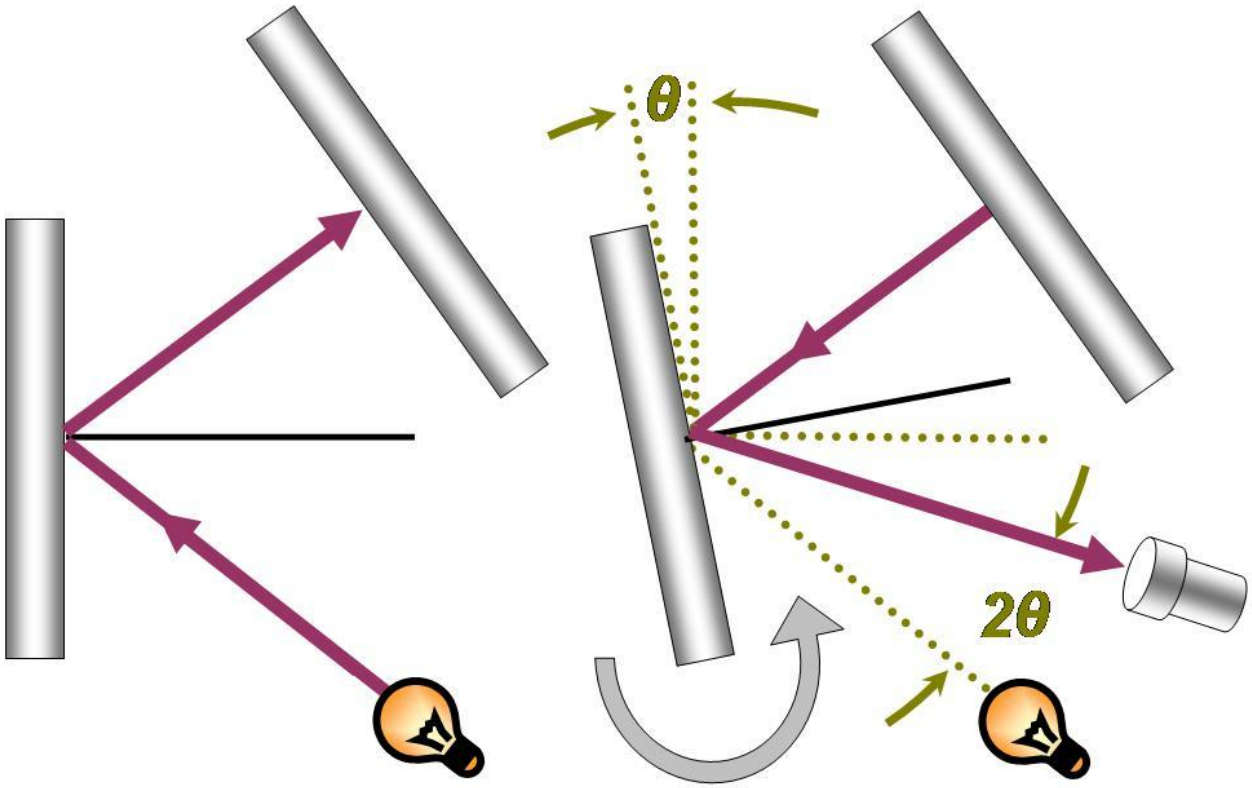
4.0.6 DEMONSTRATION METHOD

The dictionary meaning of the word "demonstration" is the outward showing of a feeling etc.; a description and explanation by experiment; so also logically to prove the truth; or a practical display of a piece of equipment to snow its display of a piece of equipment to show its capabilities . In short it is a proof provided by logic, argument etc.

To define "it is a physical display of the form, outline or a substance of object or events for the purpose of increasing knowledge of such objects or events. Demonstration involves "showing what or showing how". Demonstration is relatively uncomplicated process in that it does not require extensive verbal elaboration. Now it will be easy to define what demonstration method is.

To begin with, this method includes the merits of demonstration method. The teacher performs the experiment in the class and goes on explaining what she does. It takes into account the active participation of the student and is thus not a lopsided process like the lecture method. The students see the actual apparatus and operations and help the teacher in demonstrating experiments and thereby they feel interested in learning. So also this method follows maxims from concrete to abstract wherein the students observe the demonstration critically and try to draw inferences.

Thus with help of lecture cum demonstration method their power of observation and reasoning are also exercised. So the important principle on which this method works is "Truth is that works."



REQUIREMENTS OF GOOD DEMONSTRATION

The success of any demonstration following points should be kept in mind.

- It should be planned and rehearsed by the teacher beforehand.
- The apparatus used for demonstration should be big enough to be seen by the whole class. If the class may be disciplined she may allow them to sit on the benches to enable them a better view.
- Adequate lighting arrangements be made on demonstration table and a proper background table need to be provided.
- All the pieces of apparatus be placed in order before starting the demonstration. The apparatus likely to be used should be placed in the left hand side of the table and it should be arranged in the same order in which it is likely to be used
- Before actually starting the demonstration a clear statement about the purpose of demonstration be made to the students.

- The teacher makes sure that the demonstration method leads to active participation of the students in the process of teaching.
- The demonstration should be quick and slick and should not appear to linger on unnecessarily.
- The demonstration should be interesting so that it captures the attention of the students.
- It would be better if the teacher demonstrates with materials or things the children handle in everyday life.
- For active participation of students the teacher may call individual student in turn to help him in demonstration.
- The teacher should write the summary of the principles arrived at because of demonstration on the blackboard. The black board can be also used for drawing the necessary diagrams.

STEPS NEEDED TO CONDUCT DEMONSTRATION LESSON

1. **Planning and preparation:** A great care is taken by the teacher while planning and preparing his demonstration. He should keep the following points I mind while preparing his lesson.

a. Subject matter.

b. Questions to be asked.

c. Apparatus required for the experiment

To achieve the above stated objective the teacher should thoroughly go through the pages of the text book, relevant to the lesson. After this he should prepare his lesson plan in

which he should essentially include the principles to be explained, a lot of experiments to be demonstrated and type of questions to be asked form the students. These questions be arranged in a systematic order to be followed in the class. Before actually demonstrating the experiment to a class, the experiment be rehearsed under the condition prevailing in the classroom. In spite of this, something may go wrong at the actual lesson, so reserve apparatus is often useful the apparatus has to be arranged in a systematic manner on the demonstration table. Thus for the success of demonstration method a teacher has to prepare himself as thoroughly as possible.

2. **Introduction of the lesson:** As in every subject so also in the case of science the lesson should start with proper motivation of the students. It is always considered more useful to introduce the lesson in a problematic way which would make the student's realise the importance of the topic. The usual way through which the teacher can introduce the lesson is by telling some personal experience or incident of a simple and interesting experiment. A good experiment carefully demonstrated is likely to leave an everlasting impression on the mind of the young pupils and would set the students talking about it in the school.

3. **Presentation**: The method presenting the subject matter is very important. A good teacher should present his lesson in an interesting manner and not in a boring manner. To make the lesson interesting the teacher may not be very rigid too remain within the prescribed course rather he or she should make the lesson as much as broad based as possible. For widening the lesson the teacher may think of various useful application taught by him. He is also at the liberty to take examples and illustrations for allied branches of science like history, geography etc. Constant questions and answer should form a part of every demonstration lesson. Questions and cross question are essential for properly illuminating the principles discussed. Question should be arranged in such a way that their answers may form a complete teaching unit

4. **Performance of experiment:** A good observer has been described as a person who has learnt the use the senses of touch, sight, and smell in an intelligent way. Through this method we want children to observe what happens in a experiment and to state it carefully. We also want them to make generalization without violating scientific spirit i.e. we should allow children from one experiment or observation. The following steps are generally accepted as valuable in conducting science experiment generally.

a. Write the problem to be solved in simple words.

b. To make a list of activities that has to be used to solve the problem.

c. Gather material for conducting the experiment

d. Work out a format of steps in the order of preocedu8re so that everyone knows what is to be done.

e. Teacher should try the experiment before conduction.

f. Record the findings.

g. Assist students to make generalisation.

5. **Black Board Summary**: A summary of important results and principles should be written in the Blackboard. Use of blackboard should be also frequently used to draw sketches and diagrams. The entire procedure should be displayed to the students after the demonstration.

6. **Supervision:** Students are asked to take the complete notes of the black board summary including the sketches and diagrams drawn. Such a record will be quite helpful to the student while learning his lessons .Such a summary will prove beneficial only if it has been copied correctly from the black boards and to make sure that it is done so the teacher must check it frequently during this stage. Common Errors in Demonstration Lesson

A summary of the common errors committed while delivering a demonstration lesson is given below:

a) Apparatus may not be ready for use

b) There may not be an apparent relation between the demonstration experiment and the topic under discussion.

c) Black board summary not up to the mark

d) Teacher may be in a hurry to arrive at a generalisation without allowing students to arrive at a generalisation from facts.

e) Teacher may take to talking too much which will mar the enthusiasm of the students.

f) Teacher may not have allowed sufficient time for recording of data.

g) Teacher may fail to ask the right type of questions

MERITS OF DEMONSTRATION METHOD

a) It is an economical method as compared to a purely student centered method

b) It is a psychological method and students take active interest in the teaching learning process

c) It leads the students from concrete to abstract situations

d) It is suitable method if the apparatus to be handled is costly and sensitive. Such apparatus is likely to be handled and damaged by the students.

e) This method is safe if the experiment is dangerous.

f) In comparison to Heuristic, Project method it is time saving but purely Lecture ethod is too lengthy

g) It can be successfully used for all types of students

h) It improves the observational and reasoning skills of the students

LIMITATIONS OF DEMONSTRATION METHOD

a) It provides no scope for "Learning by Doing" for the Students as students are only observing the Teacher performing.

b) Since Teacher performs the experiment at his/ her own pace many students may not be able to comprehend the concept being clarified.

c) Since this method is not child centred it makes no provision for individual differences, all types of students including slow learners and genius have to proceed with the same speed.

d) It fails to develop laboratory skills in the students.

e) It fails to impart training in scientific attitude. In this method students many a times fail to observe many finer details of the apparatus used because they observe it from a distance.

4.0.7TEAM-TEACHING

Team teaching a style of instruction in which resources as well as interests and expertise of a team of teachers are pooled in order to enhance the effectiveness of instruction/curriculum transaction to the maximum possible by utilizing all facilities available in school.

CHARACTERISTIC OF TEAM TEACHING

1. It utilizes the service of two or more teacher in the process of teaching the same class.

2. It is an instructional strategy rather than training strategy.
3. In team teaching a group of teachers are responsible for realization of the educational objectives, rather than an individual teacher.
4. A team of teachers of the same subjects work together to deal relevant content area to the same group of students.
5. It can be termed as co-operative teaching , in which teachers together plan to pool resources, interests and expertise for teaching the same content for the same group of students.
6. Every individual teacher of the team gets an appropriate role in the instructional process in accordance with one's special competencies or area of specialization.
7. The group of teachers involves have shared responsibilities in planning, organizing, leading, controlling and evaluating.
8. In team teaching, the group of teachers have to jointly consider the needs of their pupils.

OBJECTIVES OF TEAM TEACHING

1. To make the best use of expertise of a number of teachers.
2. To improve the quality of teaching by utilizing the sills of more than one person.
3. To develop positive attitude towards co-operation or group in teaching – learning situations.
4. To help the student to satisfy the needs and solve the difficulties relating special content areas.
5. To develop the sense of shared responsibility in teaching and evaluation.
6. To minimize the scope of teaching wrong things to the students by any individual teacher.

TYPES OF TEAM TEACHING

1. Team teaching in the same class period.

Here the members of the team discuss the various aspects of the same topic to be covered in the same class period and share these aspects in tune with the special knowledge area in which each has expertise.

2. Tam teaching based on ability.

In this type, units are shared by different teachers not on the basis of subject matter, but on the basis of special competencies such as lecturing, demonstrating, guiding discussion etc.

3. Team teaching based on specialization

Teachers with different subject specialization are jointly made responsibilities for instruction, starting from course formation to evaluation. They share the content according to their specialization areas.

4. Team teaching on relay system.

Hear one teacher starts the instructional process, when he completes, another follows and so on. Hear the division of work not based on subject competency or skill. Each teacher supplements, enriches and supports what others have done.

PRINCIPLES OF TEAM TEACHING

1. Principle of size and composition of the class.

The size of the class should be vary according to the objectives of the team teaching. Eg. To remove the difficulties of students in certain subject, the size of the class should be small.

2. Principle of level of instruction

The entering behavior of the group of students should be determined so that the presentation of each member of the team in tune with the level of the class.

3. Principle of assigning duties to teachers of the work.

Duties to the teachers should be appropriate according to their competencies of teaching**.**

4. Principle of learning environment.

Learning environment must be generated by employing appropriate teaching aids and other inputs.

5. Principle of time factor

Time schedule should be prepared by allotting appropriate time to subtopics, lead lecture, group work etc.

6. Principle of Supervision

o The aim of team teaching is to develop mastery over subject matter by utilizing the expertise of teachers

o Supervised study is essential for assimilating various items of knowledge of a topic

o The nature and duration of supervising students activities depends upon the purpose for which team teaching is employed.

PROCEDURE OF ORGANIZING THE TEAM TEACHING

Team teaching involves three steps

1. Planning

This step involves the following activities

• Formulating the objectives of the team teaching session.

• Writing these in behavioral terms.

• Identifying the entering behavior of the learners.

• Deciding the details of the material to be taught.

• Assigning duties to teachers, such as lead lecture, follow up work and supervision considering their interest and competencies.

• Fixing up the level of instruction.

• selecting appropriate teaching aids and other inputs, if any, for generating learning environment.

• Deciding ways and means to be adopted for evaluating the student performance.

2. Organizing

The organization of team teaching is decided by considering the needs of the learners. The following are the general activities which are usually performed by a team of teachers.

• Determining the level of instruction. Some questions are asked to explore the background of the leaner's.

• Selecting the appropriate communication strategy by considering the level of language achievement of the learners.

• Presentation of lead lecture by a competent of the team; other teachers listen the lecture and note down the element of the topic that appear to be not easily understandable to the learners or nor appropriately presented.

• Follow up work. The other teachers have to supplement the lead lecture by explaining the elements of the topic in a simpler way so that the learners can understand easily.

• Providing motivation or reinforcement during both the stages. i.e, during the lead lecture and follow up work.

• Supervision of student 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. He must be well prepared and ready for implementing the plan.

3. Evaluating

Evaluation is an important aspect of ant type of teaching. It will helpful to measure the

performance of learners. It also provides reinforcement to the team of teachers as well as to the learners, this stage involves the following activities.

• Asking oral questions. Each question should measure a particular objective envisaged by the team.

• Taking decision about the level of performance and realization of the objectives.

• Diagnosing difficulties of the learners and providing the remediation.

• Revising the planning and organizing phase of team teaching itself on the basis of evaluation of the student.

ADVANTAGES OF TEAM TEACHING.

1. Better planning

• Team teaching has to overcome repetition and hence every teacher has to devote more time towards planning and preparation of his unit.

2. Better utilization of resources.

• It results in the optimum use of available resources, human, material, finance. A number of teachers can work together and make the best use of their specialized knowledge.

3. Effective use of teaching techniques.

• Teachers observe each other and thus improve their teaching techniques.

4. Better motivation.

• It provides better motivation for good teachers to become team leaders. Student too are better motivated while they are being taught by a number of teachers. Teachers with greater technical skills influence the performance of their colleagues.

5. Better follow-up work.

• It ensure better follow-up work as a number of specialists teach the same subject to the same class.

LIMITATION OF TEAM TEACHING.

1. It is very difficult to ensure co-operation among teachers of a team.
2. It is not east to assign powers and responsibilities to a group of teachers. It might happen no one takes care of the responsibilities expected.
3. Many teachers do not maintain regard and respect. Every teacher considers himself an expert of the subject and has his own style of teaching.
4. Teachers generally do not like to deviate from the routine methods of teaching and they do not prefer any change in the system of education.

4.1 LEARNER CENTERED METHODS

4.1.1 PROJECT METHOD

Project method is of American origin and is an outcome of Dewey's philosophy or pragmatism. However, this method is developed and advocated by Dr.Kilpatrick. Project is a plan of action – oxford's advanced learner's dictionary Project is a bit of real life that has been imported into school – Ballard A project is a unit of wholehearted purposeful activity carried on preferably in its natural setting – Dr.Kilpatrick. A project is a problematic act carried to completion in its most natural setting – Stevenson

BASIC PRINCIPLES OF PROJECT METHOD

Psychological principles of learning

Learning by doing

Learning by living

Children learn better through association, co-operation and activity.

Psychological laws of learning

Law of readiness

Law of exercise

Law of effect

STEPS INVOLVED IN PROJECT METHOD

1) Providing / creating the situations

2) Proposing and choosing the project

3) Planning the project

4) Execution of the project

5) Evaluation of the project

6) Recording of the project.

Step 1. **Creating the situation:** The teacher creates problematic situation in front of students while creating the appropriate situation student's interest and abilities should be given due importance.

Step 2. **Proposing and choosing the project:** while choosing a problem teacher should stimulate discussions by making suggestions. The proposed project should be according to

the rear need of students. The purpose of the project should be well defined and understood by the children.

Step 3. **Planning the project:** for the success of the project, planning of project is very import. The children should plan out the project under the guidance of their teacher.

Step 4. **Execution of the project:** every child should contribute actively in the execution of the project. It is the longest step in the project.

Step 5. **Evaluation of the project:** when the project is completed the teacher and the children should evaluate it jointly discussed whether the objectives of the project have been achieved or not.

Step 6. **Recording of the project:** the children maintain a complete record of the project work. While recording the project some points like how the project was planned, what discussion were made, how duties were assigned, hot it was evaluate etc. should be kept in mind.

Examples

RUNNING OF A HOSTEL MESS

It involve the following steps

Step 1. The number of hostellers will be recorded.

Step 2. The expected expenditure will be calculated.

Step 3. Expenditure on various heads will be allocated to the students.

Step 4. Budget will be prepared with the help of the class.

Step 5. The account of collections from amongst the students will be noted.

Step 6. Actual expenditure will be incurred by the students

Step 7. A chart of 'balance diet' for the hostellers will be prepared.

Step 8. The time of breakfast, lunch, tea and dinner will be fixed and notified.

Step 9. Execution of different programs stated above will be made.

Step 10. Weight of each hostel will be checked after regular intervals, and the same will be put on record.

Step 11. Punctuality in all the activities of the hostellers will be recorded.

Step 12. Evaluation of the entire program, and then it will be typed out for the information of all concerned.

SOME PROJECTS FOR MATHEMATICS

A few projects suitable for high school mathematics are listed below

- Execution of school bank.
- Running stationary stores in the school.

- Laying out a school garden.
- Laying a road.
- Planning and estimating the construction of a house
- Planning for an annual camp
- Executing the activities of mathematics clubs

Collection of data regarding population, death rate, birth rate etc.

MERITS

This is based on various psychological laws and principles.

- It develops self-confidence and self-discipline among the students
- It provides ample scope for training.
- It provides score for independent work and individual development.
- It promotes habits of critical thinking and encourages the students to adopt problem-solving methods.
- This method the children are active participants in the learning task.
- This is based on principle of activity, reality, effect, and learning by doing etc.
- It develops discovery attitude in the child.
- It provides self-motivation as the students themselves select plan and execute the project.

DEMERITS

- It takes more time.
- The knowledge is not acquired in a sequential and systematic manner
- It is very difficult to complete the whole syllabus by the use of this method.
- It is not economical.
- Textbooks and instructional materials are hardly available.
- The project method does not provide necessary drill and practice for the learners of the subject.
- The project method is uneconomical in terms of time and is not possible to fit into the regular time table.
- Teaching is disorganised
- This method is not suitable for a fixed curriculum.
- Syllabus cannot be completed on time using this method

Though project method provides a practical approach to learning. It is difficult to follow this method for teaching mathematics. However this method may be tried along

with formal classroom teaching without disturbing the school timetable. This method leads to understanding and develops the ability to apply knowledge. The teacher has to work as a careful guide during the execution of the project.

4.1.2 PEER TUTORING

The concept of student teaching student is not a new concept and had been happening throughout the history. Aristotle is said to have used student leaders, known as "archons" to help him. Roman used Peer tutors, they used older pupils to teach and test younger students. In the 1500's Strun and Trotzentdorf used Peer tutors, Trotzendorf wrote that he taught the older pupils who then taught to younger ones because it was too expensive to employ more teachers. It is evident that Peer tutoring is not a new concept; many teachers in different times and places have used some on other form of peer tutoring.

Peer tutoring in its simplest form involves a student helping another student learn a skill or task (Franca, Kerr, Reitz, & Lambert, 1990). The word "Peer tutoring" as explained "peer" means somebody who is equal to another person or to other people in some respect such as age, class, level. "Tutor" means teacher who teaches an individual student or a small group of students.Peer tutoring is defined as "an educational practice in which a student interact other student to attain educational goal" (Lisi, 1999). Damon and Phelp (1989) stated that "Peer Tutoring is an approach in which one student/child instructs another child in material on which the first is expert and second is novice".

Peer tutoring is an instructional strategy that consists of pairing students together to learn or practice an academic task. The pairs of students can be of the same or differing ability and/or age range. Peer tutoring allows teachers to accommodate a classroom of diverse learners including students with learning disabilities. This instructional strategy increases response opportunities for students, provides additional time for positive feedback, and increases the amount of time a student is on-task (Maheady, 2001). Regardless of achievement level, content area, or classroom arrangement, peer tutoring demonstrates effectiveness in facilitating progress in the general education curriculum (Cohen, Kulik & Kulik, 1982; Cook, Scruggs, Mastropieri, & Casto, 1985; Johnson, Maruyama, Nelson & Skon, 1981).

As the practice of the student teaching other student has a rich history dating back thousands of years (Topping, 1998; Wagner, 1990). However, the first systematic use of peer tutoring is attributed to Andrew Bell (Goodlad & Hirst, 1989). Bell used monitors to teach the children at Military Male Asylum at Egmore. While he had been experimenting on the use of the sand tray to teach children alphabets, he perceived that the use of children to teach other children was an educational discovery than that tray of sand. He attached an assistant teacher to every class. Bell found that the tutoring program is not only beneficial to the tutees but provided the tutors with various benefits.

Following the path of Andrew Bell's experiment, Joseph Lancester utilized peer tutoring to provide education to the economically poor children in London. Lancester used his monitors to teach reading, writing and elementary arithmetic. He discovered that both pupils and teacher are benefitted from this approach. Following Bell's and Lancester, in 1970's research into the case of peer tutoring became intense (Topping, 1988). It has emerged as economical method to teach a large number of students and after a number of experiments, for providing an effective and systematic individualized instruction to the Students with Intellectual Disability.

BENEFITS OF PEER TUTORING

Currently, there is sufficient research that documents the benefits of peer tutoring as a supplement to traditional instruction. Peer tutoring has been used across academic subjects, and has been found to result in improvement in academic achievement for a diversity of learners within a wide range of content areas. Common components of peer tutoring programs facilitate both cognitive and social gains in both higher-performing mentors and low performing mentees in an individualized and positive way.

- 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.

TYPES OF PEER TUTORING

Peer tutoring is an instructional method that clearly has positive outcomes. Ryan, Rein and Epstein (2004) and Miller, Barbetta and Heron (1994) have summarized most widely used format of Peer Tutoring:

i) Class wide Peer Tutoring:

In this format, entire class participates simultaneously in tutoring dyads. During each training session students can participate as both peer tutor and tutee, or they can participate as only the tutor and the tutee. It can be used to teach skills across a wide range of subject areas, ability and age levels. Kohl (1984 b) conducted a study in which they have provided intensive training program to fifth and sixth graders to be trainers of the severely handicap. They found that fifth and sixth graders are proved to be effective instructional trainer as the tutees had shown improvement in the performance. Again, Kohl (1985) conducted a study in which they trained third and fourth graders to teach cafeteria skills to person with severe disabilities. They observed that both programs were successful and peer trainers were effective and efficient in giving instructions but when they compared fifth grade and third grade/ fourth grade students as tutors, they found that older students reported to be more effective and efficient, as third graders (younger students) were easily distractible, need supervision of the staff and less responsible. On the other hand, fifth graders were punctual they require minimum supervision of the staff.

ii) Peer Assisted learning strategies (PALS):

This is a version of Class Wide Peer Tutoring (CWPT), where teacher identify children who require help on specific skills and the most appropriate student to help them on those skills. Pairs are changed regularly and over time as the students work on a variety of skills. All students have opportunity to be "coaches" and "players". In elementary grades, children's reading competence can improve when they work collaboratively on structured learning activities. Student collaboration enhances success because the interaction can strengthen academic and social achievement (Fuchs, et al., 2002).

iii) Reciprocal Peer Tutoring (RPT):

Reciprocal Peer Tutoring is an instructional strategy in which students alternate between the role of tutor and tutee. Reciprocal Peer Tutoring has a structured format where "student prompt, teach and monitor, evaluate and encourage each other" (Fantuzzo, King & Heller, 1992). Students are part of the educational process and are able to prepare instructional materials and receive feedback from the peers. Cross Age Tutoring results in

"basic academic skills, developing social behavior and discipline, and enhancing peers relationships".

iv) Same Age Peer tutoring:

Peer tutoring is an instructional strategy that consists of student partnerships or arrangements of same age pupils into interacting pairs. Same Age Peer Tutoring involves tutors and tutees from the same class; they will be of same age. Tutoring by sixth graders resulted in significant increments on the language readiness performance of kindergarten students (Frager & Stern, 1970). Fifth graders effectively tutored kindergarten children in basic arithmetic skills.

v) Cross age peer tutoring: -

In Cross Age Peer Tutoring the older students are matched with younger students to deliver instructions. Cross age Peer Tutoring is a teaching learning process in which older students are provided opportunities to use and extend their own knowledge and help younger students who are facing/ experiencing learning problems. The older students serves as an expert in the selected content/ skill area and knowledge acquisition through a structured tutoring program that provides a focus of control in the tutoring dyads (Osguthorpe & Scrugges, 1986). The older student serves as supervised instructors for the younger children (Lippett & Lohman, 1965). Reviewing the literature, Cross age Peer Tutoring was considered as effective methods in teaching various tasks. Cloward (1967) demonstrated that tutoring provided by tenth and eleventh grade students was effective in increasing the reading performance of fourth and fifth graders. Whalen & Henker (1969) trained older students with moderate retardation to teach verbal and non verbal imitation skills to younger severely handicapped student resulted into positive performance. Cross Age Tutoring can enhance self esteem among all the students who provide individualized instruction to tutees and results in a more cooperative classroom and improved school atmosphere.

PROCEDURE OF PEER TUTORING

- Orient students about Peer Tutoring Programme.
- Create a comfortable atmosphere and establish rapport.
- Select the peer tutors who are interested and sensitive students.
- Design activity and training programme.
- Start Peer tutor training programme.
- Develop special modules, worksheets and recording booklet for students.

- You can summarize activity for tutors in a piece of paper and give it to them. According to the activity you can provide with different resources and modules.
- Train tutors to Record Performance of tutees in simpler way.

DESIGNING, DEVELOPING AND IMPLEMENTING PEER TUTORING ACTIVITIES

Good Planning

Successful introduction of peer tutoring in class requires detailed planning, careful monitoring and continuous provision of support to the young tutors. Research evidence indicate that good and detailed planning contributes the most for the benefit of the students while enhancing tutors' self esteem and creating a good creative climate in the class

Careful selection of tutors

One of the most sensitive parameters for successful peer tutoring is the selection of the best tutors among the members of the group. Age and academic performance are two of the criteria used for selecting students. Engage older and good students of a group as tutors and capitalize on their cognitive and intellectual maturity on tutoring others. Important parameters on tutor selection are the sociability and personality of the potential tutors as well.

Detailed design of tutoring activities

Design activities that will allow peer tutors to actually support their tutees. Based on your personal judgement choose different tutors on different subjects or activities. Select tutors that you think they could manage with the tutoring group activity best. Give them in detail instructions on how to perform the activities and how to handle their tutees. Prepare material if necessary that will help the children to manage with the activity. Try to utilise the resources that your multigrade class has to design multidimensional activities that will benefit both young tutors and their tutees.

Ongoing supervision and support for tutors

It is very crucial not to leave the young peer tutors completely on their own to deal with their teammates. You should share your teaching time among the groups according to the lesson needs and try to guide the tutors on their work. Give them advice on how to manage tutees and try to prevent any misbehaviour phenomena by supervising the young tutors.

Demonstration of Skills or Task to be Taught

Teacher should display the activity or task selected for tutor to be taught.

Assess Readiness of peer tutors

Design activities that are going to require different levels of involvement by the students. Such activities will allow for the student tutors to learn as well by engaging themselves in productive work. Assess their skills repeatedly after each training session.

Keep record of the students' activities

Try to record the activities of each student group and the overall progress of the teams. In addition try to record any distinctive characteristics of effective or ineffective tutoring behaviour. This will help you understand better the ways that children cooperate together and will provide you input on how to support better peer tutoring in you class.

Discuss with peer tutors

Initiate a discussion with young tutors before and after the lesson. Before the activities you should encourage them on their tasks and remark the importance of their work for their teammates. Give them advice on proper behaviour to handle their tutees and try to show them verbally examples on how to instruct others. After the lesson discuss again with your tutors and try to record any positive or negative aspects of the procedure. Encourage your tutors again by thanking them for their work and try inspiring them for continuing tutoring activities at the future.

Discuss with tutees

You should talk with young tutees before and after the lesson as well. They to set away any possible fears they might have with working with other children. Explain them that they are going to assist by friends and of course ask their opinion on the lesson afterwards. Record their input and try to take it into account next time.

4.1.3 INDIVIDUAL ACTIVITIES

Individual exercises examine candidate's abilities, skills and personality traits through a number of different exercises:

- In-Tray or In-Basket Exercises
- Self-description questions
- Role plays
- Peer-ratings
- Drafting Tests
- Case studies
- Perspective listening tests

- Social Events
- Presentations
- Psychometric tests
- Interviews

In-Tray or In-Basket Exercise - In-tray exercises test your ability to skim-read, set priorities and work swiftly. Candidates receive 10 - 12 pieces of paper highlighting different problems. This directly simulates a manager's in-tray, frequently using real items from an in-tray - memos, letters, phone messages, notes, reports and press releases. Participants are required to stand in for a manager at short notice and cope with the in-tray as best as they can, working against the clock. They attach notes to each item indicating the action they are taking. The notes are assessed for analytical ability, style, sensitivity to people on the receiving end, skill in working under time - pressure, planning, organising, quality of decisions, decisiveness, management control and delegation.

Role-Play - Role-play exercises assess analytical skills (getting the facts and interpreting them), interpersonal and communication skills. An example of this would be an appraisal, counselling or grievance interview in which students are asked to play various roles. The roles can include a dissatisfied customer, employee with a grievance or marketing person selling a product.

Drafting Test - Drafting tests assess the individual's ability to express on paper, within a very tight time limit, instructions from supervisors. The candidate is asked to draft a letter on behalf of a supervisor, possibly about a complaint received or a change of plan that has to be made, refusing an application or a suggestion, or clearing up a misconception in the public's mind.

Presentation - In a presentation assessors are looking at organisational and presentation skills and the ability of the candidate to make a positive impression. Candidates may be asked to speak to the assessors and fellow candidates for a specified time about either a subject supplied to them by the assessors or one of their choices that they have prepared in advance.

INDIVIDUAL EXERCISES INCLUDE THE FOLLOWINGS

Self-description questions - involve describing yourself through the eyes of a perceptive friend or a perceptive critic.

Peer Rating - candidates are asked to rate the other candidates on a five-point scale on different competencies demonstrated during the group processes of second interviews.

Perceptive Listening Test - these tests are given to test whether or not candidates can retain detailed memory of a mass of material not particularly relevant to personal interest, e.g. a 15 minute film is shown of a European City and then detailed questions are asked.

Social Events - may not be officially assessed - but candidates will be under scrutiny. Heavy drinking will count against candidates.

Workplace Tours - a visit to the company headquarters or the organisations site, do listen, they may ask questions later, particularly in the one to one interviews.

Interviews - most assessment centres will include a formal interview as well. Check out the interview skill section on the website.

TIPS FOR EFFECTIVE INDIVIDUAL WORK

Students' Projects and Class Exercises Can Be Useful Preparation for In-Tray Exercises.

Any drama experiences or to role-play with a friend can be helpful for role-play exercises Report writing or writing of business letters can be useful for a drafting test. For presentations make sure you pick a subject you know something about and take time to gather your thoughts and collect all the material together
Use simple headings on file cards. Don't try to memorise a whole 'speech' or read a carefully worded draft.

You will need to have a definite introduction {where you tell them what you are going to

say}, a middle {where you cover four or five major points} and a conclusion {where you summarise what you've just said}. Summarise periodically if it is a long presentation.

4.1.4 EXPERIENTIAL LEARNING

The open nature of experiential learning means that it can often be difficult to define what is and is not an experiential activity. There are many activities that have the potential to be experiential, but may not be depending on the execution.

As explained by Chapman, McPhee, and Proudman: “Simple participation in a prescribed set of learning experiences does not make something experiential. The experiential methodology is not linear, cyclical, or even patterned. It is a series of working principles, all of which are equally important or must be present to varying degrees at some time during experiential learning. These principles are required no matter what activity the student is engaged in or where the learning takes place”.

To that end, Chapman et al. have provided a list of characteristics that should be present in order to define an activity or method as experiential.

CHARACTERISTICS OF EXPERIENTIAL LEARNING

1. Mixture of content and process: There must be a balance between the experiential activities and the underlying content or theory.

2.Absence of excessive judgment: The instructor must create a safe space for students to work through their own process of self-discovery.

3. Engagement in purposeful endeavors: In experiential learning, the learner is the self teacher, therefore there must be “meaning for the student in the learning.” The learning activities must be personally relevant to the student.

4. Encouraging the big picture perspective: Experiential activities must allow the students to make connections between the learning they are doing and the world. Activities should build in students the ability see relationships in complex systems and find a way to work within them.

5. The role of reflection: Students should be able to reflect on their own learning, bringing “the theory to life” and gaining insight into themselves and their interactions with the world.

6. Creating emotional investment: Students must be fully immersed in the experience, not merely doing what they feel is required of them. The "process needs to engage the learner to a point where what is being learned and experience strikes a critical, central chord within the learner."
7. The re-examination of values: By working within a space that has been made safe for self-exploration, students can begin to analyze and even alter their own values.
8. The presence of meaningful relationships: One part of getting students to see their learning in the context of the whole world is to start by showing the relationships between "learner to self, learner to teacher, and learner to learning environment."
9. Learning outside one's perceived comfort zones: "Learning is enhanced when students are given the opportunity to operate outside of their own perceived comfort zones." This doesn't refer just to physical environment, but also to the social environment. This could include, for instance, "being accountable for one's actions and owning the consequences".

Experiential learning can also be defined by what it is not, or how it differs from conventional academic instruction. In experiential learning, the student manages their own learning, rather than being told what to do and when to do it. The relationship between student and instructor is different, with the instructor passing much of the responsibility on to the student. The context for learning is different learning may not take place in the classroom, and there may be no textbooks or academic texts to study. Finally, the curriculum itself may not be clearly identified the student may have to identify the knowledge they require and then acquire it themselves, reflecting on their learning as they go along.

Experiential learning can also be defined by the qualities it imparts on its learners. Successful experiential learners have a willingness to reorder or alter their conception of a topic. They can reason for themselves and are able to successfully explain their position. They have clarity of purpose with tasks they undertake, and the self-management skills necessary to work successfully both alone and in a group. Experiential learners are aware of the "rules" governing their discipline or mode of operation, but are also open-minded, and able to work with people with different views. Finally, experiential learners are in control of their voice they can identify the role of emotion in their learning, as well as reflect on how they have come to their new knowledge.

TYPES OF EXPERIENTIAL LEARNING

Experiential learning can be divided into two major categories: field-based experiences and classroom-based learning. Field-based learning is the oldest and most established form of experiential learning, having been integrated into higher education in the 1930s. Field-based learning includes internships, practicums, cooperative education, and service learning.

Classroom-based experiential learning can take a multitude of forms, including role- playing, games, case studies, simulations, presentations, and various types of group work. Experiential learning in the classroom has been growing in breadth and depth since "Chickering and Gamson recommended 'active learning' as one of the seven 'principles of good practice' for excellence in undergraduate education" in 1987.

STEPS IN EXPERIMENTAL DESIGN

1. Analyzing your learner population and determining their needs. Are your students primarily at the graduate or undergraduate level? Are they mature learners with comprehensive past work experience, or have they never held a job in their field? What are their present levels of content mastery? Are there any cultural needs or variations? (Cantor, 1995, p.80). "Each person is a product of his or her cultural environment. Each person is conditioned over time to react in certain ways to given situations". Instructors must understand that their students have been raised in a different cultural environment, and how this will impact their interactions.

2. Identify appropriate activities for your learner population and course content. What activities are "appropriate for your course content and meet the cognitive development needs of your particular student population" (Cantor, 1995, p. 81)? Which aspects of your course content could experiential learning embellish? How does the activity you are considering meet course objectives or instructional goals? How does it allow students to experience key concepts in the course? How does the activity complement the program curriculum?.

3. Identify potential issues when integrating experiential learning. What tradeoffs are necessary to include experiential activities in your course? When designing and modifying a course, will content have to be sacrificed to make time for activities? How will the activity fit within the program curriculum as a whole? Is there institutional support for replacing traditional course content with experiential activities? For external activities, what are the liability issues? How will partner institutions be selected and how will

problems with partners are dealt with? How will students be placed to ensure equal opportunities for all?

DESIGNING EXPERIENTIAL ACTIVITIES

As mentioned above, it isn't the particular activity that is experiential; it is the way that it is framed that makes it experiential. So how instructional activities are made experiential? A general framework could be:

1. Decide which parts of your course can be instructed more effectively with experiential Learning.
2. Think about how any potential activities match the course learning objectives.
3. Think about how the potential activity complements the overall course of study. Prepared by Michelle Schwartz, Research Associate, for the Vice Provost, Academic
4. Think about the grading criteria and evaluation method that would match the proposed activity (Cantor, 1995, p. 82).

METHODS FOR ASSESSING EXPERIENTIAL ACTIVITIES

There are many potential ways to assess experiential activities, both external and internal. These methods are tied to reflection, helping learners to focus their learning while also producing a product for assessment purposes. Moon lists several examples:

• "Maintenance of a learning journal or a portfolio
• Reflection on critical incidents
• Presentation on what has been learnt
• Analysis of strengths and weaknesses and related action planning
• Essay or report on what has been learnt (preferably with references to excerpts from reflective writing)
• Self-awareness tools and exercises (e.g. questionnaires about learning patterns)
• A review of a book that relates the work experience to own discipline
• Short answer questions of a 'why' or 'explain' nature
• A project that develops ideas further (group or individual)
• Self-evaluation of a task performed
• An article (e.g. for a newspaper) explaining something in the workplace
• Recommendation for improvement of some practice (a sensitive matter)
• An interview of the learner as a potential worker in the workplace
• A story that involves thinking about learning in the placement

• A request that students take a given theory and observe its application in the workplace
• An oral exam
• Management of an informed discussion
• A report on an event in the work situation (ethical issues)
• Account of how discipline (i.e. subject) issues apply to the workplace

4.1.5 TEACHER-GUIDED LEARNING

Guided learning is an instructional sequence for small groups which is integrated into lessons to provide a bridge between whole-class teaching and independent work. It is direct teaching and works best when pupils are acquiring and developing concepts or skills in a subject. It can also be used to consolidate and refine skills and understanding. Guided sessions are flexible and can last from 10 to 30 minutes depending on the nature of the task and objectives. It is not a discrete or separate programme, but is one part of a rich, challenging and coherent curriculum. It is about pupils *taking control of their learning* through a managed process. In a guided learning group:

- pupils are grouped according to ability, or particular learning need;
- the teacher plans the session, which is structured to provide pupils with just the right amount of challenge and support so that they can begin to stretch themselves as learners;
- the emphasis is on supporting pupils so that they learn to work independently on a particular aspect.

Guided learning enables teachers to support and challenge pupils by intervening in a sustained and proactive way *at the point of learning*, as pupils read, write, talk, design, plan, make or practise. It helps to develop personalised learning since it is a means of tailoring teaching and learning to the needs of individual pupils. It does this by grouping pupils to provide structured support and challenge inside or outside normal lessons to address aspects of progress and specific needs. Guided learning builds pupils' independence through focused intervention, interaction and collaboration.

In guided learning groups, the teacher does more than 'listen in', or 'join in'. It is a place where you continue to teach, but are much closer to the pupils – you can monitor their responses, and adjust what *you* say or do, and what you ask *them* to do or say, accordingly. It is assessment for learning in action.

As with all good teaching, good subject knowledge and assessment are prerequisites for an effective guided session. Groups should be formed on the basis of the stage of progress or point of need of the pupils. They involve a small group of pupils, usually between four and six, and can take place in or outside the classroom. They are led by a teacher or, with structured notes and guidance, a teaching assistant. Sometimes the teacher will remain with the group for the duration of the guided session, but this is flexible. At appointed times during the session it is possible for the teacher to circulate among the other pupils working independently to monitor and support their work.

For guided work to take place, an effective learning climate needs to be established with the whole class, including good behaviour and positive relationships, clear routines and a well-presented environment. Guided work is helped with the greater number of teaching assistants available in schools. Once the rationale is established, the routines are in place and pupils accept that the teacher will at times spend more sustained time with specific groups, both independent and guided work become more productive as the outcome for both is a reduced dependency on the teacher.

THE PRINCIPLES OF GUIDED LEARNING

Using guided learning is not about sticking rigidly to any given structure. The guided learning sequence is underpinned by clear principles for teaching and learning. Making these explicit will enable you to apply the guided learning sequence flexibly to suit your own subjects, contexts and pupils, rather than adhering rigidly to any given structure or timing. Read the first part of the summary of research on pages 15–18 which sets out some of the theoretical principles that underpin guided group work.

The theoretical principles underpinning guided learning are consistent with those informing teaching and learning across the Strategy. They can be summarised as follows.

• Learning is a social activity in which talk is fundamental.

• Knowledge is jointly constructed and achieved.

• ‘Scaffolding’ provides support and focus through a gradual shifting of responsibility and control to the pupil.

• Metacognition, consciously focusing on and reviewing learning strategies and progress, is integral to learning.

• Language, thinking and learning are interrelated.

• Motivation and the disposition to learn are important parts of learning.

• Learning is structured into distinct episodes that follow a clear sequence which increases in cognitive demand.

• Teaching is designed to outpace rather than follow development.

• Teaching and learning are interactive, being part of a structured, focused dialogue between teacher and pupils and amongst pupils themselves.

THE TEACHER'S ROLE

In guided learning the teaching is active and interactive. If guided learning is to work well then the intervention of the teacher to bring about effective learning is crucial. Such intervention to bring about a result in learning has been called 'mediation' (Vygotsky). The idea of mediation, or intervening, is a very important component of the teacher's role in fostering learning in general and guided learning in particular.

The teacher can be seen to be mediating at three important points:

• typically when the session is introduced, the teacher does a number of important things which help pupils make sense of the forthcoming activity – stimulating, activating knowledge, focusing, establishing relevance or purpose (connecting), instructing, scaffolding;

• during the activity as pupils are working: supporting, intervening, guiding;

• after the activity, where the full meaning/significance of the activity can be explored: articulating, making meaning, connecting, exploring, drawing analogies, generalising.

4.1.6 PROBLEM-SOLVING METHOD

The child is curious by nature. He wants to find out solutions of many problems, which sometimes are puzzling even to the adults. The problem solving method is one, which involves the use of the process of problem solving or reflective thinking or reasoning. Problem solving method, as the name indicated, begins with the statement of a problem that challenges the students to find a solution.

Definition

Problem solving is a set of events in which human beings was rules to achieve some goals – **Gagne**

Problem solving involves concept formation and discovery learning – **Ausubel**

Problem solving is a planned attacks upon a difficulty or perplexity for the purpose of findings a satisfactory solution. – **Risk,T.M**

STEPS IN PROBLEM SOLVING / PROCEDURE FOR PROBLEM SOLVING

1. Identifying and defining the problem:

The student should be able to identify and clearly define the problem. The problem that has been identified should be interesting challenging and motivating for the students to participate in exploring.

2. Analysing the problem:

The problem should be carefully analysed as to what is given and what is to be find out. Given facts must be identified and expressed, if necessary in symbolic form.

3. Formulating tentative hypothesis

Formulating of hypothesis means preparation of a list of possible reasons of the occurrence of the problem. Formulating of hypothesis develops thinking and reasoning powers of the child. The focus at this stage is on hypothesizing – searching for the tentative solution to the problem.

4. Testing the hypothesis:

Appropriate methods should be selected to test the validity of the tentative hypothesis as a solution to the problem. If it is not proved to be the solution, the students are asked to formulate alternate hypothesis and proceed.

5. Verifying of the result or checking the result:

No conclusion should be accepted without being properly verified. At this step the students are asked to determine their results and substantiate the expected solution. The students should be able to make generalizations and apply it to their daily life.

Example :

Define union of two sets. If A={2,3,5}. B={3,5,6} And C={4,6,8,9}.

Prove that A U (B U C) = (A U B) U C

Solution :

Step 1: Identifying and Defining the Problem

After selecting and understanding the problem the child will be able to define the problem in his own words that

(i) The union of two sets A and B is the set, which contains all the members of a set A and all the members of a set B.

(ii) The union of two set A and B is express as ‘A U B’ and symbolically represented as A U B = {x ; x U A or x U B}

(iii) The common elements are taken only once in the union of two sets

Step 2: Analysing the Problem

After defining the problem in his own words, the child will analyse the given problem that how the problem can be solved?

Step 3 : Formulating Tentative Hypothesis

After analysing the various aspects of the problem he will be able to make hypothesis that first of all he should calculate the union of sets B and C i.e. (B U C). Then the union of set A and B U C. thus he can get the value of A U (B U C). Similarly he can solve (A U B) U C

Step 4: Testing Hypothesis

Thus on the basis of given data, the child will be able to solve the problem in the following manner

In the example it is given that

B U C = {3,5,6} U {4,6,8,9} = {3,4,5,6,8,9}

A U (B U C) = {2,3,5} U {3,4,5,6,8,9} = {2,3,4,5,6,8,9}

Similarly,

A U B = {2,3,5,6}

(A U B) U C = {2,3,4,5,6,8,9}

After solving the problem the child will analyse the result on the basis of given data and verify his hypothesis whether A U (B U C) is equals to (A U B) U C or not.

Step 5 : Verifying of the result

After testing and verifying his hypothesis the child will be able to conclude that A U (B U C) = (A U B) U C

Thus the child generalises the results and apply his knowledge in new situations.

MERITS

- This method is psychological and scientific in nature
- It helps in developing good study habits and reasoning powers.
- It helps to improve and apply knowledge and experience.
- This method stimulates thinking of the child
- It helps to develop the power of expression of the child.
- The child learns how to act in new situation.
- It develops group feeling while working together.
- Teachers become familiar with his pupils.
- It develops analytical, critical and generalization abilities of the child.
- This method helps in maintaining discipline in the class.

DEMERITS

- This is not suitable for lower classes
- There is lack of suitable books and references for children.
- It is not economical. It is wastage of time and energy.
- Teachers find it difficult to cover the prescribed syllabus.
- To follow this method talented teacher are required.
- There is always doubt of drawing wrong conclusions.
- Mental activities are more emphasized as compared to physical activities.
- Problem solving method can be an effective method for teaching mathematics in the hands of an able and resourceful teacher of mathematics.

4.1.7 SMALL GROUP/WHOLE-CLASS INTERACTIVE LEARNING:

SMALL GROUPS

Small group work is a widely used and important learning activity in higher education. It provides more scope than lectures for learner involvement and participation in two-way communication and for student-student, and student-teacher interaction not easily achievable in lectures. Personal involvement can also increase motivation and interest in the subject matter. Small group work promotes learning in providing opportunity to share and test ideas with others and to examine different perspectives on issues. The lecturer can get to know the students better, observe how they respond to the unit materials and learning activities and to diagnose learning problems and to clarify misunderstandings. Small group work also provides opportunity for co-operative and collaborative learning, for problem-based learning, for defining, exploring and solving problems, for developing higher order cognitive skills, such as using and/or transferring knowledge to new situations, for discussion and for the development of communication skills.

While small group work can enhance learning in many ways, it is important that you establish why it is desirable for learning in your unit and what particular outcomes you would like to achieve. Effective group work does not just happen spontaneously. It requires understanding of group dynamics and the planning and monitoring of appropriate group activities. You will need to be sensitive to the diverse needs of students and the development of the group. Setting aside time for reflection, evaluation and discussion of

group processes with students will also contribute to the development of effective techniques.

EXAMPLES OF SMALL GROUP ACTIVITIES

Tutorial

A regular meeting of students under the direction of a teacher/tutor to discuss a topic. Students may be asked to work through a set problem individually or in small groups, with assistance as necessary from the tutor.

Seminar

The presentation of a piece of work prepared by a student to his/her peers and subsequent discussion loosely structured by the tutor.

Workshop

A structured set of activities which provide opportunities for learning through reflection, analysis, problem solving and discussion, usually in a group context.

Laboratory session

Structured practical session where experiments may be conducted, observations made, data collected and analysed, conclusions drawn, work reported and skills introduced and practiced.

INTERACTIVE LEARNING IN THE CLASSROOM

This approach to learning happens in the traditional classroom. The teacher has made a syllabus for the course and the course sessions happen normally weekly, sometimes slightly squeezed, so that instead of two hours session there is a three-four hour session and the amount of the sessions is then smaller, respectively. Students come to the sessions that we call as “studios” like to a normal lecture. Normally the session starts with a short introduction to the theme, the lecturer gives a short presentation of the theme and the problems in it, this lasts for example one hour. The lecturer might use for example PowerPoint slides that are also printed as handouts and delivered for the students before the session. If Internet is used this material can be available there. The second part of the session is the working part.

The lecturer has prepared material and problems for the students. Students work in small groups, 2-3 persons. Each group gets one problem with the required material, books or articles. Now they have 1- 1,5 hour time to read and solve the problem, as well as

prepare an ad-hoc presentation about the results. During this part students are encouraged to move to another room if they need more silence, to have a coffee break and to discuss in the group as well as to make questions. The teacher is there available, as well as dictionaries and other source books. This short working period in often quite intensive and students really try to solve the problem, because they are expected to give the presentation. The third part of the sessions is for the presentations. Each group of students gives their solution to the problem, very informally but clearly. If they did not solve the problem, the teacher will be ready to present it. Each problem is presented and then the session is closed. It the time is too short the work can continue fluently next time.

4.1.8 STUDENT SEMINAR

The seminar method is the most modern and advanced method of teaching. A seminar is an advanced group technique which is usually used in higher education. It is an instructional technique it involves generating a situation for a group to have a guided interaction among themselves on a theme. It refers to a structured group discussion what usually follows a formal lecture or lectures often in the form of an essay or a paper presentation on a theme.

Reading maketh a full man; writing an exact man; and conference a ready man stated by Francis Bacon. The skills such as reading, writing and talking are essential for the personality development of a man. The seminar method integrates such skills of reading and writing with presentation skills.

This seminar method is employed to realize the higher objectives of cognitive & affective domains. The higher learning process requires the interactive and integrated methodologies based on the psychological principles. The seminar method applies such technique of human interaction /intervention with the learning and teaching experiences.

Seminar is a teaching technique for higher learning. A specific subject or topic is delivered as an article or report in the seminar. The article and its concepts submitted in the seminar are analyzed and discussed through group discussion to arrive a final decision or concept.

OBJECTIVES OF SEMINAR METHOD:

This seminar method is utilized to realize the higher objectives of cognitive and affective domains.

Cognitive objectives

i. To develop higher cognitive abilities.

ii. To develop the ability of responding in this manner would involve higher cognitive actions.

iii. To develop the ability of keen observation of experience, feelings and

iv. To develop the ability to seek clarification and defend the ideas of others effectively.

Affective objectives

i. To develop the feeling of tolerance to the opposite ideas of others.

ii. To develop the feelings of co-operation with other colleagues and respect of the ideas and feelings of others.

iii. To develop the emotional ability among the participants of the seminar.

iv. To acquire the good manners of putting questions and answering the questions of others effectively.

The human interaction under this technique develops the good manners and skills among the participants. Provide a good learning and scholastic experience to the participants of seminar.

TYPES OF SEMINAR

Seminars are conducted in various stages. Based on the size and organizational aspects the seminars can be classified in to four types. viz.

1. Mini seminar
2. Major seminar
3. National seminar
4. International seminar

Mini seminar:

Its coverage and scope are small and simple. A small population is enough to hold this seminar. A discussion held over the topic taught or to be taught with the students is known as Group discussion. Such group discussions held in an organized way within a class room, it is called mini seminar. This mini seminar gives the students training in questioning skills, organizing the information and presentation skills of seminar. A mini seminar is felt necessary because it gives good experience to conduct a major seminar at Institutional level.

Major seminar:

The seminar conducted at an institutional or departmental level for a specific topic or subject is known as Major seminar. Usually students and teachers are participating in this type of seminar. This major seminar can be organized at department level for every month. A specific topic or subject is selected for the theme of the seminar.

National seminar:

An association of any kind particularly with academic or professional interest or an organization (Government, Firm, etc.,) conducts the seminar at National level is called National seminar. The subject experts are invited to the seminar for discussion. The Secretary of the seminar prepares the schedule and functionaries for seminar.

International seminar:

Usually the seminar conducted by an international organization or agency is known as International seminar. Theme of this seminar has wider aspects. Globalization, Renovation, Atomic energy agreements, Policies implementation and modification etc., are examples for themes of International seminars. A Nation or its body can conduct or organize the international seminar.

Seminar Committee:

Seminar is conducted or organized by the committee proposed for this purpose only. This committee constitutes a chairperson, Organizing Secretary and subject experts who are expertise in the theme proposed for seminar. The organizing committee guides and helps with the functions of Chair person and organizing secretary. Usually a seminar has been conducted with the following team of organizing body.

1. Chairperson or President / Convenor of Seminar

Naturally, S/he may be the apex person of the Institution / Department / Government / Firm / Policy maker of the concerned body or agency.

2. Organizing Secretary of Seminar Usually he is nominated by the Chair person or President of the Seminar committee. She/he must be a good administrator and subject expert in the field proposed theme of the seminar. He must be the person of tolerance and capable of doing things in right time with right persons.

3. Chairperson of the Technical Session of seminar S/he must be the person with expertise in the theme proposed for the seminar. S/he would have a good experience to perform all the activities of technical session which is vital to the seminar.

4. Speaker of Seminar

S/he is the active participant of seminar presenting his / her paper among the other participants in the presence of Chair Person of Technical session of seminar.

5. Participants / Paper presenters of seminar

The people who are presenting papers and observing the paper presentation by participating in the seminar are termed as Paper presenters and Participants of the seminar.

STEPS INVOLVED IN SEMINAR:

The seminar is a process which allows the persons to discuss a theme in a peer group with subject experts in an objective method. The steps of the seminar method are classified in to following three steps:

- Before seminar (pre seminar phase)
- At the course of seminar (seminar phase)
- After the seminar (post seminar phase)

ACTIVITIES INVOLVED IN THE PRELIMINARY STAGE OF SEMINAR (PRE SEMINAR PHASE)

- The following activities need be done in preliminary stage of seminar.
- Selection of seminar theme and its sub-themes
- Venue (availability of physical facilities, etc.,), Date(s), and Time (duration of each session) are must be finalized well in advance.
- The panel of specialists, subject experts, Chief Guests, Observers for seminar must be prepared and obtaining the concurrence from the President or Convener of the seminar.
- The permission must be requested from the persons listed in the panel and from their head offices to utilize their services for seminar.
- A circular regarding the seminar and its information must be prepared without ambiguity.
- The seminar circular must be circulated well in advance to the people (must have the relevant knowledge about the theme of the seminar) who are able to participate in the seminar.
- The selection of the paper presenter / speakers must be based on the article submitted by them and their professional excellence. Such selected Paper presenter will be informed with the necessary regulations to be followed by them in the seminar.

- A compendium of selected papers must be prepared by a expert committee.

ACTIVITIES INVOLVED DURING SEMINAR (SEMINAR PHASE)

- Ensure the physical facilities (Stage settings, Seats, Audio-Visual equipments, etc.) available for the participants of seminar.
- Welcome the Chief Guests, Chair persons of Technical session, Observers and Participants of seminar and encourage their active participation in the seminar
- The compendium must be distributed to the participants before the beginning of seminar.
- The seminar theme and its sub-theme need be explained.
- Guide the paper presenters for their location and time of seminar session before the beginning of seminar.
- The Chair person of technical session and the paper presenters and speakers must manage the time effectively.
- Proper assistance must be ensure for every speaker / paper presenter to facilitate their paper presentation by providing appropriate Audio, Video equipments such as Public Address System, Over Head Projector, LCD projector etc.
- At the end of seminar session, the seminar events will be briefed by the Chairman of the seminar. This gives a clear definition to the seminar conducted and the further steps to be done in future also.
- The chairman or organizing secretary will announce the concept derived by the seminar.
- Deliver of Vote of thanks to the Participants, Seminar Committees and all the people who engaged in the seminar activities either directly and indirectly.

ACTIVITIES INVOLVED AFTER THE END OF SEMINAR (POST SEMINAR PHASE)

- Correction of the presented papers / articles from the authors (paper presenters) must be done by themselves.
- The restructuring of paper submitted is essential, because the clarifications received during the discussion must be incorporated. A clear, definite idea or concept of each paper will be reached through the restructuring the seminar paper.
- Compilation of the restructured papers will be done by a panel of experts.

- The prepare compilation (Compendium) must be sent to the concerned firms, institutes, Agencies, Government departments for further follow up activities.
- The compendium may be distributed on request to the people of similar interest also (with the permission of Chair person of Seminar)
- Finalization of Accounts must be done. A clear budget report must be prepared and sent to the auditing committee / officers for approval are essential. Evaluation of Seminar:
- The seminar can be evaluated using formal and informal evaluation methods.
- The evaluation must be made to get the immediate feedback from the speaker and participants regarding the seminar paper and other seminar details.
- The objectivity of the paper presented, the view of audience also need be evaluated.
- The observation schedule, questionnaire can be used as evaluation tools for seminar.
- The information obtained through the evaluation tools must be a feed back for the paper presenters.
- The evaluation of overall seminar process can be used for the study and feasibility of forth coming seminars and its arrangements.

MERITS OF SEMINAR METHOD

- Naturally, the spontaneous learning can be achieved effectively in this method.
- Seminar is usually learner centered.
- Information seeking and retrieval behavior is encouraged very much in this method.
- The learner himself prepares and compiles his own paper for the seminar gives readiness of mind and learning becomes structured.
- Learning by doing is encouraged in this method.
- The paper presenter / participant receive a reinforced learning experience from the Group discussion.
- Learning experiences is highly structured by the learner himself.
- The teacher or chair person of technical session only plays the Guidance and instructional role.
- Develops cognitive, affective domains based learning.
- Norms of behavior is developed and reinforced.
- Develops open mindedness, suppress the subjective ideas from the learners.

- ❖ The interactions and interrogations develops the spirit of information seeking behaviors (norms of behavior)
- ❖ The data processing skills, compilation skills, communication skill are easily inculcated in this method.
- ❖ Learner gets in-depth knowledge of the subject he presented.
- ❖ This method built better social values and fault tolerance levels in the minds of learner.

4.1.9 GROUP DISCUSSION

Group discussion is an important activity in academic, business and administrative spheres. It is a systematic and purposeful interactive oral process. Here the exchange of ideas, thoughts and feelings take place through oral communication. The exchange of ideas takes place in a systematic and structured way. The participants sit facing each other almost in a semi-circle and express their views on the given topic/issue/problem.

WHY IS A GROUP DISCUSSION AN IMPORTANT ACTIVITY AT COLLEGE LEVEL?

As a student, it helps you to train yourself to discuss and argue about the topic given, it helps you to express your views on serious subjects and in formal situations. It improves your thinking, listening and speaking skills. It also promotes your confidence level.

It is an effective tool in problem solving, decision making and personality assessment. GD skills may ensure academic success, popularity and good admission or job offer. Thus it is important to be able to take part in a GD effectively and confidently. Participants should know how to speak with confidence, how to exhibit leadership skills and how to make the group achieve the goals.

The panel which normally comprises of the technical and HR (Human Resource) experts of the company will observe and evaluate the members of the team. The rules of the GD – the time limit, panel's expectations etc are explained after the initial introduction by the panel, soon after the topic or case to be discussed is given to the group members. The panel does not interfere during the discussion, it only observes. The panel at its discretion may provide some time to think over the topic or may ask them to start

immediately. Each candidate is supposed to express their opinion either supporting or against the topic. The discussion carries on till the panel signals termination. It is left to the discretion of the panel to extend or cut short the given time.

The objective of a selection in GD is mainly to check your team playing skills. You have to understand the other persons' point of view, while making your point and ensure that your team as a whole reaches a solution or agreement that is both feasible and accepted by all team members.

There are four major areas of evaluation in selection GDs: subject knowledge, oral communication skills, leadership skills and team management.

SUBJECT KNOWLEDGE

Participants must possess a thorough understanding of the topic on which they are supposed to speak. You must prepare yourself to talk on a wide range of subjects. Be abreast of the current events, national and international affairs, burning social and economical topics, scientific and environmental issues, key newspapers' controversial topics and any experience that may be expected of an educated person. As a member of the group, you are expected to contribute substantially to the discussion. The originality of your ideas, your knowledge and initiative and your approach to the topic or case contribute to your success in the group discussion. The best way to equip yourself is to read daily newspapers, good magazines, national and international journals and also watch new bulletins and informative programmes on the television. Internet is the greatest boon which provides you with everything you are looking for. The World Wide Web is a vast database of current authentic materials that present information in multimedia form and reacts instantly to a user's input.

The greater your knowledge of the subject, the more enthusiastic and confident you will be during the discussion. Once you have understood the topic or issue, you should be able to generate ideas as well as organize them so that you present it well. You will have the ability to analyze facts or information in a systematic way. A person putting forward new ideas that may work will be accepted as the natural leader of the group. The panel will observe the ideas put forward, their originality, the depth of analysis and their relevance to the topic. Problem solving skills are essential and do not hesitate to give solutions. Your approach to the case study will be observed keenly by the evaluators.

ORAL COMMUNICATION SKILLS:

If subject knowledge is important, communication skills is more important as without expression, the knowledge is of no use. As the exchange of ideas in a group discussion takes place through speech, one of the pre-requisites of success in a GD is the ability to speak confidently and convincingly. Good communication skills include active listening, clarity of though and expression, apt language and proper non verbal clues.

LISTENING SKILLS

One of the weaknesses of most human beings is that we love to listen to our own voice rather than listen to others. Listening is as important as speaking in a GD, unless you listen, you cannot contribute to the stated purpose of communication. It is extremely important to listen very carefully, only then you will be able to pick up the thread of discussion and continue. Only active participation as a listener in a group makes a person a good leader. A leader is identified by the panel.

CLARITY OF THOUGHT AND EXPRESSION

Clarity is the art of making yourself clear to the audience. Only when your expressions are clear, you can convince your team and the panel. More than words, it is the tone in which they are spoken that conveys the message. You should not be too loud or too soft. A lively and cheerful voice with appropriate modulations will attract the audience. Proper articulation of words, achieved through phonetic accuracy is very essential slang, and artificial accents are to be avoided.

APT LANGUAGE

The flow of language must be smooth. Use simple language and avoid long winding sentences. Appropriateness of language demands that there should be no errors of grammar. Do not use unfamiliar phrases and flowery language. Be precise. Be polite and courteous.

PROPER NON VERBAL CLUES

Non verbal clues include eye contact, body movements, gestures and facial expressions. The panel very keenly watches the non verbal behavior of the team. They generally evaluate the body language cues of the team to determine personality factors such as nervousness, co-operation, frustration, weakness, insecurity, self confidence, defensiveness, etc. A candidate who appears professional is more likely to be noticed by the panel. A confident posture,

appropriate facial expressions and meaningful eye contact with the team will create a good expression.

TEAM BEHAVIOR

Your group behavior is reflected in your ability to interact with the other members of the group. You must be mature enough to not lose your temper even if you are proved wrong. You must be patient and balanced. Your success in a GD depends on how well you play the role of initiator, information seeker, information giver, procedure facilitator, opinion seeker, opinion giver, clarifier, summarizer, social-supporter, tension reliever, compromiser, attacker, humorist and dominator.

The selection panel notes the differences in the amount of participation of the members. They observe the silent spectators, the ever dominating but not contributing much, member who participates actively exhibiting his knowledge and the moderate ones. Your ability lies in analyzing the problem well and making others to endorse your view. Finally while appreciating others point of view, you should effectively present yours without contradicting other's opinions. Your ability in convincing the team is your success.

LEADERSHIP SKILLS

The success of any team depends to a larger extent on its leader. The panel evaluates a candidate's personal skills which allow him to prove himself as a natural leader in the GD. Though there is no appointed leader in a GD, a leader emerges. Assertiveness, emotional stability, objectivity, self-confidence, decision making, discretion, initiative, good communication skills, patience, persuasiveness and adaptability are some of the leadership qualities that are immensely useful in proving oneself as a natural leader in GD.

A good leader should neither be very authoritative nor submissive but must be democratic. Such leaders see to it that all the members in the team participate and when there is a problem, try to deal with it amicably. Leaders should know how to deal with the 'bull dozers', who make noise but do not have any logic.

SOME TOPICS FOR GROUP DISCUSSION:

- Terrorism in India
- Religion should not be mixed with politics

• Morals & Values among Indians is Degenerating

• With Media Publishing and Telecasting Trivia, Censorship is the Need of the Hour

• We are not serious about saving Wildlife/Environment

• The education system needs serious reforms

• The Internet is an exercise in hype

• Is our Political System Reason for our Backwardness?

• Politics is run by the Barrel of Gun

• Corruption is the Price we pay for Democracy

• What India needs is a Dictatorship?

• Nuclear War cannot be won and should not be foughtShould Research on Human Cloning be banned?

• Brain-Drain has to be stopped

• Should Animals be used for Testing New Drugs & Medical Procedures?

• Do NGOs in India Really Work for Others OR Work for their Own Vested Interests?

• Security Cameras & Privacy

• Advertisements Cheat People, Hence Should Be Banned

• What is the Difference between People who do Things Rightly and People who do Right Things?

• Are Peace and Non-Violence Outdated Concepts?

• Capital Punishment should be Banned or Allowed?

• Is Dependence on Computers a Good Thing?

• Every Cloud has a Silver Lining

• Nice Guys Finish Last

• Privatization of Higher Education

• How effective are Indian B-schools?

• E-Learning: A Substitute for Classroom Learning?

• Cricket as a National Obsession is a Detriment to Other Sports.

4.1.10 MIXED-ABILITY GROUPING

Mixed ability teaching is related to working with students who have different personalities, skills, interests and learning needs. Though most classes are usually multi-level, teachers (especially those with little or no experience), find teaching such classes a very difficult and demanding task as it involves planning lessons which include a rich diversity of tasks corresponding to a variety of learning styles and abilities. The differences which cause problems in such classes are in language learning ability, language knowledge, cultural background, learning style, attitude towards language, mother tongue, intelligence, world knowledge, learning experience, knowledge of other languages, age, gender, personality, confidence, motivation, interests, and/or educational level. However, these variations may occur in different degrees in different classes. Thus, if the teacher wants to ensure that all students perform to their maximum potential, the teacher must identify these problems and deal with them accordingly.

Howard Gardener's Theory of Multiple Intelligences tells us that we all may learn in different ways and we also have natural preferences to the way in which we enjoy learning. If we only teach in one way many students will be disadvantaged. They will find it difficult to engage in the lesson and may switch off. They are not less able than others, they just need a different kind of stimulation.

Mixed ability level teaching is related to working together with students who have different personalities, skills, interests and learning needs. Though most classes are usually multi-level, teachers (especially those with little or no experience), find teaching such classes a very difficult and demanding task as it involves planning lessons which include a rich diversity of tasks corresponding to a variety of learning styles and abilities.

The adoption of a flexible methodology is considered a challenge by some teachers as they have to put more effort when designing their lessons, they might need to learn new

organizational and / or classroom management skills – and that may be something beyond their pedagogical skills.

However, teaching a non-homogeneous group of pupils can be viewed positively because it serves as a trigger for teachers' professional growth and development as it involves the usage of variety of approaches, teaching techniques, interaction patterns, and tasks.

Mixed ability classes are a fact of not only language classes but of all courses. Since no two students can be the same in terms of language background, learning speed, learning ability and motivation, it is a utopian view to think that our classes could be homogeneous in terms of these aspects; no matter where we live in the world or at which school we teach. Therefore, the language teachers should be aware of the problems of mixed ability classes and their solutions to identify the source of troubles in their classes and to cure them.

In the middle of 1930's, some schools in the United Kingdom decided to divide students according to their IQ tests. However, it was seen that the new groups still had variations among students, and it is not feasible to change these groups and the curricula every time (Kelly 1979). Furthermore, Prodromou (1989, 2) indicates that even when students are grouped according to their test scores, their progress rates will always be at different levels due to the teaching methods, materials and/or learning style differences. The teachers become the key factor in reaching each and every student in a class. It is important for teachers to be aware of the problems resulting from mixed abilities in their classes and to decide on techniques and strategies that could be used to solve such problems.

The differences which cause problems in such classes are in language learning ability, language knowledge, cultural background, learning style, attitude towards language, mother tongue, intelligence, world knowledge, learning experience, knowledge of other languages, age, gender, personality, confidence, motivation, interests, and/or educational level. However, these variations may occur in different degrees in different classes. Thus, if the teacher wants to ensure that all students perform to their maximum potential, the teacher must identify these problems and deal with them accordingly.

SOME PROBLEMS IN THE MIXED ABILITY CLASSES

Effective Learning

As a teacher, our aim is to reach all of our students. However, it is well known that every student has a different way of learning, and learns and progresses at different speeds. Thus, while some students may find the learning task very easy to deal with, others may find it difficult to understand. Besides, learning also depends on what students have brought with them into class. Since each comes from a different family, a different environment and/or a different nation, the multi-cultural population of the classroom may be an obstacle for the teachers in reaching the students, which eventually results in ineffective learning. Moreover, although it is quite difficult for the teacher to know about each student and to follow what each one does during the lessons even in small classes, it is important for teachers to monitor each and every student and to reach their needs in a variety of ways to achieve effective teaching.

Materials

Since most language textbooks are designed for an ideal classroom environment, teachers always have to deal with the problem that students react to the textbook differently due their individual differences. First of all, some students may find the textbook boring and very hard, whereas some find it interesting or very easy. In addition, as language teaching course materials are currently based on content-based or theme-based syllabi, some students may find the topics dull, strange, or meaningless; whereas others find it enjoyable, familiar or interesting. Therefore, it is usually necessary for the teacher to evaluate and adapt the materials according to her class.

Participation

Since the classroom is the first and only environment for many foreign language learners, they should use this chance as much as possible. However, some of the students find it difficult to speak in the target language for many reasons ranging from interest to confidence, from age to knowledge. Other students, however, would like to express everything they think or feel by using the new language. As a result, some students may take many turns, while others do not speak for the entire lesson.

Interests

Interest problems may arise due to the differences among students in terms of their attitude towards the subject matter and/or the teacher; their knowledge of language; and their personality. Furthermore, some of the students may not be interested in the lesson, unless they do get the chance to express their own ideas since the teacher talks too much

during the lesson or the other students take many turns. Teachers should be aware of the different interests of the students to organize and to arrange activities accordingly.

Discipline

Often the quicker students finish the tasks given before the other students. As a result, they may misbehave while waiting for the others to finish. The weaker students, on the other hand, cannot finish the tasks as quickly as the strong ones and may lose their confidence and/or show ill-disciplined behaviour for a variety of reasons related to that. Consequently, mixed abilities may result in classroom management problems.

LET'S TAKE THE EXAMPLE OF A MIXED LEVEL GROUP AND SEE THE POSSIBLE OUTLINE FOR THE LESSON

Stage one The lesson starts with a warm-up activity consolidating the simple past, which all students have met previously.

Stage two The class then divides. The elementary and weaker intermediate students, who the teacher thinks need a full structured presentation, remain with the teacher while the stronger intermediate students work autonomously on a second simple past consolidation activity – maybe a short listening or reading activity.

Stage Three After the teacher has completed the presentation, the class comes back together and completes a receptive practice activity which asks them to distinguish between the two verb forms. This has the aim of checking whether all the students understand the use of the form. If the teacher finds that any of the higher level students in fact don't, s/he can ask the lower level students to explain. This a) checks that the students who heard the presentation really understand, and b) aids motivation: one of the problems of a mixed ability group is that it is always the same, weaker or lower level students who "don't know/can't do". This activity gives them the chance to be the ones who do know.

Stage Four The class then splits again. This stronger students go back to the computer (or other materials) and work on consolidation activities for the present perfect at their own level. These may be grammar practice activities, a listening consolidation, or whatever the teacher thinks the students need. Meanwhile the lower level students remain with the teacher for some controlled practice work.

Stage Five The groups then swap. The stronger students meet the teacher for some semi-controlled or freer practice, while the weaker ones work autonomously at their own level – which may or may not mean working on the same activities that the stronger students did in stage four.

Stage Six The group comes back into lockstep and works on a final activity in which either a)students are paired high/low level with the stronger having a more demanding role, b)students are again paired high/low and work on an activity in which the strong students help the weaker students c) students are paired high/high, low/low and work on an activity at their own level.

4.1.11 MATHS THROUGH GAMES AND PUZZLES

Mathematical games are 'activities' which:

• involve a challenge, usually against one or more opponents; a

• are governed by a set of rules and have a clear underlying structure;

• normally have a distinct finishing point;

• have specific mathematical cognitive objectives.

Benefits of Using Games

The advantages of using games in a mathematical programme have been summarized in an article by Davies (1995) who researched the literature available at the time.

• Meaningful situations - for the application of mathematical skills are created by games

• Motivation - children freely choose to participate and enjoy playing

• Positive attitude - Games provide opportunities for building self-concept and developing positive attitudes towards mathematics, through reducing the fear of failure and error;

• Increased learning - in comparison to more formal activities, greater learning can occur through games due to the increased interaction between children, opportunities to test intuitive ideas and problem solving strategies

• Different levels - Games can allow children to operate at different levels of thinking and to learn from each other. In a group of children playing a game, one child might be encountering a concept for the first time, another may be developing his/her understanding of the concept, a third consolidating previously learned concepts

• Assessment - children's thinking often becomes apparent through the actions and decisions they make during a game, so the teacher has the opportunity to carry out diagnosis and assessment of learning in a non-threatening situation

• Home and school - Games provide 'hands-on' interactive tasks for both school and home

• Independence - Children can work independently of the teacher. The rules of the

game and the children's motivation usually keep them on task.

4.2 RECENT TRENDS IN TEACHING MATHEMATICS

4.2.1 CONSTRUCTIVIST LEARNING

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. 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.

CONSTRUCTIVIST THEORY

Formalization of the theory of constructivism is generally attributed to Jean Piaget, who articulated mechanisms by which knowledge is internalized by learners. He suggested that through processes of *accommodation* and *assimilation*, individuals construct new knowledge from their experiences. When individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework. This may occur when individuals' experiences are aligned with their internal representations of the world, but may also occur as a failure to change a faulty understanding; for example, they may not notice events, may misunderstand input from others, or may decide that an event is a fluke and is therefore unimportant as information about the world. In contrast, when individuals' experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to the theory, accommodation is the process of reframing one's mental representation of the

external world to fit new experiences. Accommodation can be understood as the mechanism by which failure leads to learning: when we act on the expectation that the world operates in one way and it violates our expectations, we often fail, but by accommodating this new experience and reframing our model of the way the world works, we learn from the experience of failure, or others' failure.

It is important to note that constructivism is not a particular pedagogy. In fact, constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or following the instructions for building a model airplane. In both cases, the theory of constructivism suggests that learners construct knowledge out of their experiences.

However, constructivism is often associated with pedagogic approaches that promote active learning, or learning by doing. There are many critics of "learning by doing" (a.k.a "discovery learning") as an instructional strategy (e.g. see the criticisms below). While there is much enthusiasm for Constructivism as an design strategy, according to Tobias and Duffy "... to us it would appear that constructivism remains more of a philosophical framework than a theory that either allows us to precisely describe instruction or prescribe design strategies.(p.4)".[2] This is unfortunate because there is quite a bit of promise to the educational philosophy behind constructivism, but constructivists seem to be having difficulties defining testable learning theories. In part this is due to Piaget's distrust of empirical methods and reliance upon the clinical method.

BASIC CHARACTERISTICS OF CONSTRUCTIVIST LEARNING ENVIRONMENTS

Tam (2000) lists the following four basic characteristics of constructivist learning environments, which must be considered when implementing constructivist instructional strategies:

1) Knowledge will be shared between teachers and students.
2) Teachers and students will share authority.
3) The teacher’s role is one of a facilitator or guide.
4) Learning groups will consist of small numbers of heterogeneous students.

PEDAGOGICAL GOALS OF CONSTRUCTIVIST LEARNING ENVIRONMENTS

Honebein (1996) summarizes what he describes as the seven pedagogical goals of constructivist learning environments as:

1)To provide experience with the knowledge construction process (students determine how they will learn).

2)To provide experience in and appreciation for multiple perspectives (evaluation of alternative solutions).

3)To embed learning in realistic contexts (authentic tasks).

4)To encourage ownership and a voice in the learning process (student centered learning).

5)To embed learning in social experience (collaboration).

6)To encourage the use of multiple modes of representation, (video, audio text, etc.)

7)To encourage awareness of the knowledge construction process (reflection, metacognition).

BENEFITS OF CONSTRUCTI VISM

1. Children learn mo re, and enjoy learning mo re when they are actively involved, rather than passive listeners.

2. Education works best when it concentrates on thinking and understanding, rather than on rote memorization. Constructivism concentrates on learning how to think and understand.

3. Constructivist learning is transferable. In constructivist classrooms, students create organizing principles that they can take with them to other learning settings.

4. Constructivism gives students ownership of what they learn, since learning is based on students' questions and explorations, and often the students have a hand in designing the assessments as well. Constructivist assessment engages the students' initiative s and personal investments in their journals, research reports, physical models, and artistic representations. Engaging the creative instincts develops students' abilities to express knowledge through a variety of ways. The students are also more likely to retain and transfer the new knowledge to real life.

5. By grounding learning activities in an authentic, real-world context, constructivism stimulates and engages students. Students in constructivist classrooms learn to question things and to apply their natural curiosity to the world.

6. Constructivism pro motes social and communication skills by creating a classroom environment that emphasizes collaboration and exchange of ideas. Students must learn how to articulate their ideas clearly as well as to collaborate on tasks effectively by sharing in group projects. Students must therefore exchange ideas and so must learn to "negotiate"

with others and to evaluate their contributions in a socially acceptable manner. This is essential to success in the real world, since they will always be exposed to a variety of experiences in which they will have to cooperate and navigate among the ideas of others.

PRINCIPLES OF CONSTRUCTIVISM

Constructivist teaching is based on recent research about the human brain and what is known about how learning occurs. Caine and Caine (1991) suggest that brain - compatible teaching is based on 12 principles:

1. The brain is a parallel processor. It simultaneously processes many different types of information, including thoughts, emotions, and cultural knowledge. Effective teaching employs a variety of learning strategies.
2. Learning engages the entire physiology. Teachers can't address just the intellect.
3. The search for meaning is innate. Effective teaching recognizes that meaning is personal and unique, and that students' understandings are based on their own unique experiences.
4. The search for meaning occurs through 'patterning'. Effective teaching connects isolated ideas and information with global concepts and themes.
5. Emotions are critical to patterning. Learning is influenced by emotions, fee lings, and attitudes.
6. The brain processes parts and wholes simultaneously. People have difficulty learning when either parts or wholes are overlooked.
7. Learning involves both focused attention and peripheral perception. Learning is influenced by the environment, culture, and climate.
8. Learning always involves conscious and unconscious processes. Students need time to process 'how' as well as 'what' they've learned.
9. We have at least two different types of memory: a spatial memory system, and a set of systems for rote learning. Teaching that heavily emphasizes rote learning does not promote spatial, experienced learning and can inhibit understanding.
10. We understand and remember best when facts and skills are embedded in natural, spatial memory. Experiential learning is most effective.
11. Learning is enhanced by challenge and inhibited by threat .The classroom climate should be challenging but not threatening to students.
12. Each brain is unique. Teaching must be multifaceted to allow students to express preferences.

IMPLIC ATI ONS OF CONSTRUCTI VISM FOR TEAC HING AND LEARNING

Central to the tenet of constructivism is that learning is an active process. Information may be imposed, but understanding cannot be, for it must come from within. Constructivism requires a teacher to act as a facilitator whose main function is to help students become active participants in their learning and make meaningful connections between prior knowledge, new knowledge, and the processes involved in learning. Brooks and Brooks (1993) summarize a large segment of the literature on descriptions of „constructivist teachers". They conceive of a constructivist teacher as someone who will:

- Encourage and accept student autonomy and initiative;
- Use a wide variety of materials, including raw data, primary sources, and interactive materials and encourage students to use them;
- Inquire about students" understandings of concepts before sharing his/her own understanding of those concepts;
- Encourage students to engage in dialogue with the teacher and with one another;
- Encourage student inquiry by asking thoughtful, open-ended questions and encourage students to ask questions to each other and seek elaboration of students" initial responses;
- Engage students in experiences that show contradictions to initial understandings and then encourage discussion;
- Provide time for students to construct relationships and create metaphors;
- Assess students" understanding through application and performance of open-structured tasks

4.2.2 PROBLEM-BASED LEARNING

Many attempts have been made to define the concept `problem-based learning'. Howard Barrows, who was involved in the early stages of the development of PBL at McMaster University in Canada, defines the concept in terms of specific attributes as being student-centred, taking place in small groups with the teacher acting as a facilitator, and being organised around problems. However, the actual design will be very different from institution to institution [2±5]. Gijselaers defines PBL in relation to theoretical learning principles, such as learning as the construction of knowledge, meta-learning and contextual learning. Savin-Baden describes five different models of PBL resting on five different views of the objective of PBL, including the perception of knowledge, learning,

problems, students, teacher roles, and assessment. Savin-Baden refers to these five PBL models as: attainment of knowledge, PBL for professional work, PBL for interdisciplinary comprehension, PBL for cross-discipline learning and PBL for critical competence. In the various definitions of PBL, the following three levels can be distinguished: central theoretical learning principles. Specific educational models based on PBL principles; and different practices within the guidelines of traditional educational models.

PBL, therefore, refers to theory, models, and practice. To further complicate this matter, PBL has been developed first and foremost on the basis of practice. This is in spite of the fact that there were many theoretical considerations behind the establishment of PBL models such as those practiced at the universities of Linko Èping, Maastricht, Roskilde and Aalborg. The development of PBL through the 1970s and 1980s has been characterized by small adjustments for pragmatic reasons. Teachers have developed their own routines and, if something does not work, they have simply changed it.

The theoretical roots of PBL began to receive serious consideration in the 1990's. In Denmark, the PBL tradition builds on the experiential learning that was more or less formulated by Dewey, along with Negt/Kluge's theories of the development of work education and the development of political consciousness formulated at the beginning of the 1970's. More recently, researchers have related PBL concepts to a variety of theoretical notions, such as experiential learning (Kolb), the reflective practitioner (SchoÈn) constructivism and social learning (Piaget, Vygotsky, Lave and Wenger) [6, 8, 9, 10].

The following are typical theoretical learning principles mentioned by these writers on PBL: Problem-based learning is an educational approach whereby the problem is the starting point of the learning process. The type of problem is dependent on the specific organisation. Usually, the problems are based on real-life problems which have been selected and edited to meet educational objectives and criteria. However, it could also be a hypothetical problem. It is crucial that the problem serves as the basis for the learning process, because this determines the direction of the learning process and places emphasis on the formulation of a question rather than on the answer. This also allows the learning content to be related to the context, which promotes student motivation and comprehension. It is essential that the directing force is consistent with the way the assessment drives the educational method .

Who formulates the problem statement and who is responsible for the main decisions is dependent on the next principle, participant-directed learning processes, or `self-directed learning', which has a far more individual-oriented focus. In the vast majority of cases, students have the opportunity to determine their own problem formulation within the given subject area guidelines. In other cases, the teacher defines the problem and the student uses this as a starting-point.

Experience learning is also an implicit part of the participant-directed learning process, where the student builds from his/her own experiences and interests. To link the formulation of the problem to the individual's world of experience increases motivation, because it relates to the opinions and understandings previously formed by the student.

Activity-based learning is a central part of the PBL learning process, requiring activities involving research, decision-making and writing. This can motivate and give the student the opportunity to acquire deeper learning.

Inter-disciplinary learning relates to problem orientation and participant-directed processes, in that the solution of the problem can extend beyond traditional subject-related boundaries and methods. This principle is critical for organising the teaching, so that teachers do not just consider objectives within the known subject-oriented framework, but also consider problems or real situations.

Exemplary practice is concerned with ensuring that the benefits derived by the student are exemplary in terms of the objectives. This is a central principle, as the student must gain a deeper understanding of the selected complex problem. However, there is an inherent risk with PBL that a sufficiently broad overview of the subject area is not provided. The students must therefore acquire the ability to transfer knowledge, theory, and methods from previously learned areas to new ones.

Group-based learning is the last principle, whereby the majority of the learning process takes place in groups or teams. Personal competencies are thereby developed, so that students learn to handle the process of group co-operation in all its stages. The above principles are drawn from various learning theories, and, from an abstract theoretical perspective, act as a `point of reference' for designing the specific course. The principles

cover traditional PBL models as they are practised at the universities in Maastricht and LinkoÈping, but they also cover the project models as they are practiced in Aalborg and Roskilde.

CURRICULUM STRUCTURE

The curriculum is structured in thematic blocks, in which the semester is divided into a series of periods of approximately six weeks, and each period focuses on a particular theme. A series of cases are planned for the students to work on in each period. The students themselves choose to analyse one of the cases, which in turn can be done both orally and in writing.

The subject disciplines are integrated through relating the case to professional practice. For example, in the field of medicine, the starting point is often a description of the patient. In Maastricht, the `Seven Step' method was developed to help students analyse the problem:

1. Clarify the concepts;
2. Define the problem;
3. Analyse the problem;
4. Find the explanation;
5. Formulate the learning objective;
6. Search for further information; and
7. Report and test new information.

The learning process Self-directed study groups discuss and analyse selected cases. The typical study group (8±12 students) meets once or twice a week. Each individual student in the study group presents his/her work. It is then discussed and the group decides who will continue with what tasks. Often students organise their work in such a way that their individual work supplements the work of the group, enabling them to develop a broader perspective of the related themes.

ASSESSMENT

The assessment methods must be compatible with the objectives of the learning process. With PBL this means progress testing to establish the individual's knowledge and testing for competence rather than for isolated factual knowledge. Different PBL models organise the didactic elements quite differently, allowing for variation within the general

framework. However, there are limits to this flexibility. It is, for instance, not enough to simply change the educational format within the framework of ordinary class teaching.

This is one of the classic `mistakes' made when changing to PBL. Changes in the educational format must be consistent with the form of the examinations or with the principles of material selection. Otherwise, the students will soon figure out the `examination code' and single that out as a learning goal instead of completing the PBL process.

Project-organised learning as a model Project work is problem-based by definition. In identifying how to reach the project goal, the members of a team have to learn to co-operate effectively. This creates good conditions for learning, as it involves both individual and co-operative activities, interactive discussions and a writing process (mostly in the form of a project report).

Project work teaches competencies such as project management and co-operation. Project assignments are also highly challenging. The more the task reflects reality, the more the students feel motivated, so working on a project can be seen as a way of organising various simultaneous and/or integrated learning processes.

The original idea of using project work as a teaching method has been attributed to the American author William Killpatrick. In Denmark, this educational model gained popularity in the 1970s, when it was established and developed at Roskilde University and Aalborg University. The extent of the project work can vary. At Aalborg University, project work accounts for 50% of the students' time, but many other institutions only allocate around 20% of the students' time to project work. The main characteristic of project work is that the students write together and are assessed together in groups.

The extent of the students' involvement will determine the project's broadness and complexity. The broader and more complex the project is, the more students will be challenged to spend time on it. In addition, the more complex the project is, the broader the approach to the project needs to be, and this is directly related to the degree of freedom students have to find alternative solutions. The opportunity for students to make critical choices is a prerequisite to gaining ownership of the project, and this is an important motivational factor.

Group co-operation can be difficult, and it is one of the elements that students find most difficult in the first years. One of the major findings in a study on the progression of process competencies suggests that developing the ability to work co-operatively involves

a number of skills, such as dealing with problems within one discipline, the ability to show understanding and respect for one another, reflection on personal development, and communication and listening skills. Students' personal skills develop and, in particular, their skills in co-operation and project management increase.

TYPES OF PROJECTS

The basis for the organisation of the project work lies in the subject-oriented nature of the process, where learning objectives related to subject matter exist that must be satisfied within an educational programme. The experiences, interests and guidelines for participant-directed projects do not necessarily meet these objectives, and the typical `why-why' approach to problem formulation goes beyond the specified subject area within technical educational programmes. This means that the degree of `freedom' to choose the problem is also very dependent on didactic considerations in that subject. On the other hand, some considerations are related to learning, where the students' motivation is dependent on the degree of participation the more decisions the students are able to make, the greater their motivation.

Even though there are specific learning objectives, the student must have enough freedom to get the maximum enjoyment from the work. This is a very central didactic consideration. The degree of teacher-centred planning and direction of the student's learning activities in relation to the desired objective varies along a sliding scale. Three fundamental types of project work can be distinguished: the task project, the discipline project, and the problem project. The task project is characterised by a very high degree of planning and direction on the part of the teacher (teaching objectives) involving a large task that has to be solved. Both the problem and the subject-oriented methods are chosen in advance, so that, for the student, the primary concern is to complete the project according to the guidelines provided. At times there can be such a narrow framework that students do not have the opportunity to make their mark on the starting-point or the process, but instead follow a strictly directed process in which the choices are made for them in advance. This is especially unfortunate, given that the defining factor for student motivation is that they should feel that the project belongs to them (and not the teacher). Therefore, this type of project cannot be recommended.

The discipline project is usually, though not necessarily, characterised by a fairly high degree of direction from the teacher (study programme requirements), in that the disciplines and the methods are chosen in advance. It may, however, still allow the groups

to identify and define the problem within the guidelines of the described disciplines (which are described in the theme descriptions). Metaphorically, this type of project can be compared to a football game in which the playing field is specified. Similarly, some overriding guidelines are given for the game, but the ball has not been kicked off and thus the group must enter the field and set the game into play.

The problem project is a full-scale project in which the course of action is not planned in detail by the teachers. The problem formulation directs the choice of disciplines and methods and the problem itself arises from the problem-oriented theme. In other words, within the same work environment theme, the group can actually work with widely different disciplines and subject methods. In terms of the analogy of a football game, this means that the students have the ball but lack the playing regulations and a marked playing field. A considerable amount of the work therefore involves marking the field and defining the playing rules, before the game can be started.

4.2.3 BRAIN-BASED LEARNING

Effective teachers never stop exploring different ways to improve student achievement. As there is no single, perfect solution, educators look to research to guide their practice. Recent innovations in science have allowed an unprecedented look into the way the brain works. The exciting learnings about brain function and its effects on learning have the potential to revolutionize teaching and learning.

Brain research has provided new knowledge about the many ways that humans learn. Brain-based *learning* has resulted from educators and researchers applying the findings of brain research to guide teaching practice. The last decade has seen more systematic implementation of brain-based strategies that emphasize emotion, thematic instruction, differentiated learning, movement, and the use of mental models. As well, changing conceptions of memory, assessment, the learning environment, the biology of the brain, and uses of time have all served to improve student achievement. Brain-based teaching involves the implementation of carefully-designed principles with due consideration of their impact before, during, and after each lesson.

The never-ending search for better teaching practices in this area has led educators to the work of key authors such as Caine, Caine, McClintic, and Klimek (2005), Erlauer (2003), Jensen (2005), Slavkin (2004), Wagmeister and Shifrin (2000), and Wolfe (2001). Most of these authors would agree with those teachers who contend they already

incorporate some aspects of brain-based learning into their classrooms. However, they would also suggest that the pathway to more effective implementation follows a process of continual research, or sustained inquiry, which involves collaboration, planning, action, evidence-gathering, and reflection on practice.

FINDINGS

1. Mental Models – enhance teacher practice

Teachers are challenged to reflect on their own mental models of what teaching and learning looks like in their classrooms before they can effectively begin to incorporate brain-based learning strategies. Caine and Caine (1995) believe that a change in mental models is equivalent to a change in teacher perception. Process groups can be one productive way for teachers to question their own and others' perspectives. Teachers can examine current literature and research and reflect on their own personal practice and beliefs before making changes to their professional practice (Caulfield, Kidd & Kocher, 2000; Caine, Caine, McClintic & Klimek, 2005; Winters, 2001). When teachers begin to take responsibility for their professional improvement, this will lead to changes in their mental models (Caine et al., 2005).

2. Emotions - impact on student learning

Students' emotional states influence their level of academic achievement. Caine, in an interview with Pool, stresses the importance of establishing a culture and environment where students feel safe and are not fearful (Pool, 1997). This is characterized by a state of *relaxed alertness* where students are not anxious about their surroundings but, rather, open and receptive to new information (Caine et al., 2005). Sylwester (in D'Arcangelo, 1998), says "…our emotional system drives our intentional system, which drives learning and memory and everything else that we do. It is biologically impossible to learn and remember anything that we don't pay attention to" (p. 25). A positive emotional state is essential for the student's ability to acquire new knowledge, and helps focus the attention of the individual (Caine, 2000; Caine et al., 2005; Caulfield et al., 2000; D'Arcangelo, 2000; Pool, 1997; Slavkin, 2004; Wagmeister & Shifrin, 2000; Wolfe, 2001).

3. Learning Environment – shaping student achievement

Learning is enhanced when the environment accommodates the needs of the learner and the instructor. Reigeluth and Beatty (2003) support the notion that the student's "…whole environment, school, home, and other settings should be considered as part of the learning environment" (p. 27). Students need to understand the impact of a lack of sleep, food and

water on their biology and how such things impact their brain's ability to learn (Erlauer, 2003; Slavkin, 2004). Students who can participate actively in teaching and learning in the classroom become more excited about their education (Goldberg & Stevens, 2001). Teachers can ensure that their classroom is a rich, stimulating environment, allowing students to become immersed in a complex milieu that stimulates the mind (Caine et al, 2005; Caulfield et al., 2000; Wagmeister & Shifrin, 2000; Wolfe, 2001). They can design a variety of teaching and learning activities that will access the brain's ability to remember visually and emotionally and encourage students to take risks (Caine et al., 2005; Caulfield et al., 2000; Saunders & Vawdrey, 2002; Wagmeister & Shifrin, 2000; Wolfe, 2001).

4. Memory – can't forget it!

Brain research has discovered multiple memory systems applicable to student learning. Tileston (2005) refers to long-term memory as "…a five-drawer file cabinet that assists with retrieval in the brain" (p. 38). *Semantic* memory refers to information regarding words, facts, and dates. *Episodic* memory refers to context and locations. *Procedural* memory encompasses muscle coordination, while *automatic* memory deals with conditioned response. Finally, Tileson believes, *emotional* memory takes precedence over all other types of memory. Saunders and Vawdrey (2002) suggest brain-based learning involves mastering and sequencing ideas so that learning can be transferred to other situations. "Recent brain research has shown that the brain pathways are strengthened with each use: often requiring six exposures (touching, seeing, hearing, doing) before the pathway is strong enough for long-term memory recall" (Saunders & Vawdrey, 2002, p. 45).

5. Assessment – achievement and motivation

"In a brain compatible classroom, assessment both measures achievement and provides motivation" (Goldberg & Stevens, 2001, p. 125). If teachers wish to establish a classroom in which brain-based learning can thrive, Caine, Caine, McClinitic and Klimek (2005) and Caufield, Kidd and Kocher (2000) all suggest allowing students to create some of their assignments and rubrics for marking. Assessment should be designed to fit the students, not vice versa (Caine et al., 2005). Erlauer (2003) suggests that because students are learning through a preferred intelligence, they should in turn demonstrate their knowledge through a preferred intelligence or learning style. Immediate, constructive feedback increases motivation and makes students aware of how to improve their work. As with teaching strategies, effective teachers are more likely to use an appropriate variety of assessment techniques in a brain-based classroom.

6. Biology of the Brain – pathway to understanding

Science has advanced our knowledge of brain biology and has provided information applicable to student learning. Winters (2001) states that recent MRI research has indicated the possible locations where cognitive functions take place relative to learning. Brain research indicates that the brain does not act as a computer, in a linear fashion, as some educators previously thought. Rather, the brain uses multiple strategies to create meaning (Caine, 2000; Caulfield et al., 2000; Slavkin, 2004). In particular, the concept of neural plasticity posits that the brain is continually rewiring itself throughout our lives to access new memories and experiences. Accordingly, brain-based instruction must also be 'rewired' on a continual basis to remain effective.

7. The body, mind, and brain - all for one and one for all

"Amazingly, the part of the brain that processes movement is the same part of the brain that processes learning" (Jensen, 2005, p. 61). Students need to access all their abilities to maximize learning. The use of natural movement in the classroom, such as dancing, clapping, manipulatives, and role play can help promote students' achievement (Caine et al., 2005; Jensen, 2000; Slavkin, 2004). "Teachers benefit by harnessing this natural energy instead of fighting it" (Given, 2002, p. 103). Brain research suggests that one of the most effective tools to maximize student learning is the incorporation of movement into lessons.

8. Time – allotment and student achievement

Duration of time on task is directly proportional to mastery of a concept. However, there are many aspects of time to consider in the brain-based learning classroom. One is the need for students to have time to achieve mastery of a concept or skill before moving on. Another is scheduling regular breaks in the delivery of instruction to allow some time for students to process information and reflect. Caine and Caine (1995) suggest that "…schedules should be tied to the actual time it takes a student to explore a point of view or to master a task, much as in a professional, research, or business setting" (p. 44). Erlauer (2003) and Jensen (in D'Arcangelo, 1998) emphasize the importance of time breaks.

> Studies have shown that adults in the work place need mental and physical breaks to increase productivity, quality, and morale…Attention span studies of children and young adults reveal similar but even more dramatic results. Students need a break in concentration at least every 20 minutes.
>
> (Erlauer, 2003, p. 76)

9. Collaborative Learning – creating synergy

"If brain-based pedagogy could be summed up in one sentence, it would be, Knowledge should be socially created" (Slavkin, 2004, p. 44). Erlauer (2003) suggests that "Collaborative learning provides the brain with the means to explore new information, typically in a problem-solving situation" (p. 136). Collaborative communities in schools can take many forms. Students can form peer groups and assist each other's learning (Wolfe, 2001).

> When students can share their own knowledge and skills with others, not only do the "receivers" gain because they learn something new, but the student who is acting as the teacher will solidify his or her knowledge teaching it to others. (Erlauer, 2003, p. 145).

> Students and teachers can also work collaboratively to make sense of information. This helps create an environment of relaxed alertness to increase student comfort and ability to focus in class (Caine et al., 2005; Pool, 1997).

10. Thematic Instruction – enhances student learning

Thematic instruction encourages students to connect meaningful activities to relevant practice. Through the application of evocative experiences and the relevance of complex situations in which learners are immersed, thematic instruction builds on prior knowledge and enhances comprehension (Caine et al., 2005; Caulfield, et al., 2000; Pool, 1997; Slavkin, 2004; Wagmeister & Shifrin, 2000; Wolfe, 2001). Patterning or chunking information for thematic instruction assists students to mentally 'place' or sort new information in a way that has meaning. This allows for greater internalization and recall of this information can be maximized (Wagmeister & Shifrin, 2000). Teachers can help this process by acknowledging the diversity of learners while focusing on the relationship of students' prior knowledge with the new knowledge to be acquired (Pool, 1997). Students can be intrinsically motivated to actively participate and complete assignments when they are given some ownership over implementation, process, practice, and assessment.

4.2.4 COLLABORATIVE LEARNING

Collaborative learning is an umbrella term for a variety of educational approaches involving joint effort by learners. Collaborative learning activities vary widely, but most centre on the learner's exploration or application of the curriculum, not simply on the

teacher's presentation of it. The teacher's role is to create an environment where young people are willing and able to work collaboratively, where there are plenty of opportunities and stimulating contexts for learners to work with others, and where they feel safe to share their emerging ideas and understandings.

Usually, learners are working in groups of two or more, searching mutually for understanding, solutions, meanings, or creating a product. Group challenges often require learners to produce a product for a specified audience and purpose. Collaborative learning programmes also place great emphasis on assessing the contribution of individuals within the group and of the performance of the team.

In collaborative learning situations, pupils are not simply taking in new information or ideas - they are creating something new with the information and ideas.

American researchers David and Roger Johnson have done more than anyone to popularise the concept of collaborative learning. Their research identified 700 studies relating to cooperative, competitive and individualistic efforts to learn and they identified five defining characteristics of cooperative learning.

1. Groups work together to accomplish shared goals. Group members buy into a mutual goal. They seek outcomes that are valuable for themselves and the group. They believe they sink or swim together.
2. Group members are hard on themselves and each other - they make each other accountable for producing high quality work and achieving goals.
3. Group members work face to face and support each other to produce joint products.
4. Group members are taught social skills and are expected to use them to work together to achieve their goals.
5. Group members analyse how effectively they are working together in achieving their goals.

COLLABORATIVE LEARNING IN SCHOOLS

Collaborative learning is not new to schools. For example, Circle Time, a very effective form of collaborative learning, has been embedded in the learning routines of many Scottish primary pupils for some time.

In Scotland two recent initiatives have focused on promoting collaborative learning techniques. North Lanarkshire's 'Cooperative Learning Programme' uses materials which emanate from the Johnson brothers' work in Canada. The aim of the authority is to have all teachers trained in cooperative learning.

The other initiative is known as the 'Critical Skills Programme'. This programme was developed in the 1980s after leaders in the business and education communities identified a similar wish list of skills and dispositions required of school leavers.

THE IMPLICATIONS FOR LEARNERS

'In classrooms where a sense of community is built, students are the crew not the passengers.' Chris Watkins

In a collaborative learning situation pupils are active agents.

In collaborative learning environments students:

- frequently work as a team
- actively solve meaningful problems
- publicly exhibit their learning
- reflect on what they are learning and doing
- apply quality criteria to their work
- take responsibility for and ownership of their learning.

Collaborative learning places different demands on students. It requires the group or class to become a community of learners that takes more responsibility for their learning, motivation and behaviour.

There is significant evidence to suggest that where collaborative learning is done well, students become self-motivated and much less reliant on the teacher. They have greater autonomy for their own learning and also understand how to be team players.

To do this they need to develop a range of new skills, which require a lot of scaffolding and support to begin with.

BENEFITS OF COLLABORATIVE LEARNING

- Develops higher level thinking skills
- Promotes student-faculty interaction and familiarity
- Increases student retention
- Builds self esteem in students
- Enhances student satisfaction with the learning experience
- Promotes a positive attitude toward the subject matter
- Develops oral communication skills
- Develops social interaction skills
- Promotes positive race relations
- Creates an environment of active, involved, exploratory learning
- Uses a team approach to problem solving while maintaining individual accountability
- Encourages diversity understanding
- Encourages student responsibility for learning
- Involves students in developing curriculum and class procedures
- Students explore alternate problem solutions in a safe environment
- Stimulates critical thinking and helps students clarify ideas through discussion and debate
- Enhances self management skills
- Fits in well with the constructivist approach
- Establishes an atmosphere of cooperation and helping school wide
- Students develop responsibility for each other
- Builds more positive heterogeneous relationships
- Encourages alternate student assessment techniques
- Fosters and develops interpersonal relationships
- Modelling problem solving techniques by students' peers

- ❖ Students are taught how to criticize ideas, not people
- ❖ Sets high expectations for students and teachers
- ❖ Promotes higher achievement and class attendance.
- ❖ Students stay on task more and are less disruptive

4.2.5 FLIPPED LEARNING

While often defined simplistically as "school work at home and home work at school," Flipped Learning is an approach that allows teachers to implement a methodology, or various methodologies, in their classrooms.

To counter some of the misconceptions about this term, the governing board and key leaders of the Flipped Learning Network (FLN), all experienced Flipped Educators, have composed a formal definition of "Flipped Learning." Explicitly defining the term may dispel some of the myths repeatedly promulgated by teachers, the media, and researchers.

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.

THE FOUR PILLARS OF F-L-I-P

FLEXIBLE ENVIRONMENT

Flipped Learning allows for a variety of learning modes; educators often physically rearrange their learning spaces to accommodate a lesson or unit, to support either group work or independent study. They create flexible spaces in which students choose when and where they learn. Furthermore, educators who flip their classes are flexible in their expectations of student timelines for learning and in their assessments of student learning.

LEARNING CULTURE

In the traditional teacher-centered model, the teacher is the primary source of information. By contrast, the Flipped Learning model deliberately shifts instruction to a learner-centered approach, where in-class time is dedicated to exploring topics in greater depth

and creating rich learning opportunities. As a result, students are actively involved in knowledge construction as they participate in and evaluate their learning in a manner that is personally meaningful.

INTENTIONAL CONTENT

Flipped Learning Educators continually think about how they can use the Flipped Learning model to help students develop conceptual understanding, as well as procedural fluency. They determine what they need to teach and what materials students should explore on their own. Educators use Intentional Content to maximize classroom time in order to adopt methods of student-centered, active learning strategies, depending on grade level and subject matter.

PROFESSIONAL EDUCATOR

The role of a Professional Educator is even more important, and often more demanding, in a Flipped Classroom than in a traditional one. During class time, they continually observe their students, providing them with feedback relevant in the moment, and assessing their work. Professional Educators are reflective in their practice, connect with each other to improve their instruction, accept constructive criticism, and tolerate controlled chaos in their classrooms. While Professional Educators take on less visibly prominent roles in a flipped classroom, they remain the essential ingredient that enables Flipped Learning to occur.

4.3.6 BLENDED LEARNING

Blended learning refers to a strategic and systematic approach to combining times and modes of learning, integrating the best aspects of face-to-face and online interactions for each discipline, using appropriate ICTs.

NEED FOR BLENDED LEARNING

Blended learning strategies vary according to the discipline, the year level, student characteristics and learning outcomes, and have a student-centered approach to the learning design.

Blended learning can increase access and flexibility for learners, increase level of active learning, and achieve better student experiences and outcomes. For teaching staff, blended learning can improve teaching and class management practices.

A blend might include:

• face-to-face and online learning activities and formats

• traditional timetabled classes with different modes, such as weekend, intensive, external, trimester

• well established technologies such as lecture capture, and/or with social media and emerging technologies

• simulations, group activities, site-based learning, practical's.

DIFFERENCE BETWEEN BLENDED LEARNING AND CLASSROOM LEARNING

Teachers have been blending or integrating different types of learning activities and resources in classroom, laboratory, practicum, studio contexts for a very long time. Today, the term 'blended learning' has evolved to mean the integration of classroom learning with online or e-learning.

TOOLS TO SUPPORT BLENDED LEARNING

LEARNING AND TEACHING STRATEGIES

Learning theories are a set of concepts about how people learn and to some extent they identify strategies underlying cognitive processes involved in learning. The info graphic on the right provides a clear categorisation of the learning theories you may need to be aware of as an educator. You may be familiar with established learning theories like behaviourism, cognitivism and constructivism and these can all be useful in designing blended learning activities, however there is another learning theory, connectivism, that can be very effective.

• Commentary and analysis: Blogs are an ideal tool for disseminating regular commentary and opinion. These blogs might be written by a single author or several. Multi-author blogs in particular can provide an opportunity for improving communication and increasing impact.

• Supporting research projects: Blogs make an ideal tool for recording the process of completing a project and distributing findings.

• Learning Journals: Students can use blogs to support and develop their learning. These blogs are often reflective and might be private, shared with a teacher or completely public. It allows learners to document their learning and can enable the Instructor to gauge a students' depth of understanding about a task or unit content.

• Learning communities: This could be in the form of a group blog for a unit involving teachers and / or students using it to share information and discuss topics. Learning communities can also be loosely connected networks involving many individuals reading and commenting on each other's blogs around a common theme.

• Resource sharing: Blogs can be used as a resource sharing tool allowing students to share, review and critique resources.

• Collaborative authoring: Blogs can be used to develop a 'publication'. The commenting functionality allows readers and collaborators to comment on each other's text.

• Blog journaling: creating a list or bullet points of main concepts and/or reporting events.

MIND MAPPING

• Cause –effect diagrams: create cause-effect diagrams that show outcomes of an experiment.

• Flowchart: create a flowchart of events that led to a significant moment in history.

• Brainstorming: when students are working in groups, scope out ideas to help in the development of the project.

OPEN EDUCATION RESOURCES

• Anchored instruction: use a short 'anchoring' that students can watch and revisit. Create a problem solving context or environment to 'anchor' student's interest in the video.

• Digital storytelling: using multimedia software such as iMovie, enables students to create their own instructional, historical or autobiographical video.

• Expressive dimension: listen to literary analysis of many great works such as those of Shakespeare adding a more expressive dimension

• Prediction: play a portion of a video and then ask students what they think will happen next.

FLIPPED CLASSROOM

In a flipped classroom, students have a voice and are encouraged to debate, question, make decisions, make choices and be supported in a learning environment. Of course, good pedagogy is key and teaching involves providing dynamic and varied learning experiences.

DESIGNING YOUR UNIT FOR BLENDED LEARNING

Good practice in blended learning involves using a few tools in effective ways to achieve quality learning outcomes. When designing a unit for blended learning start first with the learning outcomes and consider what supports students will need to achieve successful learning outcomes. This planning process includes the integration of blended learning in your unit and designing the learning activities.

THE BLENDED LEARNING ACTIVITY IS PLANNED IN ADVANCE, AS SOMETHING THAT THE STUDENT DOES

A blended learning activity is designed as a learning process which the student does. Typically, it involves the student in doing something more than just reading on-screen. The sequence of what the student will do in the blended learning activity is mapped out in advance. The resources and supports that students will need, and when they will need these are also mapped out in advance. Resources and supports include: task instructions, learning guide, online tools, and appropriate FAQs, web links, media files, etc.

THE ACTIVITY LEADS STUDENTS TOWARDS ACHIEVING THE LEARNING OUTCOMES AND/OR COMPLETING ASSESSMENT FOR THE UNIT

An effective blended learning activity is designed as an integral component of the unit. The activity may help students achieve the learning outcomes for the unit, for example, by practicing written communication skills and critical thinking in an online discussion (if these are learning outcomes, or implicit in the learning outcomes for the unit). Or it may help students prepare for an assessment task, for example by doing practice quizzes which allow multiple attempts. Blended learning activities extend learning opportunities beyond the classroom.

THE ACTIVITY TAKES ACCOUNT OF STUDENTS' INCOMING LEVEL OF EXPERTISE IN ONLINE LEARNING/INDEPENDENT LEARNING

Students who have not experienced online learning may find it challenging, at least initially, to do a blended learning activity. Blended learning places more emphasis on individuals to learn independently including monitoring their own progress. Blended learning activities, particularly for first-year students, should build students' confidence in themselves as online and independent learners. This doesn't imply making blended learning activities trivial, but it does imply careful design so that the activity is both challenging and achievable, with support. Although mature students may initially be more apprehensive about blended learning, there is some evidence that older learners may be better equipped than younger students to study independently?

STUDENTS ARE PROVIDED WITH CLEAR GUIDELINES/EXPECTATIONS ABOUT WHAT THEY ARE TO DO, WHERE, AND WITHIN WHAT TIME FRAME

Before beginning the blended learning activity, students are provided with an overview of what they will do in the activity. As well, students are provided with information about the components of the activity, where they will do these, in what sequence, with what support,and within what timeframe/s. This information is provided

online so that students can refer back to it, at will. Usually this information is also discussed in class. When preparing guidelines, it's a good idea to ask someone else to trial these, aiming to identify any gaps or information that could be misinterpreted by students.

THE RATIONALE FOR THE ACTIVITY IS MADE CLEAR TO STUDENTS

Students are informed about why they are doing the particular blended learning activity. Explain how the activity will help them to achieve the learning outcomes for the unit, and/ or complete assessment task(s) for the unit. Remember too, to explain how the blended learning activity will help them develop professional skills for the workplace. For example, blended learning activities can help students enhance their independent learning skills, writing skills, collaboration skills, investigation skills, etc.

STUDENTS GET FEEDBACK ON THEIR PERFORMANCE AS PART OF DOING THE ACTIVITY OR FOLLOWING COMPLETION OF THE ACTIVITY

An advantage of blended learning is that it can enable students to receive immediate feedback on their performance (eg automated feedback on quizzes). It can also enable students to receive more feedback (eg feedback from multiple students and the teacher/ guest presenter in an online discussion). Feedback provided in online discussions is also "persistent" in the sense that the student can return to the feedback and re-read it, thus increasing the likelihood of learning.

THE ACTIVITY IS MANAGEABLE BY STAFF

When designing a blended learning activity, keep in mind what it is feasible for you to do during semester. A built-in feedback process can reduce your blended learning teaching time. To keep your workload manageable, you could also create a Frequently Asked Questions resource so that you don't have to answer any task-related questions multiple times. Remember to tell students how frequently you will be monitoring the site and responding to questions, posts etc. One final word: as with anything new, it is wise to expect to devote a little more time to an activity the first time you run it.

4.2.7 E-LEARNING

INTRODUCTION

E- Learning is defined as a acquisition of knowledge and skills using electronic technologies such as computer, internet based courseware and local and wide area network. E-learning is a way of providing training and development to the employees through various electronic media such as internet, audio, video. In a society, the student generation have to realized the importance of technology and have to be well aware how to teach the future leaders. Annually, the demand for higher education is growing globally and India is no exception to it. In fact, in India, the number of applicants is three to five times as against the number of seats in any institution of higher education. It can be also defined as a "Internet based Training (IBT)".

Therefore, need arises for such a system, which will help to reach to the maximum number of learners and „e-learning" is the solution for it. E-Learning is the experience that is delivered or enabled by electronic technology. The delivery of learning or content can be over the intranet, extranet or over the Internet, via CDROM, interactive TV, or satellite broadcast (WAGNER, 2008). With the passage of time, student's number is exploding on university campuses.

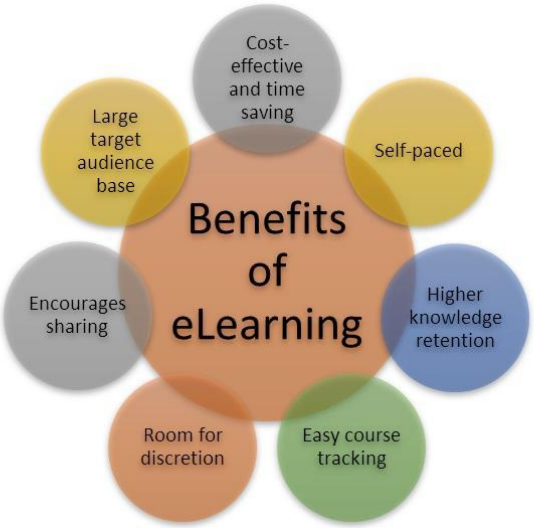
SCOPE OF E-LEARNING

There are basically to parts or phases of e-learning. In one phase e-learning is used for educational purpose and at other level it is been used for training. The educational; use is limited to secondary and higher secondary level. In the second phase it is used to provide training to the employees and to upgrade their skills. E-learning is growing at very low rate in India as compared to international market where it is been used at all levels.

In India if we can be able to make e-learning as a source of learning in rural areas then it is the easiest and fastest tool to educate people. If we consider the population in India it is hard to accommodate all the people in specific university or educational area o get the education.

BENEFITS OF E-LEARNING

A multi-billion dollar industry does not spring to fame without an amazing array of benefits tagging along, which make the millions all the more worthwhile. Let's have a look at some of them.



CHALLENGES IN e-LEARNING IN INDIA

In case of India majority of population is leaving in rural areas so it is bit difficult to make them aware about the concept of e-learning. The second problem is to make it available to the rural areas. The problem of infrastructure, connectivity and internet availability are also there. The life style of people also affect for all this. We can take these measures to implement the concept of e-learning in rural area where we will be having full utilizations of the system. The social implication of e-learning can be very important issue to be considered for the success of e-learning in India. The social implication consists of religion, gender, literacy, geographical area, literacy, lifestyle etc.

If we consider cultural issues the following factors matters which includes content, style of writing , material used and style of utilization. Some contents may be favorable or unfavorable to the to some group of people, so we need to take care of this .

FUTURE OF e-LEARNING IN INDIA

E-learning has a major role to play in India to grow up in all aspects in international market. As India is one of the leading IT service provider countries. The presence of world class IT infrastructure and IT professionals enable it to be one of the leading e- learning service providers in India. The government is taking proactive measures I regulatory and financial capacity to boost the e-learning environment in India. Already lots of funds are being invested in setting up internet kiosks in rural areas for the purpose of communication which can be used for e- learning purpose.

4.2.8 VIDEO CONFERENCING

Videoconferencing is two-way audio and video signal transmission. The video and audio signals are compressed and transmitted over a digital phone line

• advantage: interactive

• drawback: picture quality

• need to: vary and visualize

A videoconference system must have audio-visual equipment (monitor, camera, microphone, and speaker) as well as a means of transmitting information between sites. A **broadband** (a high-capacity communications circuit/path; it usually implies a speed greater than 1.544Mbps.) **satellite connection** with studio-quality equipment produces an excellent full-motion video connection, but the equipment and transmission expense is huge. Recent advances in computer and telecommunications technologies have sparked an interest in **compressed video systems**, when the vast amount of information in a normal TV transmission is squeezed into a fraction of its former bandwidth by a codec- **Co**der-**Dec**oder (videoconferencing hardware that codes the outgoing video and audio signals and decodes the incoming signals). Some information is sacrificed in the process, which may result in diminished picture and sound quality.

Videoconferencing connections may be limited to a **closed network** (such as a LAN) or may use **public networks** (such as regular phone lines). Many connect via **ISDN** (Integrated Services Digital Network) because it is an economical solution for high-quality videoconferencing. ISDN works over regular copper telephone lines, transmits at a dedicated minimum of 128 Kbps per line, and provides bandwidth for smooth audio and video (15-30 frames per second). The preferred rate for events is at least 384 Kbps. In contrast, an Internet-based connection shares or competes for bandwidth with other Internet data. This may result in audio clipping or delays creating jerky video. Many institutions are developing **high bandwidth networks** and are experiencing better results with IP videoconferencing. Many believe that the Internet will eventually replace ISDN as the medium of choice for videoconferencing.

The most significant distinction among videoconferencing systems has to do with how data is transmitted. Transmission is important not only because it impacts audio and video quality, but also because it limits connection options. For example, an Internet-based CU-See Me system won't be able to connect with an ISDN-based VTel system without a some sort of gateway.

TYPES OF VIDEOCONFERENCING SYSTEMS

ROOM-SIZE

Room-size videoconferencing systems typically use high quality audio-visual components, sophisticated **codecs**, and feature-rich control devices to create an experience suitable for a room full of participants. Room-size videoconferencing is often used to support distance education.

DESKTOP

Recent advances in technology and the increasing availability of ISDN as a cheap delivery media have promulgated the move toward "desktop" videoconferencing. Desktop systems use a personal computer with special hardware and software to code and decode the signal. This kind of system uses cheaper components and is most appropriate for individual or small group use.

Desktop systems often include a document sharing feature, which allows participants to see and edit a computer document as they see and hear each other. Document sharing and the relatively low cost of desktop systems make this an ideal tool for communication, collaboration, and learning. Desktop videoconferencing is characterized by:

• many to many interaction
• equal participation
• more relaxed method of control
• informal communication among participants

EQUIPMENT COMPONENTS-CODEC

The codec takes the analog video signal and codes (digitizes and compresses) it. The codec also has to decode (decompress and un-digitize) the received transmission. The most obvious consequence of a slow codec or low-bandwidth connection is a "jerky" picture and an audio time delay.

VIDEO EQUIPMENT

Desktop systems display video in a small window on the computer monitor. Room systems have one or two large video monitors and usually display the local audience as well as the remote audience. The camera can be anything from a tiny desktop camera that sits on top of a computer monitor (desktop system) to a high-quality model with remote control pan and zoom features (room system). High-end systems often come with a document camera and a second video connection.

AUDIO

Most high-quality systems come with a microphone designed to work best with a small group of people. In many cases, an additional microphone can be connected as well, making your setup more versatile for larger groups. The best systems use sophisticated processing to cancel out background noise and echo.

CONTROL

Controls allow users to place calls, adjust volume, and sometimes even pan and zoom the camera. Desktop systems display controls and tools on the computer monitor window. Room systems come with remote control or console devices. To participate in a regular point-to-point ISDN call, participants simply dial another ISDN unit's phone number and the call is initiated just like a regular phone call. Newer ISDN videoconferencing units adhere to **H.320 standards** which means that any unit that is standards-compliant can connect to any other H.320 compliant unit. It is also possible to connect with more than one other site.

This is called a "**multipoint**." In the "old" days, you had to dial a special number to connect to a **multipoint bridge**. These systems allowed you to see only one site at a time--usually the one that was making noise (called **voice activated**) -- no matter how many were connected. Newer systems now have built-in bridges which allow you to connect to multiple sites just as you would in a point-to-point call. You can even add other sites once you are in a call. These units are great because they eliminate the need to schedule and pay for time on a bridge. In addition, many of the new units support "Hollywood Squares." Technically called **continuous presence,** these units allow you to view of multiple sites at the same time.

SOFTWARE-Microsoft Net Meeting

Using your PC and the Internet, you can now hold face-to-face conversations with friends and family, and collaborate with co-workers around the world.

Features:

Video and Audio Conferencing

NetMeeting's audio and video conferencing features let you communicate with anyone on the Internet.

Whiteboard

The whiteboard lets you collaborate in real time with others via graphic information.

Chat

Chat lets you conduct real-time conversations via text, with as many people as you like.

Internet Directory

The Microsoft Internet Directory is a Web site provided and maintained by Microsoft to locate people to call on the Internet.

File Transfer

File transfer lets you send one or more files in the background during a NetMeeting conference.

Program Sharing

NetMeeting's Program Sharing feature lets you flexibly share multiple programs during a conference and retain greater control over the way they're used.

Remote Desktop Sharing

Remote Desktop Sharing lets you operate a computer from a remote location.

Security

NetMeeting uses three types of security measures to protect your privacy.

Advanced Calling

This feature gives you the flexibility to send a mail message to a NetMeeting user or initiate a NetMeeting call directly from your mail address book.

SYSTEM REQUIREMENTS

To use the data, audio, and video features of NetMeeting, your computer must meet the following hardware requirements:

• For Windows 95, Windows 98, or Windows Me, a Pentium 90 processor with 16 MB of RAM (a Pentium 133 processor or better with at least 16MB of RAM is recommended).

• For Windows NT, a Pentium 90 processor with 24 MB of RAM (a Pentium 133 processor or better with at least 32 MB of RAM is recommended).

• 4 MB of free hard disk space (an additional 10 MB is needed during installation only to accommodate the initial setup files).

• 56,000 bps or faster modem, ISDN, or LAN connection.

• Sound card with microphone and speakers (sound card required for both audio and video support).

• Video capture card or camera that provides a Video for Windows capture driver (required for video support).

FINANCIAL EVALUATION

• Monthly INTERNET unlimited traffic with a bandwidth of 384 kbps 2100 USD/month

• CREATIVE - PC-CAM 300 1.3MP 120 USD

• CREATIVE - Sound Blaster Live! Player 5.1 37 USD

• SONY - Microphone V-120 14 USD

• SONY – Audio Headphones P180 20 USD

• Codec is included in the PC-CAM pack

• Microsoft NetMeeting is included in Windows 2000

• Installation 50 USD

Prices don’t include the VAT.

QUESTIONS

1. Explain the teacher centered methods of teaching Mathematics.

2. Critically analyse the recent trends in teaching Mathematics.

3. Explain briefly the learner centered methods of teaching Mathematics.

4. Discuss the interactive methods of teaching mathematics.

UNIT V RESOURCES FOR TEACHING MATHEMATICS

5.0 PRINT RESOURCES

5.1 NEWSPAPERS

A newspaper may be described as a document which is printed and published regularly and consists of news reports, articles, photographs and advertisements which are on large sheets of paper folded together but not permanently joined. Newspapers may be published daily, weekly or every fortnight. Examples of newspapers are the DAILY GRAGHIC in Ghana and the WASHINGTON POST in the United States of America. Newspapers are very important in the lives of many people in the world. As a section of the Press, newspapers have the main aims of informing, educating and entertaining the public.

We the students of West Africa Senior High School at Adenta, a suburb of Accra, the capital city of Ghana, working on Learning Circle Project have found out from our research that newspapers are very important in not only educating the youth but also help in informing and entertaining them in our country, Ghana as well as in other parts of the world.

NEWSPAPERS IN EDUCATION:

- -Articles from newspapers give facts about current affairs which may not be found in textbooks in their schools.
- -Students learn new or unfamiliar words, expressions and spelling which add up to their vocabulary.
- -Newspapers provide topics that students may use in their conversations with their friends.
- -The youth are educated on social, political and economic issues when they read articles in the newspapers.
- -Newspapers educate both the youth and adults on the opinions and feelings of people in the world on various issues.

- -Newspapers educate people about new inventions, discoveries and developments in Science, Technology, Health and Diseases.
- -When students read newspapers, they learn about different styles of writing.
- -Students who read newspapers regularly improve their reading in terms of fluency and speed as they become familiar with a lot of words.

NEWSPAPERS IN THE INFORMATION OF THE PUBLIC:

-Newspapers provide reports on both local news and foreign news. They provide news on crime, natural disasters, wars, the Stock Exchange, Sports, the weather and many other issues. These news are important in the lives of many people including the youth.

-Newspapers give information on current and existing laws, rules, regulations and bye-laws.

-The youth can easily obtain information on the problems facing their country and other countries e.g. food shortage.

-Through advertisements, information can be obtained from newspapers on **types of goods** one wants to buy and in **which shops** they can be located. These goods may be clothes, shoes, computers etc.

Newspapers in Entertainment

We the youth are very much interested in entertainment.

-Newspapers provide advertisement on entertainment, that is, various forms, venue, date and time.

-Some students read newspapers during their free time as a form of entertainment.

-The youth find crossword puzzles and quizzes in newspapers challenging and entertaining.

-Some youth also get a lot of fun from reading jokes, poems, comics and cartoons in newspapers.

Although newspapers are **advantageous** in educating, informing and educating the youth, they also have **disadvantages**. Some newspapers, especially private newspapers, contain some articles that are not reliable and therefore not good or useful for the youth.

From our research, about 55% of our students read newspapers regularly. Most of them prefer reading youth newspapers especially JUNIOR GRAPHIC published by the Graphic Communications Group. The students were of the opinion that newspaper reading improves their reading. The students said the youth-focused newspapers write articles that are suited to their needs. Headlines of ten youth-related articles we selected from March 2008 editions of major newspapers are: NGO introduces new methodology for English; Social welfare looks for parents of missing children; Catholic Church announces new youth programme; Dadebo stresses the need for teaching ICT in schools; Child Protection committees set up in 11 districts; Queen advises youth to be self-dependent; Academic excellence goes with discipline; President's lifeline for BECE failures; NCCE expresses concern about child labour; ENO Environment members mark Day.

We cannot imagine a world without newspapers. In view of the great importance of newspapers, we suggest that all youth should be encouraged to read newspapers especially those written for the youth. Schools should also be encouraged to publish their own newspapers where it is possible. All the youth are invited to the educative world of newspapers. Let us cultivate the habit of reading newspapers.

5.2 JOURNALS

LEARNING JOURNAL

A learning journal is a collection of notes, observations, thoughts and other relevant materials built-up over a period of time and maybe a result of a period of study, learning and/or working experience. Its purpose is to enhance your learning through the process of writing and thinking about your learning experiences. Your learning journal is personal to you and will reflect your personality, preferences and experiences.

WHY USE A LEARNING JOURNAL?

- To provide a "live" picture of your growing understanding of a subject experience
- To demonstrate how your learning is developing
- To keep a record of your thoughts and ideas throughout your experiences

- To help you identify your strengths, areas for improvement and preferences in learning

A learning journal helps you to be **reflective** about your learning, this mean that your journal should not be a purely descriptive account of what you did but an opportunity to communicate your thinking process: how and why you did what you did, and what you know think about what you did.

STRUCTURING YOUR LEARNING JOURNAL

Your learning journal may be called several different things: a learning log, a fieldwork diary or personal development planner. Different subject areas may ask you to focus on different aspects of your experience and may have different formats. A journal could be a notebook, an electronic document or sometimes recorded verbally on tape. Choose a method that works best for you!

WHAT IS REFLECTIVE LEARNING?

Reflective learning is a learned process that requires time and practice. It is an active process: involving thinking through the issues yourself, asking questions and seeking out relevant information to aid your understanding. Reflective learning works best when you think about what you are doing before, during and after your learning experience. Reflective learning is therefore not only about recognizing your something new, it is also about see reality in a new way. Reflection is an important skill to develop and requires you to think about how you are personally relating to what is happening in the workshop or in your work.

CONTENT OF YOUR LEARNING JOURNAL

A learning journal should focus on your personal responses, reactions and reflections to new ideas or new ways of thinking about a subject that you have been introduced through:

- Workshops, seminars, training sessions
- Research and reading including any visual research including television, film and internet
- Conversations and discussions with other participants, your Manager, Mentor, Coach and other colleagues
- Significant experiences in the workplace

PROCESS OF REFLECTIVE LEARNING

What do I think about this issue/topic/ experience? Explore my understanding, perceptions and ideas Question my assumptions Identify anything confusing or difficult to understand

What more do I need to know to help my understanding Develop and refine my ideas and beliefs Identify, locate and interpret relevant information and resources. How can I use this experience to improve my learning, thinking and working? e.g. What would I do differently next time?

5.3 MAGAZINES

A magazine is a publication that is issued periodically. It generally contains essays, stories, poems, articles, fiction, recipes, images etc. Magazines are directed at general and special audience, often published on a weekly or monthly basis.

We know that the word "magazine" is derived from Arabic word makhazin or "storehouse," which contains a collection of facts and fiction, all bundled together in one package. Gentlemen's Magazine, founded in 1731 is considered as the world's first magazine. Then we had The Economist, Collier's, The Saturday Evening Post, National Geographic, Time, The New Yorker,Life, People etc. In the present age of the tablet and social media, the idea of a "magazine" is returning to its storehouse roots. Functionally, a magazine still represents the idea of a bunch of thematically-related content put together as one package.

A magazine can also be considered as a cabinet of curiosities; i.e. a display case in which interesting, unusual and occasionally 'eccentric' objects are collected and displayed as a conversation piece or an expression of the writer's wide-ranging interests or tastes. The readers are treated with a fascinating, mind-expanding and unique set of wonders they had never dreamt of.

CHARACTERISTICS OF MAGAZINES

While popular magazines provide broad overviews of topics, scholarly journals provide in-depth analysis of topics and report the findings of research, and trade magazines report on industry trends, new products or techniques. A popular magazine which caters to the general public uses non-technical language. The contents of these magazines include interviews, general interest articles and various types of features. They usually cover a wide range of topics based on research, source comments and generalizations. Articles are usually written by a staff writer or a journalist; in some cases,

interesting articles of freelancers are also encouraged. They generally contain many interesting and sometimes sensuous photographs to attract readers. In general, magazine articles are easy to read, fairly brief in length, and may include illustrations or photographs. Magazines don't necessarily follow a specific format or structure in writing the articles. Its attractive appearance, eye-catching cover pictures and illustrations on quality paper make it more appealing to the reading public. Magazines also contain many colourful and impressive advertisements.

STRUCTURE OF A MAGAZINE ARTICLE

As soon as you're ready to write a magazine article, you need to think about structure. With magazine articles, you can move beyond the inverted pyramid style of news by scattering important points throughout the article.

Tell a story

The important thing to remember is that you're telling a story to your readers. That means you need a beginning, middle and an end. It also means you need to think about where you're taking your reader and create a logical path to that end point.

The beginning

To get people to read your article, you need to find a way to grab them. For example, you can begin an article with a quote or an anecdote from a person's life. However, you can also set the scene or use anything that will attract the reader's attention.

The middle

With most magazine articles, you talk to a person or people. People like reading about other people, so if your interviewee says something good, use a quote rather than the reported speech. This makes your magazine article more interesting.

The ending

Finally, end with a bang. This could be in the form of an important point, a revelation or another anecdote or quote. The idea is to satisfy your reader and to get that reader interested in your other writings as well.

Extra credit

When you do research for an article, you often have information left over that didn't make it into the main piece. Don't get rid of this. Use it to create a sidebar or table (editors will love this), or as the starting point for another article.

MAGAZINE WRITING STYLES

Readers are primarily interested in what you have to say. Depending on the way in which you say it may encourage them either to read on or to give up the piece. Writing style is always personal; it is your own. Like your signature, it is unique and distinct. Writing style reveals the writer's personality or voice. The aims and objectives of the magazine are clearly reflected in the style of writing. The potential readership of magazines also determines the style. The specialized magazines have their own unique style of writing and presentation depending on the above discussed criteria. Let us now discuss some of the common styles used by the magazines in their presentation of articles.

Narrative writing

Narratives are works that provide an account of connected events. In a narrative style, you'll need to tell a story in such a way that the audience learns a lesson or gains an insight. Narrative writing is a type of writing in which the author places himself as the character and leads you to the story. Here, being a narrative, a story or bevent is told through characters and dialogues. Narrative writing has definite and logical beginnings, intervals and endings. Narrative writing uses many literary techniques to provide deeper meaning for the reader and it also helps the reader use his / her imagination to visualize situations. Literary techniques include metaphors, similes, personification, imagery, hyperbole, alliteration, back story, flashback, flash-forward, foreshadowing and narrative perspective or point of view. It also makes use of literary elements such as setting, plot, theme, characters, style/structure, perspective, voice etc. since literary techniques are best understood in the context of one of these elements. Figurative language is a common element in narrative writing.

Serialised narrative writing

In this style you cannot find out what's going to happen next. You have to wait. Here the writer really understands how to hold a reader by his/her side and make them stick on with the piece till the end. That's the skill absolutely essential for this style of writing. The first and most essential quality of a serial narrative is that it has to be immensely, intensely and inescapably readable. They should have a powerful pull on all readers with the power of a delicious sense of enforced writing. The writer can also make use of dialogues in this style to convey the real emotional spirit, if necessary. One of the reasons for a serial narrative's power is that the plot unfolds gradually because it is unfolding the rhythms of life. The writing should end with something that makes the reader feel it wasn't a waste of time.

Descriptive writing

Descriptive writing focuses on describing a character, an event or a place in great details. It is sometimes poetic in nature in which the author is specifying the details of the event rather than just the information of that event. In a descriptive style, the writer needs to describe a person, object or event so vividly that the reader feels like s/he could reach out and touch it. The writer attempts to convey as many of the senses related to the subject as possible for a clearer understanding of what is being described. Descriptive writing has a unique power and appeal, as it evokes sensory description through sights, smells, sounds, textures and tastes through the text to your reader. Hence word choice in descriptive writing is critical. Each word must be critically evaluated to see if it contributes to the overall description. Therefore, this style tends to use more adjectives and adverbs, as well as figurative language and imagery to create details that allow the readers to envision the scenery and events in their minds.

Persuasive writing

This writing revolves around convincing someone. Persuasion requires great skill and effort to convince your readers to endorse your opinion or viewpoint. You write with the sole objective of persuading your readers. Persuasive writing utilizes the power of words to confidently and passionately convey a very important matter. Such writings are usually written with precision and authority.

Persuasive texts are set out to argue and prove a case by presenting ideas that follow in logical progression. It aims to convince a targeted audience of the validity of a viewpoint on an issue by presenting logical arguments. Anticipating and answering possible objections or opposing arguments, all types of persuasive writings should present well researched evidence to support the case and also provide facts from authorities to prove or disapprove an argument. The most common forms of persuasive texts include essays, editorials, letters to the editor, opinion articles, feature articles, interviews, speeches and submissions.

Imaginative writing

Imaginative writings present ideas, issues and arguments in an imaginative and credible way through description, characters, settings, figurative language, the five senses, etc. An imaginative writing assumes the form of fiction, specifically of short story. Depending on the idea, the imaginative article can discuss anything from space travel to civil rights. Because of this wide variation, some imaginative pieces require a very serious response, while others invite a much more light-hearted, fantastic one. Usually,

imaginative write-ups start with a hypothetical situation and ask how you would respond to it. It should be credible and plausible and must convey information through description and figurative language. Add sensory details and realistic conversation. Also include imaginary interactions with the characters. The characters should be dynamic in nature and they should see things differently or act differently by the end of the story. Narrate and describe events, characters and situations. For an imaginative writing, you will not have to use formal language, but you need to show your mastery of writing.

Visual writing

Visual writing is a good language for story telling in any medium. It focuses on the mind, distinctive details from the intricately interconnected experiences of the individual. Visual writing creates depth, quality and pacing. Visual style isn't an extension of the writing, but it has to be embedded into the writing in a way that the reader may not even be aware of its presence. This means visual style is not about adding more but enriching an already existing text. Visual communication engages meaningful experiences and feelings within individuals through richly embedded image symbols which are conveyed either directly through text or indirectly through other senses. One aspect of visual language is that it is a fluid language and it spontaneously convey meanings. Another aspect of visual language is the composition of images used and the scenes it creates. A third aspect of visual language is dialogue which uses words that invoke images. The dialogue creates movement in the story.

Multiple inverted pyramid

In the field of magazine journalism, the term 'multiple inverted pyramid approach' refers to a style of writing which informs and entertains the readers through self-sufficiently built plots of information, each of which may be arranged in the form of an inverted pyramid. The fact is that the idea of the whole story is spilled in the first paragraph itself. The reader can decide whether to continue reading the details or to go into something else. But even if the reader stops at a certain point, this form of writing may provide some essential facts to the readers.

TYPES OF MAGAZINES

Today, there are thousands of magazines worldwide. They inspire, inform, educate and entertain audiences across the globe. Nearly 600 years after the advent of the printing press, magazines continue to change the nature of things throughout the world. The major categories of magazines are briefly explained below:

1. General interest magazines

This type of magazine is published for a wider audience to provide information, in a general manner and the focus is on many different subjects. The main purpose of a general interest magazine is to provide information for the general audience. No background knowledge or expertise is assumed. Articles usually provide a broad coverage of topics of current interest. They are written by journalists, freelance writers or staff correspondents of the magazine. These periodicals may be quite attractive in appearance, with articles often heavily illustrated with photographs. The language of these publications is geared to any educated audience. There is no specially assumed target audience. Mere interest and a certain level of intelligence is only required to read and enjoy such magazines. These are usually published by commercial enterprises, though some are published by professional organizations. Examples of general interest periodicals are: Time, Newsweek, Outlook, India Today and The Week.

2. Special interest magazines

Special interest publications are magazines directed at specific groups of readers with common interests. Most special interest magazines cater to any specific interests or pursuits. For instance, there are magazines that cover sports, news, fashion, business, music and so on. While some attempt to cover all aspects of a broad subject, others are concerned only with a particular element of the general subject. Sports Illustrated, for example, contains stories on practically any sport, but Golf Digest carries only stories related to golf. Other special interest publications find their audiences through different demographic segmentations.

There are magazines published primarily for men (Field and Stream, Gentlemen's Quarterly (GQ), etc.), women (Woman's World, Grihalekshmi, Vanitha etc.), boys (Boys' Life) and girls (Teen Vogue). Specialized periodicals also serve most professions, industries and organizations.

Specialist magazines have been growing in recent years, not only in terms of the number of readers, but also in the increasing number of consumer advertisers who have seen the benefits of the medium. Circulation varies for a special interest magazine. But, even though the circulation is small, it is usually stable over the short term and offers an advertiser a well-defined market. Obviously, for a specialist product, there is no better place to advertise than in a magazine which concerns itself directly with the product area, such as gardening or photography.

We can categorize some special interest magazines into the following genres based on their content and target audience:

a. Farm magazines

These are magazines featuring news and information pertaining to the agricultural sector. It is a resource for farmers and vendors of farmers' markets. There are various farm magazines that contain information about various farming equipment, farming practices, ideas and technology suitable to small and big farms, raising unusual livestock, growing high-value crops, direct marketing of their products to bring in more income, the latest techniques for growing bountiful, nutritious crops and many more articles that could provide information to the farmers who are their target audience. They also share the success stories of artisans and farmers, on government policies and programmes and also about how to promote their business by reaching new customers and develop value-added products.

c. Business magazines

Most of these magazines are dedicated to the dissemination of information related to particular business areas like accounting, banking, finance, international business, management, marketing and sales, real estate, small business etc. They explore latest news and reviews on current trends in the world of business. Business magazines offer readers an unparalleled look at business and economic news, with incomparable access to business drivers around the globe. It also provides the most recent news about trends and developments in global business, financial markets and personal finance.

b. Sports magazines

A sports magazine usually features articles or segments on sports comprising of many photographic images and illustrations. Some magazines concentrate on all general sports news and related issues while others concentrate on specific sports or games such as football, baseball, athletics etc. But the common aim of any sports magazine is to take fans inside the game and provide a mix of columns, features, and profiles of their favourite players, scores, statistics and analysis of the game. News and information about sports, reviews, interviews, expert advice, player profiles, season previews, predictions and pre-game analysis as well as quality photos are some of the main ingredients in a sports magazine.

d. Environmental magazines

The aim of this type of magazine is to provide information about environmental issues and to share ideas about our very diverse and dynamic environment so that readers can live

more sustainable lives and connect themselves to ideas and ongoing efforts for change, as well as for building a more just and sustainable future. They cover everything environmental - from the big issues like climate change, renewable energy, toxins and health to the topics that directly impact the readers' daily lives: population, poverty, consumption and the environment in general. In-depth reviews of major policy reports, conferences, environmental education initiatives, environmental reports and photos from around the world with an emphasis on human involvement in an environmentally changed scenario are some of the highlighted features of environmental magazines.

e. Entertainment magazines

Entertainment magazines are usually glossy in nature and provide entertainment. They usually carry news, original stories, scandals, gossips and exclusives about celebrities in various entertainment fields such as film, music, TV, fashion and related similar areas of the industry. Cultural criticism, beauty, lifestyle trends and shopping guides also find expression in such magazines. As its main focus is on celebrity fashion or lifestyle, it is graphically rich in nature, featuring many photographs or other images.

f. Automobile magazines

Automobile magazines offer a rich and varied examination of the automotive universe in all its forms, illustrated with vibrant photography. They present interesting automotive news in the industry and celebrate the automotive lifestyle and its personalities, past and present. It also offers insights into emerging trends in the industry and also creates images of whatever comes next in the written and visual form. Updates in motor vehicle arena such as newly arrived cars and bikes, contemporary style of vehicles, recommendations to buyers, reviews of newly launched vehicles are some of the attractive elements in these magazines.

j. Literary magazines

A literary magazine devoted to literature, usually publishes short stories, poetry, essays, literary criticism, book reviews, biographical profiles of authors, interviews and any content related to literature. Its aim is to promote literature, encompass an overall sense of the word, preserve indigenous literature and provide a platform for creative writers through its articles.

5.4 ENCYCLOPEDIA

A book or numbered set of books containing authoritative summary information about a variety of topics in the form of short essays usually arranged alphabetically by

headword or classified in some manner. An entry may be signed or unsigned, with or without illustration or a list of references for further reading. Headwords and text are usually revised periodically for publication in a new edition. In a multivolume encyclopedia, any indexes are usually located at the end of the last volume. Encyclopedias may be general (example: Encyclopedia Americana) or specialized, usually by subject (Encyclopedia of Bad Taste) or discipline (Encyclopedia of Social Work).

TYPES OF ENCYCLOPEDIAS

Encyclopedias for General Information

General encyclopedias cover a wide range of topics in the form of short articles written by knowledgeable experts. Due to the number of topics covered, the information contained in such volumes has limited depth but gives enough information to provide key words and possible sources for further research. Historically, general encyclopedias were alphabetized and printed in multivolume sets to be included in schools of all levels. More contemporary versions like Encyclopedia Brittanica are available online and regularly updated by content experts.

Subject-Specific Encyclopedias

If you're looking for depth on a topic or subject beyond what a general encyclopedia offers, then a subject-specific encyclopedia is your best bet. For instance, if you look up astronomy in a general dictionary, you will get some basic information on the history of astronomy and specific disciplines of the science. However, if you reference a subject-specific encyclopedia in this area, you can learn about topics like dark matter and supernovas in much greater detail. These encyclopedias also include bibliographies that help you track down specific books and articles related to your field of research. Many university libraries carry in-print and online versions of subject-specific encyclopedias like the Encyclopedia of Astronomy and Astrophysics and the Cambridge Encyclopedia of Astronomy.

Electronic Encyclopedias

We live in a digital world where information is available instantaneously and things change rapidly. To evolve with such a connected society, many encyclopedias have

moved their print versions online while retaining a similar editorial staff and contributors that include experts in their respective fields. Such online knowledge bases allow students and teachers quick, up-to-date access wherever they are connected to the web, whereas expensive and heavy books serve as a barrier to some. World Book Online, for instance, offers a subscription-based version, and Scholarpedia is a free, peer-reviewed and online-only knowledge base.

Crowd Sourced Encyclopedias

Crowd sourcing knowledge has become an easy way of accumulating information in the digital age. Online encyclopedias and forums, like Wikipedia, are popular places for amateurs and experts alike who wish to share their knowledge with the world. While some of these sources are criticized as having questionable credibility, others believe that the ability to have limitless people post, critique and fact check creates a reliable source of information. According to researchers at the University of California Irvine in 2010, articles that have been featured on Wikipedia had high-quality information 86 percent of the time, compared to non featured articles that had a similar level of quality 74 percent of the time, so the quality of the content for such articles increases as they go through revisions. But before you jump right in, it's always a good idea to ask your teacher if you're allowed to use a crowd sourced encyclopedia as a source.

5.5 AUDIO RESOURCES

RADIO TALK

Think of the village or town in which you live. You find people belonging to all communities' men and women, rich and poor. Radio plays a very important role in the lives of the people of India. Though there are plenty of rich people and highly developed cities, a majority of our people are poor and a large number of them cannot read or write. So the only medium that can really reach them to inform, educate and entertain is the radio. Radio stations especially those run by the government perform a public service duty.

TYPES OF RADIO FORMATS

Do you remember the programmes you have heard on radio. Try and recall some of them. You may have heard the names of radio stations, from where the programmes are

broadcast. Many of you would remember Vividh Bharati, AIR FM Gold or some private commercial station. You may also remember the time being mentioned and what programme you are going to listen to. These are called ***announcements***. Announcements have been traditionally made by people who are known as ***announcers***. The commercial radio channels may call them Radio Jockeys (RJs) or anchor persons. Before you learn about the different radio formats, you must know the ingredients of a radio format. As you know most of what is spoken on radio is written down. As you have already learnt that what is written for radio is heard and is referred to as 'spoken word' as against the 'written word'. But the spoken words on radio is written down or what is generally called 'scripted'. A Radio format can be split into three parts: They are:-

(a) Spoken Word or Human Voice

(b) Music

(c) Sound Effects

All radio formats have the above three ingredients

SPOKEN WORD

1. Announcements : These are specifically written clear messages to inform. They can be of different types. For example station/programme identification. These mention the station you are tuned into, the frequency, the time and the programme/song you are going to listen to. As mentioned already you find in today's commercial radio channels, these announcements have become informal and resemble ordinary conversation. There can be more than one presenter in some programmes like magazines.

2. Radio talk : The radio talk probably is the oldest format on radio. There has been a tradition in India and Britain to invite experts or prominent persons to speak for 10 or 15 minutes on a specific topic. These talks have to go through a process of being changed into radio's spoken word style. Over the years, these long radio talks have become unpopular. Instead, today, shorter duration talks are broadcast. Of course, you can listen to these talks only on public service broadcasting stations.

3. Radio interviews: Have you ever interviewed anyone? Probably yes. In the media, be it the newspaper, magazine, radio or television, journalists use this technique of asking questions to get information. There can be different types of interviews in terms of their duration, content and purpose. Firstly, there are full fledged interview programmes. The duration of these may vary from 10 minutes to 30 minutes or even 60 minutes depending up on the topic, and the person being interviewed. Most of such interviews are personality

based. You might have heard of long interviews with well known people in the field of public life, literature, science, sports, films etc.

Secondly, there are interviews which are used in various radio programmes like documentaries. Here the interviews are short, questions specific and not many. The purpose is to get a very brief, to the point answer.

Thirdly there are a lot of interviews or interview based programmes in news and current affairs programmes. Have you heard such interviews on radio? With phone-in-programmes becoming popular, you might have heard live interviews with listeners. These interviews have been made interactive.

There is another type of interview based programme. Here generally just one or two questions are put across to ordinary people or people with knowledge on some current topic to measure public opinion. For example when the general budget or the railway budget is presented in the parliament, people representing radio goes out and ask the general public about their opinion. Their names and identity may not be asked. Such programmes are called 'voxpop'which is a Latin phrase meaning' voice of people'. You have to be very inquisitive and hard working to be a radio interviewer with good general awareness and communication skills.

4. Radio discussions :- When you have a problem in your family or with your friends, don't you say "let us discuss?" Yes we do. Through a discussion we can find out a solution to problems. In any discussion there are more than 2 or 3 people and then ideas can be pooled to come to some conclusion. In radio, this technique is used to let people have different points of view on matters of public concern. Radio discussions are produced when there are social or economic issues which may be controversial. So when different experts meet and discuss such issues, people understand various points of view. Generally, these discussions on radio are of longer duration-say 15 to 30 minutes. Two or three people who are known for their views and a well informed senior person or journalist who acts as a moderator take part and discuss a particular topic for about 30 minutes. The moderator conducts the discussion, introduces the topic and the participants and ensures that every one gets enough time to speak and all issues are discussed.

5. Radio documentaries/features: If you see a film in a movie hall, it is generally a feature film, which is story based and not real. But there are also documentary films which are based on real people and issues. A lot of programmes you see on television are educational and public service documentaries. Radio also has this format. Unlike documentary films, radio documentaries have only sound – i.e. the human voice, music

and sound effects. So a radio documentary is a programme based on real sounds and real people and their views and experiences. Radio documentaries are based on facts presented in an attractive manner or dramatically. Radio documentaries are radio's own creative format. The producer of a documentary needs to be very creative to use human voice, script, music and sound effects very effectively. Radio documentaries are also called ***radio features.***

6. Radio drama: A Radio drama or a radio play is like any other play staged in a theatre or a hall. The only difference is that while a stage play has actors, stage, sets, curtains, properties movement and live action, a radio play has only 3 components. They are the human voice, music and sound effects. Radio of course uses its greatest strength for producing radio plays and that is the power of imagination and suggestivity. For example, if you want to have a scene in a radio play of a north Indian marriage, you don't have all physical arrangements made. All that you have to do is to use a bright tune on the shehnai and excited voices of people to create in a listeners' imagination, a wedding scene. The voice of the actors, music and sound effects can create any situation in a radio play.

7. Running commentaries : If you can't go to see a football or cricket match in a stadium, you may watch it on television. But for that you have to be at home or at some place where there is a television. But if you are travelling or outside, then you may listen to radio for a running commentary of the match.

A commentator would give you all the details of the match such as the number of players, the score, position of the players in the field etc. So by listening to the running commentary, you get a feeling of being in the stadium and watching the match. The commentator needs good communication skills, a good voice and knowledge about what is going on. Running commentaries on radio can be on various sports events or on ceremonial occasions like the Republic Day Parade or events like festivals, melas, rath yatras, swearing in ceremony of ministers, last journey (funeral procession) of national leaders etc. Today radio running commentaries especially of cricket and other sports can be heard on your mobile phones.

8. Magazine programmes : You are familiar with magazines which are a form of print media. They are published weekly, bi-weekly, fortnightly or monthly. There are general magazines and magazines for specific readers. These magazines could be for children, women, youth or on health, sports, science or music. If you open any one of these magazines, you will find articles, reviews, features, photo features etc. Radio also has magazine programmes like those in the print media.

A radio magazine is broadcast at a particular time on a particular day of a week or a month. That means it has periodicity. Similarly it has plenty of variety in contents. Some or many formats of radio are included in a radio magazine. These may be talks, discussions, interviews, reviews, music etc.

Likewise, the duration of each programme or item in a magazine programme also vary. Another characteristic of a radio magazine is that it has a signature tune. A signature tune is an attractive piece of music which is specific to a programme. It can be like the masthead (title) of a magazine. A magazine programme also has a name and one or two presenters or anchor persons who link the whole programme. In the beginning, the titles of the day's programme will be given by the presenters after the signature tune. They also give continuity and link the whole magazine.

Magazine programmes are generally broadcast for a special or specific audience. As the name suggests, a specific audience refers to listeners with specific needs as mentioned in the beginning.

9. NEWS: Among all the spoken word formats on radio, news is the most popular. News bulletins and news programmes are broadcast every hour by radio stations. In India, only All India Radio is allowed to broadcast news.

Duration of news bulletins vary from 5 minute to 30 minutes. The longer news bulletins have interviews, features, reviews and comments from experts.

MUSIC

When we say radio, the first thing that comes to our mind is music. So music is the main stay in radio. There is no radio without music. Music is used in different ways on radio. There are programmes of music and music is also used in different programmes. These include signature tunes, music used as effects in radio plays and features. India has a great heritage of music and radio in India reflects that. Let us understand the different types of music.

Classical Music

There are 3 types of classical music in India. They are:-

- Hindustani classical
- Carnatic classical
- Western classical

There are also vocal and instrumental music forms. There are also light classical music forms like, Thumri and Dadra. Insturmental music forms include string (sitar, sarod etc.)

wind (like flutes, shehnai) and percussion (drum) instruments.You might have heard such music on radio. You may know of a large variety of devotional and folk music in your area and across the country. Which are broadcast on radio.

But which is the most popular form of music? You would most probably say 'film music.' While there are film songs in different languages, the one with a national appeal and popularity is Hindi film songs. On most radio stations, be it public service or commercial, Hindi films songs are heard everywhere.

Light western and pop music are also popular among some groups of listeners and there is a large section of young people listening to western pop music.

SOUND EFFECTS

Let us see how sound can be used in radio formats.

- Sound can play a major role in evoking interest.
- Sound can be used for comic effects to evoke laughter
- Sound can be used to create certain moods or enhance them.

DIGITAL AUDIO TAPES

Digital Audio Tapes (DATs) are 4mm (or 3.81mm) magnetic tape cassettes that store audio information in a digital manner. DATS are visually similar to compact audio cassettes, though approximately half the size, use thinner tapes, and can only be recorded on one side. Developed by Sony in 1987, DATs were quite popular in recording studios and were one of the first digital recording systems to become employed in archives in the late 1980s and 1990s due to their lossless encoding. Commercial use of DATs, on the other hand, never achieved the same success as the machines were expensive and commercial recordings were not available on DAT.

Depending on the tape and machine used, DATs allow four different sampling modes: 32 kHz at 12 bits quantization, and 32 kHz, 44.1 kHz, and 48 kHz at 16 bits. All support two-channel stereo recording. Some of the later DATs (before being discontinued) could extend the bit-depth to 24 and up to 98 kHz, however, these tapes were likely rarely playable on other models. DATs can run between 15 and 180 minutes in length, one again depending on the tape and quality of the sampling. Unlike some other digital media, DATs do not use lossy data compression, which is important in the lossless transferring of a digital source to a DAT. Sony ultimately discontinued the production of DAT machines in 2005.

Digital audio and video tapes are able to store high data densities through the use of these thin tapes, magnetic pigments, and a slightly different recording process than their analog counterparts. Digital audio recordings measure (sample) the level of a sound wave at a regular interval and then record this information as a discrete value using a predefined number of binary bits. This bitstream is the raw audio data that is used to reconstruct the original waveform when played back. “Audio sampling is based on the Nyquist-Shannon sampling theorem, which concludes that for accurate signal reconstruction the sampling frequency should be at least twice the bandwidth of the source signal.” The sample rate (frequency) is the “rate at which the samples are captured or played back, measured in Hertz (Hz).” This is equivalent to the horizontal precision of the digital waveform. Higher sampling rates also allow for accurate recordings of higher frequencies. It is thought that the “maximum essential frequency audible to the human ear is approximately 20KHz….therefore in audio systems the minimum sampling rate needs to be approximately 40KHz.” If the sampling frequency is not at least twice the bandwidth of the source signal then aliasing (distortion resulting when the signal reconstructed from the samples does not match the original signal) can occur. The sample format (sample size or sample-width) is “the number of digits in the digital representation of each sample.”16 Whereas the sample rate is the horizontal precision, the sample size is the vertical precision of the digital waveform. Higher sample sizes provide for more dynamic range, described as louder “louds” and softer “softs.” With lower bit-depth comes the problem of quantization, wherein gaps between the samples are rounded up to the nearest value, producing noise. The more accurate the sample reading compared with the original signal, thelesser the chances of quantization.

A DAT recorder utilizes elements of both videotape and CD technologies. To record on digital magnetic tapes, the tape moves across an electromagnet recording head, which produces a magnetic field that varies according to the signal it receives from the recording device. As digital tapes store high density data, a higher band-width and recording speed than analog magnetic tapes is required. In order to accommodate this, digital magnetic tapes are recorded using a rotating head (analog uses a stationary head), which leads to a helical scan, “in which the rotating head writes tracks at an angle to the direction of tape travel.” Thus the head is able to move at a higher speed, while the tape moves at a slower speed, in order to capture the higher density data without requiring absurd tape lengths. In terms of mechanics, “the rotating drum contains two separate heads

180 degrees apart" with each head maintaining "contact with the tape for 90 degrees, with the tape wrapped around the head the same 90 degrees." Though this results in a discontinuous signal coming off the heads, as the signal is already a discrete signal, this is not an issue. In order to synchronize tape movement and the rotation of the heads, "on either side of the PCM data, a special ATF (automatic [or area-divided] track following…) signal burst is recorded," which is then used by each head to "servo the capstan rotation and thereby align the tracks and heads." However, this process means that DATs cannot be physically edited by cutting and splicing like analog or open-reel digital tapes. Also included in the signal data are sub codes, which indicate the start and end of tracks in order o allow for indexing and can count absolute time from the beginning of the tape. Along with analog inputs and outputs, DATs have digital input and output that allows copying directly onto another DAT; a digital-to-digital copy, and therefore (supposedly) lossless. Finally, the signals can then be retrieved by "running a tape across a replay head, which picks up the magnetic information and converts it back into an electric signal."As will be discussed in later sections, the alignment of the DAT machine plays an important role in both the recording and playing of the tapes. For best recording (and by extension, playback), blank DATs should be fast-forwarded completely and then rewound just prior to recording, in order to align the tension of the tape with that of the machine. Also, there should be enough room left blank before and after the recording in order to prevent the loss of information caused by the stress of loading and unloading.

PHYSICAL PRESERVATION ISSUES

There are physical preservation issues that accompany each element of a digital magnetic tape. In general, as with many other audio/visual formats, there is the risk of mold if stored in humid or warm conditions, which can eat away at the magnetic layers. More specifically for magnetic tapes, while the base layer of polyester is considered "mechanically stable and chemically robust," with rising temperatures comes thermal expansion, increasing tension within the tape pack. Rising temperatures can also cause print-through in magnetic tapes, where the magnetized tape of one section causes the magnetization of tape wrapped around it. This cause reelto-reel given their greater retention of their magnetic signal. The pure iron particles in the magnetic layers are subject to oxidation and the pigment binders themselves, in some cases, can break down completely, resulting in complete loss of the information carried in the magnetic layer. The use of polyester urethane binders also can cause hydrolysis, a chemical reaction between water in the air and the polymers in the polyurethane; changing the chemical and

physical properties of the original polymer. this often produces a by-product, which acts as an auto-catalyst, which enhances the destructive process. This causes the tapes to become sticky, squeal when played, and shed magnetic powder on audio heads, which clogs them and leads to significant loss of high frequencies. The lubricants can also cause clogging, along with dust and other foreign matter. Digital magnetic tapes are more resistant to magnetic influences than analog magnetic tapes, though caution should be taken in regards to exposing magnetic tapes to other magnetic influences. “The most dangerous sources of magnetic stray fields typically found in audiovisual archives are dynamic microphones, dynamic head phones, loudspeakers and moving coil instruments (level meters).” Magnetic board stickers should not be used and magnetic media should be kept at the greatest possible distance of lightning conductors. There is no risk in using metal storage shelves, as long as they are neither magnetized nor a part of the previously mentioned lightning conductor system. Overall, "even minor damage or contamination can have major impacts on signal irretrievability," making proper storage and handling of DATs

STORAGE AND HANDLING

DATs should be stored in an environment that balances Relative Humidity (RH) levels and temperature and is well ventilated. The *Image Permanence Institute Media Storage Guide* advises, based on ISO 18923 recommendations that for a maximum temperature of 52 degrees the maximum RH should be 50 percent, for a maximum temperature of 62 degrees the maximum RH should be 30 percent, and for a maximum temperature of 73 degrees the maximum RH should be 20 percent. If binder degradation or mold is present, DATs should be stored at a low temperature with 30 percent to 50 percent RH. Cold and frozen temperatures are not recommended as they can lead to lubricant separation and exudation.

It should be kept in mind, as with other audio/visual media, even if stored in the ideal conditions, DATs will still deteriorate, just at a slower rate than less ideal temperatures/humidity settings. Tapes should also be stored upright. DATs are most physically vulnerable when threading; therefore the tapes should either be stored in the rewound or wound position. It should be noted that some DAT players, however, do not automatically wind past the latest audio recording point. Cleaning Tapes were marketed alongside DATs and machines in order to remove some of the danger of damage to the tape surfaces and of the magnetic deterioration of the tape. There is debate among audio engineers and other specialists about the benefits of these tapes, which are quite abrasive

on the DAT heads. If employed, cleaning tapes should be used every 20 to 30 hours of audio. These cleaning tapes should not be considered an alternative to manual cleanings, however.

Servicing of DAT machines should be done regularly, their frequency depending on the duration of use and the starting condition of the machine and the DATs played. There are special flat cleaning swabs made for cleaning video machines that can be used to clean the helical scan heads. The swabs are less abrasive than the cleaning tapes and can remove any loose material that might be clogging the heads.Any technician that has experience cleaning video players should be able to handle cleaning a DAT machine. Though to ensure greatest possible longevity of the DAT machine, a trained technician should be utilized in order to not only properly clean the machine, but also address any other issues and hopefully spot future ones. One opinion is that DAT machines should be professionally serviced every 1,500 hours or about once a year, unless there are problems.

5.6 DVD's/CD's

Earlier data storage devices used to mainly be Floppy drives which had a small storage space. However, with the development of computer technology, we today have pen drives, CD/DVD devices and other removable media to store and transfer data. With these, you store/save/copy files and folders containing data, pictures, videos, audios etc. from your computer and even transfer them to another computer. There are called secondary storage devices. To access the data stored in these devices, you have to attach them with a computer and access the stored data. Some of the examples of external storage devices are- Pen drives, CDs and DVDs.

INTRODUCTION TO CD/DVD

CD/ DVD is another alternative for carrying data, however it cannot store as much data as is stored in a pen drive. CD (Compact Disc) is a storage medium that has a storage capacity of 650 MB or 700 MB. DVD (Digital Versatile/Video Disc) is storage medium with a greater audio-visual data storage capacity than that of the CD of the same dimensions. (A single layered DVD holds a little more than 4 GBs of data).

Computers have a hard disk drives (e.g. C: and D :) and a few removable storage devices such as a floppy drive, a CD-ROM drive (F :) etc.

DVD/CD DRIVE

CD/DVD

VIEWING FILES ON YOUR CD/DVD

1. When you insert the CD/DVD into the drive, you will get the options screen to select the activity you may want to do. If the CD/DVD has audio/video content then it is played automatically in the default audio/video player of your computer.

2. If you want to view the files on the CD/DVD, select ‘Open folder to view files’ from the options dialog that appears.

3. If you want to copy files from the CD/DVD to the computer you should follow the same steps as in section ‘C. Copying files from a pen drive to the computer’ after selecting the files from the CD/DVD.

COPYING FILES FROM A COMPUTER TO A CD/DVD – 'WRITING/BURNING A CD/DVD'

There is a difference between Pen drives and CDs/DVDs in terms of the method of storing data on them. Though pen drive acts in all respects like a hard disk, CDs and DVDs are generally non-rewritable. This means that unless otherwise specified, space occupied by files on a CD/DVD is non-recoverable. Storing data into a CD/DVD is known as writing or burning a CD/DVD. Let us see how it is done.

1. Open the location in your computer where the files and folders to be written are saved.

2. Select the files and folders.

3. 'Right Click' on the selected files and folders to get the menu. Select 'Send To' and choose CD/DVD drive that appears in the menu.

4. The contents to be written in CD/DVD will be now copied in the virtual memory of the DVD-RAM drive. You will be able to see the estimated time remaining for copying the selected files and folders in the window that shows the progress of the copying process

5. After the files are copied into the virtual memory of the DVD-RAM drive, a small message window will pop up in the bottom right hand corner of the desktop saying 'You have files waiting to be written on CD/DVD' as shown below.

6. Now insert the blank CD/DVD in the CD/DVD Drive of your computer. Open 'My Computer' and check the CD/DVD Drive, it will display the blank CD/DVD.

7. Open the CD/DVD and you will be able to see the files and folders copied in the virtual memory of DVD-RAM drive for 'writing' into the blank CD/DVD.

8. Select 'Write these files to CD' (or DVD) from the left hand side menu 'CD Writing Tasks'.

Alternatively, you can right click on the CD/DVD to get the Quick menu and select 'Write these files for CD' (or DVD) from it.

9. A CD writing window will pop up asking to give a ‘name’ to your CD/DVD. If you do not want to write any other disc, then you can check the box in front of ‘Close the wizard after the files have been written’. And then click on ‘Next’ option.

10. The contents start copying in the blank CD/DVD. First, it will add the contents from virtual memory of DVD-RAM drive to the CD/DVD image.

11. After adding the contents to CD/DVD image, the contents starts writing (copying) into the blank CD/DVD. Estimated time left to complete the writing process in also displayed in this window. Wait for a few seconds and when deleting process is completed, select the ‘Finish’ option to complete the writing process.

12. On selecting ‘Finish’, the written CD/DVD will automatically eject from the CD/DVD drive of your computer. Alternatively, you can also eject by opening ‘My Computer’. Right click on the CD/DVD (for example, ‘My Disc’) and select ‘Eject’ option form the menu.

13. Copying (Writing) contents into the CD/DVD from the computer is complete.

FUTURE APPLICATIONS OF INTERACTIVE DVDS

Using interactive DVD**s** as an educational platform.

• *Wikipedia*. We have already mapped the entirety of schools-wikipedia.org (a validated subset of Wikipedia, intended for use by schools) to a dual-layer TV-DVD. It consists of 5,500 articles, which translates to over 250,000 screens on DVD. The technical details of this mapping, as well as its usability evaluation, are beyond the scope of this paper and will be published separately.
• *Language tutoring*. Popular language-learning software, as provided by Rosetta Stone or the Azim Premji Foundation, is a perfect match for the capabilities of DVD players. Lessons consist of animated audio/video sequences, while exercises consist of multiple-choice questions.

• *Medical decision systems*. The typical hierarchy of a medical decision system maps naturally to an interactive DVD. The system can query a patient about the absence or presence of various symptoms, and make a recommendation (or diagnosis) at one of the leaf nodes.

• *A world atlas*. With 100,000 images on a single DVD, one could provide an atlas that zooms to the level of small towns anywhere in the world; or, alternately, zooms to the street level for individual countries.

• *An Internet portal*. Using the same engine that burns Wikipedia content to DVD, one could map arbitrary sets of HTML pages in response to a user's query. For example, a student could send an SMS query for a report that they are writing. The server could crawl the Web for 4.7 GB of results, which are burned to a DVD and mailed back to the student via the post for browsing on TV.

5.7 VISUAL RESOURCES

CHARTS

Charts Objectives of charts: To visualize some principle or concept To show relationship between facts figures or statistics To summarize information To present abstract concepts in visual form. To show continuity in process. To create problems and stimulate thinking etc.

Important points to remember:

Important points to remember Clearly analyze the main theme in various relationships which are to be depicted in the chart. Visualization and illustration of ideas by rough sketches. Transferring rough sketches to chart. Coloring if necessary. Lettering the charts.

MAKING CHARTS EFFECTIVE

Making charts effective Teacher made charts should be preferred. Students should be involved. Should be large enough. Chart should display information only about one specific area Chart should not have too much of written material It should not have too many details. It should give neat appearance. Pointer should be used.

A POSTER

A Poster Posters are the graphic aids with short ,quick and typical messages with attention capturing paintings. It can be used for: Advertising an event or product Campaigning for a cause Giving a directive Popularizing a slogan Drawing attention towards desirable actions or values Giving a warning Popularizing a symbol or a sign propaganda.

PHOTOGRAPHS

When using photography along with GeoGebra , we can better connect and show our students how math surrounds us. In today's technologically-oriented world, students need to be skilled in Science, Technology, Engineering, and Mathematics (STEM) fields. By the National Council of Teachers of Mathematics (NCTM, 2000) endorsement and the new Common Core State Standards (CCSS) in Mathematics emphasis, it is necessary that we teach using technology, encourage connections to other disciplines like social studies, and make the math that students are learning relevant and meaningful. Geometry is the main branch of mathematics that relates s to the visual aspects of our surroundings.

By relating geometric shapes and relationships to historical photographs, students not only recognize the shapes but understand their purpose and how they are created. This paper looks at ideas for teaching mathematics with the use of technology, photography, and content integration to social studies using the free dynamic mathematics software, GeoGebra, to provide connections and motivation in learning mathematics.

Historical Locations and Mathematical Shapes. The presentation continued with the participants seeing the below questions and photos:

- Can you identify where each one of these photos was taken?
- Can you give a historical account that took place for each photo?
- Can you see some mathematical idea within the photo?

Using Photography to Teach Mathematics Munakata and Vaidya (2012) based on their research found that students do not consider mathematics and science to be creative endeavors, though the traditional artistic disciplines rank high in this regard. To address this problem in perception, the authors used photography as a means to encourage students to find the deep-rooted connections between science, mathematics and the arts. The photography project was used in a formal classroom setting as well as an outside activity, i.e. in a more informal setting. The project found student interest and motivation were peaked when photography was part of the instructional strategies to teach new material while making meaningful connections to the math using the photography. Math teachers should encourage students to take photos that include math concepts (Northcote, 2011). This idea works well with the authors' suggestions of having students import photos into GeoGebra and then use the software to point out important mathematical ideas.

Examples of Mathematical Concepts found at Historical Sites:

- Circles
- Parabolas
- Parallel Lines
- Perpendicular Lines
- Pythagorean Theorem
- Reflections
- Similar Shapes
- Spirals
- Symmetry
- Tessellations

FLASH CARDS

Flash cards are one of the best methods to use for studying and memorizing information. You can use flash cards to learn just about any information for any class,

such as vocabulary, mathematical equations and formulas, terms and definitions or main ideas and topics.

However, there are right ways to prepare and use flash cards and there are wrong ways. If done the right way, you will find that creating flash cards is one of the most effective ways you can study for your exams.

CREATING YOUR FLASH CARDS

♣Don't wait to create your flash cards the day before the exam. Begin creating them right away, after every class (using your class notes) after every chapter you finish in your textbook.

♣Use both sides of the card. One side should ask just one question. On the other side of the card, write the answer to that question.

♣Bring blank flash cards with you to class. If something comes up in class that will be important for you to know or study later, prepare a fast flash card right away, and the n if need be, make a new, more thorough one at home.

♣If you have a question about something you learn in class, write that question down on a flashcard. After class, ask your teacher the question, and write his/her response on the reverse side.

♣Sometimes it's helpful to colour code your flash cards. For example, if you are studying a language, try using pink cards for feminine nouns and blue cards for masculine nouns. Or, you can use different colour cards for each of the chapters in your biology textbook.

♣Try to use your own words when writing your flash cards, unless a specific definition is required.

DON'T put too much information on a single flashcard. Each flash card should be designed to teach you just one piece of information. Even if the information is related, it is better to have five flashcards than just one.

STUDYING FLASH CARDS

Now that your flash cards are ready, it's time to start studying with them! The following tips will help you get the most out of your flash cards.

•Don’t study your cards for long periods of time. Instead, study them for intervals of fifteen to twenty minutes throughout the day.

•Break your flash cards up into several, related groups. People tend to memorize the first and last things in a series first. If you have a lot of flash cards, the mid-section is very big and therefore takes

a long time to learn. Study the flash cards in small groups so that you can remember more!

•Go through your flashcards and try to answer each one’s question. If you know the answer, put the card in one pile. If you do not know the answer, put that card into a different pile.

•Keep going through the pile of cards that you didn’t know the answer to, and as soon as you get the answer right, put that card in the other pile. You’ll see the pile of cards you didn’t know the answer to get smaller and smaller, until there are no cards left in it. Then start all over again. You’ll discover that you’ll remember a lot more each time you go through them.

•Review them often. Don’t just look through them once and put them away for the rest of the week. Carry them everywhere with you and look through them every time you have a free moment: on the bus, waiting in line at the bank, or in between classes.

•Be sure to shuffle the cards often. This helps you learn the individual pieces of information and not just in relation to the card before it and after it.

•You know you’ve done a good job of studying when you can answer your entire stack of flash cards twice, preferably with a day in between.

5.8 MODELS

A models is a recognizable representation of real things three dimensionally i.e. height , width and depth are felt as reality. This makes the understanding of the things better and easy. Use of models become necessary because: The real thing may not be available in that season or may be away from the school. The real things may be too big or too small May be too dangerous to be felt or handled Real thing may be too expensive

Types of models

Solid models

Cut-away cross sectional Working models

ADVANTAGES

Heighten reality of things make learning direct and meaningful Illustrate application side of certain principles and laws. Explain complex and intricate operations in a simplified way are lasing and cheaper. Still models are easy to make with discarded material Convenient to handle Involve more senses make; earning more effective.

5.9 ICT RESOURCES

RADIO

INTRODUCTION

The establishment of the Indira Ghandi National Open University (IGNOU) in 1985 was an important milestone in India's educational history. Through the use of open and distance modalities, IGNOU currently provides an array of educational options to those desiring to improve their qualifications and upgrade their academic skills. By design, IGNOU establishes a direct bridge between education and vocation, thus extending the scope and reach of higher education to underprivileged groups and individuals, many of whom reside in India's remote and rural areas.

IGNOU's mandate is to provide higher educational opportunities to one and all, a principle that acts to democratise higher education in India. In its effort to provide student support services and to deliver open and distance programmes, IGNOU has developed a diversified delivery system comprising a vast physical network of regional study centres. Reflecting differences in the needs of learners and the didactic nature of the programmes, different types of study centres have been developed. IGNOU's institutional network is further augmented through the use of such electronic media and computer networks as: radio, television, cable TV, audio/video cassettes, CD-ROMs, Internet, interactive systems (one-way-video/ two-way-audio teleconferencing) and interactive radio counselling. In this educational mix, radio is an important medium that helps support students studying at a distance, as well as those generally interested in expanding their knowledge.

RADIO FOR EDUCATION

Radio has been used in different formats for educational purposes the world round. Radio technology was first developed during the late nineteenth century and came into popularity as an educational medium during the early twentieth century. Although often overshadowed as educational medium vis-à-vis other technologies such as television, radio remains a viable medium that has proven educational worth in terms of both pedagogical importance and geographical reach. Radio is capable of delivering high quality educational programming to highly diversified audiences located across broad geographical expanses – all at a low per unit production cost (Couch, 1997). Studies conducted by the Open University UK have demonstrated that, when used as a supplementary learning tool, radio benefits weaker students (Tripp and Roby, 1996). The Agency for International Development has shown radio to be more cost-effective and capable of exerting greater learning effects than textbooks or teacher education (Tripp and Roby, 1996). Radio has the advantage of permitting the teaching of subjects in which classroom teachers are untrained or lacking certain knowledge sets. Another benefit for multi-grade classroom use is that radio can provide instruction for one group of students, whilst the teacher is occupied with another. Radio can also bring new or previously unavailable resources into the classroom, thereby greatly enhancing student learning (Muller, 1985). As a medium that can be listen to in the privacy of one's home or room, radio is often the preferred choice for those seeking information on culturally taboo topics such as HIV/AIDS or STDs.

Jaminson and McAnany (1978) report three main advantages of radio: (1) improved educational quality and relevance; (2) lowered per student educational costs; and (3) improved access to education, particularly for disadvantaged groups. Some limitations of radio for educational purposes are that it inherently lacks interaction; instructor feedback and clarification are generally unavailable; instruction cannot be interrupted or reviewed by students (unless it is tape-recorded); the pace of the lesson is fixed; note taking is difficult for some; and time for reflection is minimal. To overcome these drawbacks, preparation, supporting materials, and follow-up exercises are recommended when possible (McIsaac and Gunawardena, 1996). Below are a few points made by the many academics that have researched the use of radio for educational purposes:

- Byram, Kaute, and Matenge (1980) reported on the use of radio for civics education in Botswana.
- Muhlmann de Masoner, Masoner, and Bernal (1982) described the use of radio in Columbia for various educational subjects.
- Ray (1978) revealed radio as effective in promoting improvements in farming practices and production in Guatemala.
- Long (1984) reported the use of radio in India for rural development.
- Kinyanjui (1973) found radio to be a supportive medium in Kenya correspondence courses.
- Ouane (1982) described use of radio in Mali for literacy training.
- Ginsburg and Arias-Goding (1984) examined use of radio for literacy training and other programs in Mexico.
- Cooke and Romweber (1977) found radio was used in Nicaragua for health education.
- In Nigeria, Shears (1984) reported radio being used for management courses in the agriculture sector.
- Academy for Educational Development (1979) described radio being used in Paraguay to offer primary school instruction.

- Cooke and Romweber (1977) reported adoption of radio in the Philippines for nutrition education.
- Park (1967) reported radio in support of family planning in South Korea.
- Academy for Educational Development (1980) reported use of radio in Sri Lanka to promote family planning and health education.
- Byram and Kidd (1983) reported using radio for public health purposes in Swaziland.
- Galda (1984) reported use of radio in Thailand to teach mathematics to school children and Faulder (1984) reported its use for teacher training and other curricula.
- White (1976) reported adoption of radio in the Dominion Republic to support primary education.
- Saettler (1990) revealed that the University of Wisconsin and the University of Minnesota received licenses to establish educational radio stations in 1922.
- Gueri, Jutsun, and White (1978) reported use of radio in Trinidad and Tobago to promote knowledge of breastfeeding.

RADIO FOR EDUCATIONAL PURPOSES IN INDIA

Vyas, Sharma and Kumar (2002) reported some major educational radio projects in India:

- The School Broadcast Project was commissioned in 1937 to focus on elementary school students.
- Adult education and community development project (Radio Forum: 1956), served residents of 144 villages in the vicinity of Poona, Maharastra state, which were the main beneficiaries.
- Farm and Home Broadcast Project, which commenced operation in 1966, targeted farmers and those living in rural towns and villages.
- University broadcast project, launched in 1965, targeted university students.

- Language Learning Programme, launched in 1979-80, provided instruction in Hindi as a first language to school aged children.

- IGNOU-AIR (All India Radio) was launched in January 1992 in collaboration with IGNOU, AIR stations of Mumbai, Hyderabad and Shillong. IGNOU-AIR broadcasts IGNOU educational programmes to serve students enrolled in both open and conventional universities.

- IGNOU-AIR Interactive Radio Counselling, launched in 1998, targets university students enrolled in both conventional and open programmes of study.

- Gyan-Vani, India's first exclusive educational FM radio network, was launched in 2001 to serve a target audience of university students enrolled in both conventional and open programmes of study.

India's government has allotted certain frequencies in the popular FM band for educational purposes. The anticipated results are that the increased availability of knowledge and information will reach and benefit all sectors of Indian society – including illiterate populations. With UNESCO support, IGNOU conducted an experiment in 2001 that led to the evolution of the concept of 'Radio-Vision' or 'Home School.' The multi-site, multi-partner pilot experiment explored innovative applications of satellite based digital radio broadcasting systems (Asia Star of WorldSpace) primarily for distance learning purposes. A feasibility study was thus designed and conducted using the same new satellite digital technology in distance learning. Sreedher (2002) reported successful transmission of such media in terms of hyper-linking and downloading multimedia courseware, conditions that lead to cost effective transmission and distribution of audio-visual courseware. Dikshit (2002) suggested using terrestrial FM radio transmitters in conjunction with satellite radio transponders to enable the global distribution of local content. For more details, please visit: http://www.ignou.ac.in/unesco/unesco46.htm.

Another use for FM radio (e.g., teaching tool) has been the recent introduction text data transfer technology delivered and received via computer networks (e.g., students' tool). In short, the introduction of this new technology creates a new radio/ text environment. The convergence of radio with computer technology now allows students to send and receive text messaging to the radio station, a dynamic which greatly enables and

enhances student learning using low cost FM radio delivery technology. Chaudhary (1996) described an experiment using radio-text at Yashwant Rao Chavan Maharashtra Open University, Nasik, India. In his study, he revealed high satisfaction (more than 80 per cent) among learners using radio-text technology.

GYAN VANI: CURRENT REALITIES AND FUTURE DIRECTION

The Gyan Vani educational FM radio network, which was launched in 2001, will eventually comprise of 40 Stations linking various cities and towns across India. Gyan Vani will broadcast approximately 43,800 hours of educational programming per year. Currently, six FM radio stations are now operating at Allahabad, Bangalore, Coimbatore, Lucknow, Vishakhapatanam, and Bhopal. Gyan Vani's radio network is slated to expand in phases, thus incrementally expanding its educational reach to all parts of the country.

Gyan Vani FM radio uses 10 Kw stereophonic FM transmitters capable of emitting a broadcast footprint with a radius of about 60 Kms, enough to cover an entire city or town plus its surrounding suburbs. In terms of technology, FM radio stations are usually fully digital and operated by professionals. Representatives of educational organizations, colleges, training institutions, universities, professional institutions, NGOs, government, and quasi-governmental organizations are expected to contribute to the programming content of public radio, primarily in the form of pre-recorded programmes, or through participation in interactive radio sessions. Thus Gyan Vani radio FM is positioned as an ideal medium for fulfilling local educational, developmental, and socio-cultural aspirations and needs.

Gyan Vani: A cooperative model

Gyan Vani's mandate is to carve out an identity that is both unique and distinct from India's other radio broadcast interests. It achieves this employing a decentralized managerial approach and philosophy. Each station has been given a measure of autonomy; its programming and delivery of localized content is guided by a local steering committee consisting of different community stakeholders. Gyan Vani's central office assumes responsibility for policy planning, monitoring, budget, and administrative support. The suggested cooperative model envisages 60:40 programming ratio, a mix representing the following educational and social sectors:

- Serva Shikha Abhiyan
- Primary and Secondary Education
- Adult education
- Technical and vocational education
- Higher education
- Distance education
- Extension education
- Indian ministries such as Agriculture, Environment, Health, Women and Child Welfare, Science and Technology, etc.
- NGOs
- United Nation agencies

Each partner receives between one to two hours of broadcast time daily. Subsequent resource mapping and audience profile studies examining all 40 centres' broadcast needs will be undertaken with the help of established institutes and social sector stakeholders. Key stakeholders will collaboratively shoulder responsibility for periodic monitoring, reviewing, and evaluating content.

Gyan Vani: Vision statement

Gyan Vani's vision is to be an interactive, participatory, educational initiative that bridges the gap between those who are educationally privileged and those who are deprived (ERT Unit, 2001). Using radio as a medium to disseminate information and facilitate communication, Gyan Vani promotes the development of community values and establishment of a learning environment in Indian society. By facilitating the ideas and ideals of public participation, it seeks to empower India's people, particularly those who are disadvantaged. Its mission is to overcome the social burdens of illiteracy and other disadvantages in the learning domain through the use of modern interactive communication technologies. Ultimately, Gyan Vani strives to revive indigenous knowledge systems premised on rich oral traditions, culture and heritage. To achieve this objective, Gyan Vani will be building larger and nation-wide collaborations, whilst at the same time strengthening local level partnerships.

ADVANTAGES OF RADIO

- Radio is one of the media which covers huge population.
- Radio can be enjoyed at home, in office, while driving car and can be enjoyed anywhere.
- Radio channels varies from region to region, hence you can listen radio in your regional language.
- Like other entertainment media, Radio is also favourite of large number of population.
- You can advertise your product on radio and the rate of advertisement is usually lower than other medium of communication.
- Important information or news can be easily spread on radio.
- For local market radio is one of the powerful medium of communication.

DISADVANTAGES OF RADIO

- Only an audio medium for communication.
- During bad weather you cannot listen radio properly. Often unclear and is affected by weather.
- You need to adjust frequency properly.

Less and limited radio channels are available compared to other communication medium

5.10 TELEVISION

INTRODUCTION

Television, which has an important place in mass communication, has a significant role in distance education with its special position, the way of presentation and qualities peculiar to itself. Technological developments in the field of communication can be adapted in the field of education as it is adapted to many fields of life. Thanks to the new technologies available in this field and the advantages they provide, television can already be seen as an outdated tool. Yet as long as the opportunities it provides still keep its validity, television technology is not far from the new developments.

ROLE OF TELEVISION IN THE FIELD OF EDUCATION

Television has been given considerable importance in many countries as a source and a tool of teaching. The success stories of using television for education in many countries has negated the concept that television is basically on entertainment oriented

medium and it is hostile to thoughts. Television is adaptable and can follow different approaches when used in the different educational situations. The medium is used for formal, non-formal and informal education. To support formal education, television usually function as supportive and reinforcement tool. Television can be attached with school curriculum and time tables. When systematically organized it takes the form of school broadcast. In non-formal education, television has a more specific role to play. When used as a part of multi-media communication tool, television can directly or indirectly teach the subject matter.

Importance of television to communicate information, idea, skills and attitudes has been affirmed by researches. You should attempt to study various reports published on educational television in different countries in different situations. In the words of Director BBC "next to home and school I believer television to have a more profound influence on human race then any other medium of communication."

If media is to work as an effective teaching tool then certainly it is helping hand towards, achieving the aim and objectives of education. Media is an agent of boost cultural economic and social development activity. Television, as an important mass medium disseminates education through formal and information methods.

Television also continues to benefit the masses by making them conscious of the environment, rights, duties and privilege. It is a source of teaching etiquettes, language skills, hobbies, social relations and religious believes.

Role of television is neither fixed nor easily tangible and measurable. The role is directly related to the question of how the planners are serious and determined to use television. The role could either be enormous or, on the contrary very meager depending upon the specific tasks and available resources. Generally television can help to achieve the following objectives:

a) Social quality in education
b) Enhance quality in education
c) Reduce dependency on verbal teaching and teachers
d) Provide flexibility of time and space in learning.
e) Stimulates learning
f) Provide mass education opportunities.

As far the impact of education television it should rather be studied in more narrow and specific areas. In the world of scram; TV is more effective in teaching mathematic,

science and social studies. Where as history, humanities, and literature has not benefited from this medium the same degree.

The impact of television on macro level should be studied in three areas namely;

i) Teacher's Competencies

ii) Student's Competencies

iii) Effects on general viewers

EDUCATIONAL PROGRAMMES OF AIOU

AIOU is a distance learning institution. Students in this system are not supposed to come at campus for class study. However, the "open learning system" of AIOU is not absolutely parallel to that of independent studies by the private and external students who are registered with the boards or universities and appear only for the final examination. They get degree on successful completion of terms. AIOU learning system is more systematic and disciplined.

For the purpose of educational programme of AIOU, electronic media is used for a variety of purposes depending on the requirement of the courses and teaching methodologies. Follow is the summary of various uses of television;

i) To show practical application of principle already written in the textbooks and to show the laboratory work and demonstrations.

ii) To humanize distance education and to improve language skills and teaching skills by showing model teaching techniques.

iii) To show real life situation and microscope things on magnified scale

iv) Animations, dramatic presentations, slow motions and case studies.

AIOU has so far produced more than four hundred television programmes and many non-broadcast audio-visual cassettes. Slide tapes and flip charts are also used as visual media. Television is used in sciences, technical and vocational subjects. The demonstration through television helps to substitute the laboratory experiments. In social science and language, television is used to show real life situation. Television also helps to understand information, which is too complex for the written or spoken explanation.

5.11 IMPORTANCE OF INTERNET TO EDUCATION

Students have easier access to lectures and notes on the Internet.

The Internet has introduced improvements in technology, communication and online entertainment, but it is also incredibly useful for education purposes as well. Teachers use the Internet to supplement their lessons, and a number of prestigious universities have opened up free online lectures and courses to everyone. It has even allowed retired teachers to read to and educate children in poorer countries. Widespread use of the Internet has opened up a substantial amount of knowledge to a much broader range of people than ever before.

ENHANCED LESSONS

Teachers can make use of the Internet by giving students extra resources and material from the Internet, such as interactive lessons and educational games. Many college courses use a "hybrid" model where many lessons are done online, requiring fewer in-class meetings. This saves students from having to commute to campus with their heavy textbooks every day. Tests, homework, collaboration with students and research can all be done from any computer with Internet access. Even for non-hybrid classes, the Internet is used as an addition to normal studies.

STUDY AND RESEARCH

The Internet contains a wealth of knowledge that is available instantly upon any search. Because of this, the Internet has superseded libraries as a source for information gathering and research. Many teachers will now ask students to visit specific websites to study from home, and online encyclopedias provide masses of knowledge on almost every

topic imaginable. The variety of sources allows students to pursue subjects in much greater detail rather than being limited to whatever the teacher sends home.

COMMUNICATION

It used to be that students that forgot work, missed a lecture or couldn't remember an assignment were out of luck until talking face to face with a teacher or a classmate. However, the Internet allows instantaneous connection to your classmates and teachers. Improving communication between students and teachers allows teachers to assist students without having to stay after class. It also allows for students to have greater efficiency when working on projects with their peers when everyone cannot attend or asking for clarification when something is unclear.

ACCESSIBILITY

A number of universities, such as Harvard, Yale and Stanford, have opened up free courses on a variety of subjects that are accessible to anyone for free. These typically come in the form of lectures on video, but some also have notes attached. This means there is easy access to plenty of free lectures without emptying your bank account to pay tuition. The Internet also makes education accessible to impoverished communities. The "Granny Cloud," for example, made use of Skype as a number of volunteers, mostly retired teachers, read stories aloud over Skype to children in India to teach them how to read.

5.12 MULTIMEDIA

A medium is "an intervening agency, means, or instrument by which something is conveyed or accomplished." The plural form of medium is media which, in the context of education, includes the means to create, store and present instructional content. These include tools, such as chalk and talk, books and computers, slide projectors, video projection, overhead projectors, document cameras1, audio systems (a CD player, radio), combined sound and video systems (television, digital video cameras, and DVD's), and the media objects themselves. The term multimedia was introduced in the 1960s to describe the combined use of several media, such as text, film, video, still images, and audio.

Today, multimedia has become closely associated with instruction that includes the computer-based technologies.

CONCEPT OF COMPUTER-BASED MULTIMEDIA

Teachers have always employed many means to capture children's attention and thus promote learning. As such, multimedia, interpreted broadly, is nothing new. Yet, in general, we rely on very basic tools to express the ideas conceived in the brain. As Wurman (1989) observed: "There are only three means of description available to us words, pictures, and numbers. The palette is limited. Generally the best instructions rely on all three, but in any instance one should predominate, while the other two serve and extend. The key to giving good instructions is to choose the appropriate means."

In the classroom, teachers and students alike rely on words, pictures and numbers to convey ideas. These are the basic tools of intellectual conversation. But there are many ways in which words, pictures and numbers can be conveyed and many ways in which they can be supplemented and supported. The concept of multimedia encapsulates these many ways video, still images, text and sound in which words, pictures and numbers can be delivered for the purpose of conveying meaning. The concept also encapsulates the technologies used to store, edit, project, and transmit the data that are the raw material of meaning.

MULTIMEDIA HARDWARE

Today's standard classroom multimedia system includes all the components of a basic computer system-the computer itself, a color monitor, a CD and/or a DVD read/record drive, a printer (which should be high resolution with color capability), speakers (internal or external), a headset, a mouse (or equivalent), and a keyboard or other input device. The digital classroom also has a high-speed connection to the Internet and should have a voice Communication system as well.

Multimedia requirements have led to the extension of the basic computer system to include multiple tools for the creation, editing, and playback of multimedia. These technologies are constantly changing as innovation improves on the state-of-the-art. Luckily, hardware has a useful "life" of longer than the six months it takes to improve

upon it. But at least you will get some idea of the kinds of tools available to help you teach and, above all, to help your students learn. There are three categories of multimedia hardware:

- data capture devices that are necessary to capture or convert information to the digital format that can be handled by the computer;
- data storage technology that is large enough and fast enough to facilitate easy use of digital material;
- data display devices that are good enough to allow the user to view multimedia material in the most convenient and high quality manner possible.

DATA CAPTURE DEVICES

Scanners: Scanners are used to digitize flat (usually paper based) images or text so that they can be stored and manipulated by a computer. Flatbed scanners are most commonly found in classrooms. Fixed "pass-by" scanners and handheld scanners are often used in the library and for security control tasks within a school.

Digital video and still image cameras: Video cameras, or camcorders, are useful for recording events of interest in any subject area. A digital video camera bypasses the conversion process, recording digital data (audio and video) directly onto its own internal memory or onto a removal memory medium. Newer camcorders record in a “high definition” format, which projects better.

Probes and Microscopes: Real-time display of collected data is a powerful AV/IT experience. Imagine, for example, collecting heart-rate data from a physical education fitness class and displaying class averages and individual results on a monitor for all to see. Imagine also the impact of an elementary school lesson on leaves, or the biological diversity and similarity of hair, which uses a digital microscope to project, and save, "close up views" for the entire class. Teachers who are able to use these inexpensive devices find that they stimulate curiosity and discussion much more than words or text images.

DATA STORAGE TECHNOLOGY

CD-ROM, DVD: These two storage formats appear identical; each is a flat disk identical to a music CD. Both use laser technology to "write" still and full-motion images, text, and audio, including multilingual sound tracks, making them available for integration with other curriculum materials and incorporation into lesson plans. There is a significant increase in storage capability, however. A CD-ROM will hold up to 750MB of data; a DVD will hold up to 17GB, the equivalent of several full-length movies16. Today, CD-ROM/DVD-+R and RW (Read and Read- Write) drives have replaced the "floppy disk" drive in desktop and laptop computers. DVD is replacing CD as a commercial format. So popular is the DVD format, because it can be displayed on TV monitors, that new digital video cameras record directly to a mini-DVD format and edit the video on-camera, bypassing the need to download video to a computer.

Portal small storage formats: Students and teachers creating multimedia projects in the classroom or computer lab often find that storage of media files becomes a problem. For

this reason, many schools have invested in *flash* drives, inexpensive mini-hard drives that can be worn on a lanyard or keychain and connect to the computer via the USB port. Also call key drives, flash drives are available in many memory sizes, from about 128MB to over 4GB, with a subsequent variation in cost. At the smallest level, they are accessible to most families, and many students may have their own.

Computer and Network Storage: For small media files and file distribution, the fastest storage, and sometimes the only storage, is on the classroom computer or student laptop hard drives. As long as the teacher, or a knowledgeable student, remains constantly aware of the memory available on the computer(s), this is a safe system. In fact, most media files, especially large files, should be opened only after moving them off of external storage media and onto a local drive.

The computer network, including the Internet, is a good solution for teachers wishing to make media files, or "learning objects," available to others anytime, anywhere there is an Internet connection. A broadband network connection is recommended, however, because uploading and downloading media files over a dial-up or P2P connection can be painfully slow. Apple's *.Mac* account, which is actually storage space on a remote computer, is one example of the inexpensive commercial solutions to media storage. Networked schools generally make storage space available to students and teachers on the school's data server, which in some cases can be accessed from home.

DATA DISPLAY DEVICES

Projection systems: Often there will be situations where the computer is used to display material to a large class group. A teacher may want to demonstrate software, or display data sets, or display graphics developed from data sets, or display work such as word processing which is the product of group collaboration. In such situations, the small size of

the computer screen makes it impractical for working with more than one or two students at a time.

Large screen, high resolution color monitors: In a computer classroom or an instructional computer lab, the monitor is naturally at the heart of a multimedia system. Indeed, one can say that the quality of the monitor affects the quality of the entire system. No matter how powerful the computer is, or how extensive the collection of instructional DVDs, or how super the sound system, if the images displayed on the screen are not large enough or crisp enough, the impact will be impaired.

It is becoming more common in school for there to be a large-screen, flat-panel display (like those used in a home theater) mounted in a highly visible, and highly trafficked, area, such as a central hallway or lunchroom. When available, these monitors display selected content that "shows off" student work, as well as content that informs the school community of news and upcoming events. As these displays come down in price, they may begin to appear in multimedia and smart classrooms as well.

Touch screen systems: Voice recognition and touch screen systems can motivate students because of the intuitive nature of the interaction. To-date, few applications have been devised that use touch screen in the classroom environment,21 but this technology, along with voice recognition, is becoming more popular for interactive computer systems in public spaces, businesses and so forth. Cell phones, e-book readers and other mobile devices are using touch screen technology almost exclusively. It is likely that the technology will find increasing application in schools and the home because of the ease of use afforded by touch and speech.

Speakers If the quality of the audio output that is built into the computer system that controls the multimedia system is unsatisfactory it is a good idea to add external speakers. This inexpensive enhancement can make an appreciable difference to the quality of the multimedia experience.

DEVELOPING MULTIMEDIA MATERIAL

Learner-Centered

> What kind of approaches and materials would be flexible enough to consider students' previous knowledge, cultural practices, and beliefs while connecting them to academic tasks?

> How can the processes of teaching and learning benefit from each student's special interests and strengths? Project-based learning activities are just one way to achieve these goals. Technology also may enable us to support these goals through a combination of preauthoring (i.e., design) tools, classroom work, portfolio-organization systems, publication systems, and collaboration tools. In such an environment, the most useful multimedia material might be small bits and pieces of software that are plugable and insertable in student's pages and projects (applets18, Flash and Shockwave files, video clips), perhaps allowing user customizations. Examples of this combination of a tool-based learning environment and preexisting content can be found in "microworlds," often written in Java, such as *Proyecto Descartes* (*http://www.descartes.es*). In this environment, students are motivated not only by the drive for visual quality in their work, but by the opportunity to use and discuss material that they, working independently in the classroom-based learning environment, would be unable to produce on their own.

Knowledge-Centered

> How can we design curricula to promote understanding instead of the acquisition of disconnected sets of facts and skills?

> How can we develop in students the ability to think and solve problems by accessing appropriate knowledge? Multimedia may help in making accessible themes that would be very hard to understand or to connect to reality as demonstrated by the site, Physics 2000.

It also can help in enabling learners to reframe knowledge. They may use conceptual maps linked to Web pages19 that highlight different aspects of a content domain: how knowledge is acquired by experts; how problems are solved; what language is used in that

domain; the current pathways of deepening knowledge; and the different possibilities of presentation for different publics of different ages.

Multimedia also can broaden the scope of school learning environments by enabling experiments that otherwise would be too dangerous, too expensive, or take too long.(There are already some excellent CD-ROMs available in this niche.) And visualization and modeling tools give students the opportunity to enter into much more complex knowledge-contexts (so many of which are now necessary in our world than ever before), while continuing to build their comprehension of the core knowledge of those domains.

Assessment-Centered

> How can we provide opportunities for students to revise and improve the quality of their thinking and understanding?

> Technology can help facilitate self-assessment and other meta-cognitive activities in students, in part by giving frequent feedback. Collaborative tools and communication tools may promote reflection and learning as a social activity, enhancing the potential for conceptual change.

Interactive multimedia can play a crucial role in helping students overcome misconceptions in other ways as well. Students can be enabled to develop their hypotheses as far as possible, aided by the capabilities of well-planned multimedia.

At that extreme point of development, visual feedback can intervene, providing alternatives or deconstructing their beliefs. It is possible to produce simulations and animations that feature embedded “expert-systems examples,” demonstrating how experts have addressed the same problems or arrived at true conclusions, only after students tried the simulations on their own.

Community-Centered

> To what extent are students aware of the differences in learning in school and in their social environment? Do they identify the building blocks of knowledge, and what knowledge they already have is applicable to real-world problems?.

How can students become aware of their role in a globalizing world and understand the importance of formal education in that world?

Technology can play a crucial role in connecting schools to professionals in their communities and around the world, and by allowing the school to develop ideas and

positions and make them public. What types of multimedia material support more community-centered environments?

People need to see and reflect on real and very often dramatic situations. Discussions can be sparked by showing videos. It may be useful to begin with small problem sets, in which only the most relevant variables are shown; then other variables can be inserted step by step. All of these features can be implemented in well-planned simulations.

Many students are motivated to include high-quality material in their projects and pages. With access to appropriate databases of educational and multimedia resources they can search, modify, and combine such material to use in their presentations and explanations.

ADVANTAGES TO USING MULTIMEDIA

Students who learned from materials containing both text and graphics produced 55 percent to 121 percent more accurate solutions to problems, according to David Taylor at the University of Maryland. The use of images, along with words, diminishes the overwhelming nature of text and helps the student to manage the cognitive load, which increases retention. Specifically, graphics are found to support retention because important elements are focused on via placement, layout and color. Activation of prior knowledge is engaged quickly with visual analogy, and mental models are created easily as diagrams can enhance understanding of how a concept works. Additionally, learning is made easier because simulations allow students to visualize real-life situations, and motivation is increased as students are able to see the relevance of skills.

DISADVANTAGES TO USING MULTIMEDIA

When designing a multimedia learning experience, the role of the teacher shifts from instructor to facilitator. If a lesson allows students to complete learning at their own pace as they move through stages of learning, classroom management becomes increasingly difficult. This is particularly true if students work in groups to view multimedia sources or share computers. Additionally, students who are not as proficient with technology may have to spend more time learning computer skills to access information than focusing on course materials.

5.13 INTERACTIVE WHITEBOARD

An Interactive Whiteboard (IWB) is a large, touch-sensitive (thus interactive) board that when used with a combination of a computer and digital projector facilitates interactive ICT engagement. It resembles a traditional whiteboard and can be used similarly. The computer connected to the interactive whiteboard can be controlled by touching the board directly or by using a special pen. From the research available, it seems clear that the interactive whiteboard is widely considered to be a positive and motivational asset to the classroom.

USE OF THE INTERACTIVE WHITE BOARD

Interactive whiteboards present educational resources in a new and impressive way. They are suitable for both whole class and in small group settings. IWBs allow pupils to explore ideas, carry out assignments and follow-through on learning activities in new and interactive ways. The boards are highly motivational and elicit strong responses and participation within the classroom. Pupils with special needs can particularly benefit from their use in classrooms (e.g. facilitating individual contributions and enhanced access to multimedia content through a large screen).

Optimal use of an interactive whiteboard involves both teacher and student use. It can, for example, be used to:

- Allow presentation of student work in a more interactive and collaborative way
- Show video clips that present and explain difficult concepts (in any curricular area)

- Demonstrate how an educational software program works, e.g., an art program with students using their fingers or pen to draw rather than using a mouse Cater more effectively for visually impaired students and other students with special needs
- Display Internet resources in a teacher-directed manner
- Allow students to work creatively through learning activities in whole-class mode or in small groups and to present their work in multi-media form for class viewing and discussion
- Provide new opportunities for individualized learning experiences
- Create handwritten drawings, notes and concept maps during class time, all of which can be saved for future reference

TECHNICAL CONSIDERATIONS

To get an interactive whiteboard up and running, five separate components are involved:

- The interactive whiteboard itself
- A high quality digital projector (Ref Advice Sheet 15 on Digital Projectors)
- A teaching computer (i.e. a laptop or desktop PC)
- The IWB software package including learning resources
- Connectivity between the computer, whiteboard and the projector.

TYPES OF BOARDS

The surface of an interactive whiteboard is critical to its functionality and is a distinguishing factor between the different technologies used in the boards themselves. There are 3 different technologies used for this purpose, which are:

RESISTIVE MEMBRANE

The board surface incorporates a soft flexible yinyl or polyester-based plastic front surface and a rigid back board. The two layers of resistive material with a small gap between them create a touch-sensitive membrane, which is used to detect where a student or teacher touches the board. Applying pressure to the front surface (by using a pen or a finger) registers a contact point that is used as input to the interactive whiteboard software. Whiteboards based on resistive technology do not require special pens to write on the board, as ones finger can also be used.

ELECTRO-MAGNETIC PICK-UP

These whiteboards are similar to traditional whiteboards in that they are quite rigid to the touch. The pens used with them emit a small magnetic field, which the board detects

on pen impact or movement, and this information is then used as input to the computer running the interactive whiteboard software.

INFRA-RED SCANNING

By attaching infra-red scanning devices to an existing ordinary whiteboard or flat surface the board is transformed from an ordinary whiteboard or surface to act as an interactive whiteboard. These scanning devices are light and portable and can be used with different types and sizes of ordinary whiteboards. Tracking of colour and patterns is based upon using special encoded pens, each of which has a uniquely encoded reflective collar that the board uses to identify its colour and position.

ADVANTAGES OF INTERACTIVE WHITEBOARDS

BENEFITS FOR TEACHERS

- The ability to save and print what is on the board, including any notes made during the lesson
- The wealth of resources available, the stimulating nature of the presentation and the flexibility that the technology offers.
- The benefit of being able to share and reuse materials
- Ease of use, benefit of a tool facilitating collective viewing.

BENEFITS FOR STUDENTS

- Increased motivation
- Accommodate different learning styles as teachers can call on a variety of resources to suit particular needs
- Quantitative results
- The following is a summary of research provided by a team at Manchester Metropolitan University, as part of the DfES Primary Schools Whiteboard Expansion project.

DISADVANTAGES OF INTERACTIVE WHITEBOARDS

- Expensive
- Require specific software
- Require extra training for teachers
- Touch sensitive board has limitations; sometimes is not sensitive enough

- Speakers are not loud enough sometimes

5.14 MATHEMATICS LABORATORY

INTRODUCTION

Mathematics involves thinking logically and reasonably so as to understand how formulae are derived and their applications. In order to enhance learners' mastery and meaningful learning of mathematics, it is necessary to reduce to the bearable minimum its level of abstraction with the use of instructional materials. Adenegan(2010) testified to this that instructional materials, when properly used in the teaching and learning situation, can supply concrete bases for conceptual thinking, high degree of interest for students in making learning more permanent.

THE MATHEMATICS LABORATORY

As defined by Adenegan (2003), the mathematics laboratory is a unique room or place, with relevant and up-to-date equipment known as instructional materials, designated for the teaching and learning of mathematics and other scientific or research work, whereby a trained and professionally qualified person (mathematics teacher) readily interact with learners (students) on specified set of instructions. The picture below is an example of a mathematics laboratory where the children are seen playing with educational toys under the supervision of their teacher.

In a related term, a current version (miniature) of mathematics laboratory is the "mathematics corner". This indeed is still a new concept. In a school where there is no mathematics laboratory, the teacher together with the students can readily improvise and create what we call the mathematics corner in the classroom as can be found in the picture below. The teacher can start by creating a corner in the class as mathematics corner where he can be depositing periodically mathematics equipment or ask the pupils to bring, with pride and boldness, local mathematics materials like different geometrical shapes so as to facilitate a successful take off and unhindered success of the establishment. The mathematics corner can contain some of the equipment found in the mathematics laboratory but will not be as full and well organized and assembled as what we found in the later.

The materials or equipment that can be found in the mathematics laboratory include, among others constructed (wooden/metal/plastic made) mathematical sets, charts and pictures, computer(s), computer software, audio-visual instructional materials such as projector, electronic starboard, radio, television set, tape recorder, video tape, etc, solid

shapes (real or model), bulletin board, three-dimensional aids, filmstrips, tape photographs, portable board or whiteboard, abacus, cardboards, tape measure, graphics, workbooks, graphs, flannel boards, flash cards, etc.

Mathematics laboratory is relatively new in the teaching and learning of mathematics. It is a practical oriented classroom or place where materials useful for the effective teaching and learning of mathematics are kept. It is the latest design to make mathematics real. The term "laboratory method" is commonly used today to refer to an approach to teaching and learning of mathematics which provides opportunity to the learners to abstract mathematical ideas through their own experiences, that is to relate symbol to realities. It is uncommon in our schools today possibly as a result of lack of fund or the absence of any government policy on the provision of such laboratory facilities. In short, its non-existence in our schools is one of the major contributory factors to mass failure in mathematics. Thus, as highlighted by Adenegan (2003), the functions of mathematics laboratory include the followings:

- Permitting students to learn abstract concepts through concrete experiences and thus increase their understanding of those ideas.
- Enabling students to personally experience the joy of discovering principles and relationships.
- Arousing interest and motivating learning.
- Cultivating favourable attitudes towards mathematics.
- Enriching and varying instructions.
- Encouraging and developing creative problems solving ability.
- Allowing for individual differences in manner and speed at which students learn.
- Making students to see the origin of mathematical ideas and participating in "mathematics in the making"
- Allowing students to actually engage in the doing rather than being a passive observer or recipient of knowledge in the learning process.

SETTING MATHEMATICS LABORATORY

Having already discussed extensively the mathematics laboratory, we will proceed to itemize how to set a befitting and remarkable mathematics laboratory in the school.

1 Identify the necessary materials required in the laboratory by labeling them with name tags.

2 Put or assemble all related equipment or materials on the same side/place. e.g. geometric objects should not be placed where audio-visual materials are positioned.

3 Put the bulletin board close to the entrance door in case of any information display.

4 Arrange the benches and tables to allow for free movement in the laboratory.

5 Hang relevant pictures and charts on picture rails and boards.

6 The starboard or white board must be positioned where every student can readily see it.

7 Shelves can be constructed for keeping and demarcating materials.

8 Electronic materials such as projector, television, etc, should be properly displayed.

9 Electrification of the laboratory should be professionally done to allow for safety use.

10 Display materials on tables in an organized manner.

11 The laboratory should be set in such a way that it must be well ventilated.

12 Handy materials that can be easily destroyed or lost can be kept in a cabinet or separate shelve.

13 Arrange the materials in places (on tables, shelves, board, etc) in a way that they can be easily accessed when needed and returned appropriately after use.

MATHEMATICS CLUB

The Mathematics club plays an important role in creating interest in mathematics in schools. This helps the students in having an idea of the practical utility of mathematics in addition to creating their interest in Mathematics. It can serve a number of purposes.

IMPORTANCE OF THE CLUB

1. Mathematics Club is useful in arousing and maintaining interest in Mathematics.

2. Gifted students get an opportunity to satisfy their needs and interests by actively participating in the activities of mathematics clubs...

3. It is helpful in making proper utilization of leisure time.

4. The students get an opportunity of mathematical hobbies, recreational mathematics, mathematical projects, mathematical games, mathematical discussions and debates, and mathematical innovations.

5. It provides an opportunity to read mathematical literature.

6. It provides an opportunity of leadership, cooperation, joint responsibility, active participation and organizing programmes.

ORGANIZATION OF THE CLUB:

A Mathematics Club will be a great help in enlivening the teaching of Mathematics. Such a club should be run by the students under the guidance of the teacher.

Mathematics Club is an organization of the students, by the students, for the students. For proper running of a club the most important thing is the preparation of a draft constitution of the club. This draft be prepared by the Mathematics teacher in consultation with the head of the institution. This draft constitution should provide all important details about the name of the club, aims and objectives of the club, details regarding membership and the fee etc.

For efficient and successful working of Mathematics club an expert body has suggested the organization i.e.

1) Patron
2) Sponsor/In-charge
3) Staff Advisors
4) Associate Staff Advisors.

The club may have an elected/ nominated executive committee amongst the students i.e.

1) President
2) Vice-president
3) Secretary
4) Treasurer.

ACTIVITIES OF THE CLUB:

1. Arranging lecturers by renowned Mathematics Teachers or Scholars.
2. Celebrating days and events pertaining to the history of Mathematics or men of Mathematics.
3. Organizing Mathematical competitions.
4. Organizing recreational activities in Mathematics.
5. Preparing Mathematical aids and illustrations.
6. Organizing Mathematical exhibitions or fairs.
7. Mathematical articles for the school magazine.
8. Organizing seminars and career courses relating to Mathematics.

5.16 QUALITIES OF GOOD MATHEMATICS TEXT BOOK

INTRODUCTION

The mathematics textbook is an important source for learning mathematics and it plays a key role in effective teaching and learning. A textbook should stimulate reflective thinking and develop problem-solving ability among students. The textbooks should present real learning situations, which are challenging and interesting for the students and should not render itself as a means of rote learning.

Text books and teachers' guides occupy a unique place in the teaching learning process. Text book are an indispensable part of primary and secondary education. The text book is a teaching instrument. It is not only a source of information, but a course of study, a set of unit plans and learning guide. It helps to revise and reinforce the language material already taught. In the absence of any other instructional material, the text book becomes a potent tool in the hand of a teacher to teach the skill of a language and the more so of a foreign language.

QUALITIES OF MATHEMATICS TEXTBOOK

The qualities of a good textbook in mathematics can be broadly classified under the following heads

1. Physical features
2. Author
3. Content
4. Organization and presentations
5. Language
6. Exercise and illustration
7. General

1. Physical features:

Paper: the paper used in the textbook should be of superior quality

Binding: it should have quality strong and durable binding

Printing: it should have quality printing, bold font and easily readable font.

Size: bulky and thick. It should be handy

Cover: it should have an appealing and attractive cover page.

2. Author:

Qualified author should write it

Experienced teacher should write it

Competent teachers should write it

It should be written by committee of experts constituted by the state government

For the authors, certain minimum academic and professional qualifications may be prescribed.

3. Content

It should be child centered

The subject matter should be arranged from simple to complex and concrete to abstracts.

The subject matter should create interest in the pupil.

It should be objective oriented

It should be written according to prescribed syllabus

It should satisfy the demands of examination

The answers given at the end of each section should be correct

It should include the recent developments in the mathematics relating to the content dealt with.

Oral mathematics should fine its due place in the textbook.

4. Organization and presentation

It should provide for individual differences.

There should be sufficient provision for revision, practice and review.

It should stimulate the initiative and originality of the students

It should offer suggestion to improve study habits.

It should facilitate the use of analytic, synthetic, inductive, deductive, problem solving and heuristic approaches to teaching.

Content should be organize in a psychological consideration

Content should be organize in a logical way

It should suggesting project work, fieldwork and laboratory work.

5. Language

The language used in the textbook should be simple and easily understandable and within the grasp of the pupils

The style and vocabulary used should be suitable to the age group of student for whom the book is written.

The term and symbols used must be those, which are popular and internationally accepted

It should be written in lucid, simple, precise and scientific language.

6. Exercise and Illustrations:

The illustrations should be accurate

The illustrations should be clear and appropriate

It should contain some difficult problems

It should contain exercises to challenge the mathematically gifted students.

There should be well-graded exercises given at the end of every topic.

The exercise should develop thinking and reasoning power of the pupils.

7. General:

At the end of book there should be tables and appendices.

The textbook should be of latest edition with necessary modifications

The book should be moderate price and readily available in the marker.

Conclusion

Every teacher of mathematics uses a textbook. An average teacher uses it as "his stock in hand" but a good teacher uses it as "a helper". The textbook that is considered "as store house of basics information" can facilitate a teacher to do wonder in his subject.

The textbook should not be used as the only source of instructional material. It should be used as an aid in teaching.

5.17 QUALITIES OF A MATHEMATICS TEACHER

Effective described a particular teacher who had been the most successful in helping respondents to learn. Characteristics described a particular teacher's special personal qualities that the respondents felt had enabled the teachers to achieve success.

Characteristic 1: Prepared

The most effective teachers come to class each day ready to teach.

1. It is easy to learn in their classes because they are ready for the day.

2. They don't waste instructional time. They start class on time. They teach for the entire class period.

3. Time flies in their classes because students are engaged in learning—i.e., not bored, less likely to fall asleep.

Characteristic 2: Positive

The most effective teachers have optimistic attitudes about teaching and about students. They

1. See the glass as half full (look on the positive side of every situation)
2. Make themselves available to students
3. Communicate with students about their progress
4. Give praise and recognition
5. Have strategies to help students act positively toward one another

Characteristic 3: Hold High Expectations

The most effective teachers set no limits on students and believe everyone can be successful. They

1. Hold the highest standards
2. Consistently challenge their students to do their best
3. Build students' confidence and teach them to believe in themselves

Characteristic 4: Creative

The most effective teachers are resourceful and inventive in how they teach their classes. They

1. Kiss a pig if the class reaches its academic goals
2. Wear a clown suit
3. Agree to participate in the school talent show
4. Use technology effectively in the classroom

Characteristic 5: Fair

The most effective teachers handle students and grading fairly. They

1. Allow all students equal opportunities and privileges
2. Provide clear requirements for the class
3. Recognize that "fair" doesn't necessarily mean treating everyone the same but means giving every student an opportunity to succeed
4. Understand that not all students learn in the same way and at the same rate

Characteristic 6: Display a Personal Touch

The most effective teachers are approachable. They

1. Connect with students personally

2. Share personal experiences with their classes

3. Take personal interest in students and find out as much as possible about them

4. Visit the students' world (sit with them in the cafeteria; attend sporting events, plays, and other events outside normal school hours)

Characteristic 7: Cultivate a Sense of Belonging

The most effective teachers have a way of making students feel welcome and comfortable in their classrooms.

1. Students repeatedly mentioned that they felt as though they belonged in classrooms taught by effective teachers.

2. The students knew they had a good teacher who loved teaching and preferred it to other occupations.

Characteristic 8: Compassionate

The most effective teachers are concerned about students' personal problems and can relate to them and their problems. Numerous stories established how the sensitivity and compassion of caring teachers affected them in profound and lasting ways.

Characteristic 9: Have a Sense of Humor

The most effective teachers do not take everything seriously and make learning fun. They

1. Use humor to break the ice in difficult situations

2. Bring humor into the everyday classroom

3. Laugh *with* the class (but not at the expense of any particular student)

Characteristic 10: Respect Students

The most effective teachers do not deliberately embarrass students. Teachers who give the highest respect, get the highest respect. They

1. Respect students' privacy when returning test papers

2. Speak to students in private concerning grades or conduct

3. Show sensitivity to feelings and consistently avoid situations that unnecessarily embarrass students

Characteristic 11: Forgiving

The most effective teachers do not hold grudges. They

1. Forgive students for inappropriate behavior
2. Habitually start each day with a clean slate
3. Understand that a forgiving attitude is essential to reaching difficult students
4. Understand that disruptive or antisocial behavior can quickly turn a teacher against a student, but that refusing to give up on difficult students can produce success

Characteristic 12: Admit Mistakes

The most effective teachers are quick to admit being wrong.

They

1. Apologize to mistakenly accused students
2. Make adjustments when students point out errors in grading or test material that has not been assigned

Questions

1. Discuss the effect of ICT resources for teaching Mathematics.
2. What are print resources? Explain the need of print resources for teaching Mathematics.
3. Analyse the various types of resources in teaching Mathematics.
4. Bring out the need for community resources in the Mathematical instructional process.
5. Explain the different types of audio and video resources with examples.

REFERENCES

Anderson, S. B. "The Role of the Teacher -Made Test in Higher Education."In D. Bray and M. J. Blecher (eds.), Issues in Student Assessment.

New Directions for Community Colleges, no. 59. San Francisco: Jossey -Bass, 1987.

Berrenberg, J. L., and Prosser, A. "The Create -a-Game Exam: A Method to Facilitate Student Interest and Learning." Teaching of Psychology, 1991, 18(3), 167-169.

Bloom, B. S. (ed.). Taxonomy of Educational Objectives. Vol. 1: Cognitive Domain. New York: McKay, 1956.

Boniface, D. "Candidates' Use of Notes and Textbooks During an Open Book Examination." Educational Research, 1985, 27(3), 201-209.

Brown, I. W. "To Learn Is to Teach Is to Create the Final Exam." College Teaching, 1991, 39(4), 150-153.

Buchanan, R. W., and Rogers, M. "Innovative Assessment in Large Classes." College Teaching, 1990, 38(2), 69-73.

Clift, J. C., and Imrie, B. W. Assessing Students, Appraising Teaching. New York: Wiley, 1981.

Crooks, T. J. "The Impact of Classroom Evaluation Practices on Students." Review of Educational Research, 1988, 58(4), 438-481.

Ericksen, S. C. "The Teacher-Made Test." Memo to the Faculty, no. 35.

Ann Arbor: Center for Research on Learning and Teaching, University of Michigan, 1969.
"Exams: Alternative Ideas and Approaches." Teaching Professor, 1989, 3(8), 3-4.

Fuhrmann, B. S., and Grasha, A. F. A Practical Handbook for College Teachers. Boston: Little, Brown, 1983.

Geiger, T. "Test Partners: A Formula for Success." Innovation Abstracts, 1991, 13 (l1). (Newsletter published by College of Education, University of Texas at Austin) Gronlund, N. E., and Linn, R.

Measurement and Evaluation in Teaching. (6th ed.) New York: Macmillan,1990.

Hendrickson, A. D. "Cooperative Group Test -Taking." Focus, 1990, 5(2), 6. (Publication of the Office of Educational Development Programs, University of Minnesota).

Becta, What the research says about interactive whiteboards. http://www.becta.org.uk/page_documents/research/wtrs_whiteboards.pdf.

Cogill, J, (2002) How is the interactive whiteboard being used in the primary school and how does it affect teachers and training?, King's College, London. http://www.virtuallearning.org.uk/whiteboards/IFS_Interactive_whiteboards_in_the_primary_school.pdf.

Higgins et al, (2005) Embedding ICT in the Literary and Numeracy Strategies – Final Report, Centre for Learning and Teaching, Newcastle, http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/univ_newcastle_evaluation_whiteboards.doc.