

Teaching Mathematics Notes (ICT 7th Semester)

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Unit-1

Math and Math Education

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1.1 Mathematics and Mathematics Education

Mathematics:

Meaning of Mathematics

Mathematics is the science that deals with the logic of shape, quantity and arrangement. Math is all round us, in everything we do. It is the building block for everything in our lives, including mobile devices, architecture, art, money, engineering and even sports.

Meaning and definition of Mathematics:

The term "Mathematics" is derived from two Greek words:

'Manthanein' means 'learning'

'Technē' means 'an art or technique'

Hence, Mathematics means the art of learning related to disciplines or faculties.

Like other words used in daily life, the word Mathematics has different meanings for different types of people. For some, Mathematics is a basic computational skill, while for others it is the study of abstract methods. For ordinary people, basic arithmetic operations such as addition, subtraction, multiplication, division etc. ^{which} are used in their daily lives,

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is the true meaning of mathematics. It should be remembered that arithmetic is only a part of the whole mathematical science.

Mathematics teachers should be familiar with the different meanings and definitions of mathematics. Only then the real definition of mathematics - Mathematics is what mathematicians do - can be supported.

Various Definitions of Mathematics are given below:

1. Mathematics is a way of thinking, a way of organizing, analyzing and synthesizing a body of data.

2. Mathematics is the study of patterns. Regularities and similarities in nature can often be classified through mathematical description.

3. Mathematics is the language of science which uses carefully defined terms and symbolic representation that enhance our ability to communicate.

4. Mathematics is the queen of Science and arithmetic is the queen of all mathematics.

5. Mathematics is an art. As in other arts, mathematics is characterized by order and internal

consistency.

There definitions of mathematics are not perfection. Many such definitions of mathematics can be given. According to Aigel and Rero, these definitions of mathematics are not only mathematically acceptable, but are considered appropriate by most mathematics teacher.

Mathematics is a body of knowledge in the field of science, with its own symbolism, terminology, contents, contents, theorems and techniques and only a student who studies it can gain knowledge about it.

Math

Mathematics Education

Mathematics education is the practice of teaching and learning mathematics, along with the associated scholarly research.

Mathematics education is an applied discipline; the main purpose of mathematics education is to prepare a teacher who is competent or proficient in both subject matter and method. It is a synthesis of both what and method. So says Gaffon (1965) in relation to the professional math instructor working in it; As a mathematics educator we cannot afford the luxury of being a student of subject matter only, nor students of the process for transmitting the subject matter only. We cannot concern ourselves with one of these to the exclusion of the other. We must concern ourselves with both the process and the product, the how of teaching and the what of teaching.

Meaning and definition of Mathematics education:

Words such as math instructor, math teacher and arithmetic teacher are often used in communities working in math education. The math teachers working in it, have different abilities and different learning from the students who come to study from the environment.

Mathematical knowledge is still in the student's mind through appropriate teaching process in an interesting and meaningful way by removing the problems. Such an action cannot be a regular process. This is not an easy task. Therefore, a math teacher cannot be a person who is involved in only one subject or method because these two are like the two wheels of a vehicle in the process of teaching and learning math. In mathematics teaching, the subject and the method cannot be taught separately.

Some definitions of mathematics education are given below:

1. Mathematics education is referred to as the practice of teaching and learning mathematics in a way by solving problems involving learning the algorithms and formulas necessary for computations. It is a platform to learn and teach mathematics with better way.
2. It is the practice of teaching and learning mathematics, along with the associated scholarly research.
3. It is the system that encompass aspects of teaching and learning and applying mathematics.

4.

1.2 Nature of Mathematics and Mathematics education.

Nature of Mathematics

Different scholars, writers and mathematicians have different views on the nature of mathematics. Some consider its nature to be inductive while others consider it to be deductive. The third way is to take it as the science of arrival and incorporation.

According to them, the initial stage of mathematics is arrival and the final form is incorporation (Mathematics in making is inductive and mathematics in finished form is deductive). So the nature of mathematics is inductive and deductive.

1. Inductive Nature of Mathematics

Mathematics begins with the advent. Although the incorporation method is used to prove the facts obtained, such facts are invented from the arrival method. Therefore, at the school level, mathematical concepts should not be taught in a deductive way, from hypotheses to conclusions. The choice of mathematical activity should not be deductive.

2. Deductive Nature of mathematics

This includes logical processes. Logical

exemptions are not given in Mathematical. In this regard, Preston Hammer(1964) says : There is no logical excuse for either mathematics or logic. For this the student have to show the difference between valid and invalid arguments. Because mathematical possibilities are proved by logic and reason. Mathematical relations and attainments are an important part of mathematics. Student should be guided to such activities. They should also be given such an opportunity.

3. Generality Nature of Mathematics

As the field of mathematics developed, it became more ~~common~~ and more common. Nowadays, like language, mathematics has become an essential tool for daily life-practice. Now mathematics has become as common as language. It is also called the language of science. Gradual and continuous efforts in this field have helped to develop new theories and concepts in mathematics. For example, the theory of probability provided a solution to the problem of ancient mathematics failing to provide patterns of probability in the game.

4. Applied Nature of Mathematics

Mathematical relations, doctrines and concepts will continue to be used in practical life, so it should not be taught away from daily life. History has

shown that the field of mathematics is constantly evolving and its nature and structure are changing according to the needs of the society. Now generalizations are being added. As mathematics, itself is an evolving subject, the mathematics curriculum should change accordingly.

5. Mathematics is Organized Structure of Knowledge

Mathematical knowledge is organized.

Every concept, relation, theory of mathematics is based on previous knowledge about it and these concepts, relationships and theories learned become the basis for later concepts, relationships and theories. Thus, mathematics is an organized structure of knowledge.

6. Mathematics as Language

Mathematical concepts like language are often used in daily life and it is used equally everywhere. In addition, a good knowledge of mathematics is as important for higher education in the field of science and technology as it is for daily life. So, it is also a language.

1.3 Difference between Mathematics and Mathematics education

Mathematics

1. Mathematics is the science that deals with the logic of shape, quantity and arrangement.

Mathematics Education

1. Mathematics education is the practice of teaching and learning mathematics, along with the associated scholarly research.

2. Mathematics is a body of knowledge.

2. Mathematics education is teaching that knowledge to others.

3. Mathematics focuses solely on math courses.

3. Mathematics education incorporates general education classes as well as ~~the~~ class that teach you how to teach maths specifically.

4.

Unit-2

Different Learning Theories

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~~Cognitive theories of learning Mathematics~~

Meaning of Learning theory

The study of the intellectual development of ~~the~~ a child and the nature of the given mathematics and the process of intellectual development can be considered as mathematics learning theory.

It study provides a good knowledge of how a child's intellectual development takes place, why the reaction of children of the same age remains the same in any subject of mathematics. It also provides insights on how to handle complex learning situations easily.

2.1 Cognitive theories of Learning Mathematics

Cognitivists see learners as a source of information flow. According to them learning is the product of mental thinking and inner activity. Cognitive learning theory is based on three assumptions:

- 1) Information is analyzed by listening and watching two separate sources.
- 2) Resource capacity is limited, and
- 3) Learning is a process of selecting, organizing and combining information.

Therefore, learning takes place only through the mental action of the creature, only after the object has been fully and meaningfully received through realization. As soon as the learner receives information, he compares, analyzes and presents the information in his mind with the information already stored in his mind. He explains and uses it based on time and need. Therefore, Cognitivism is the product of intellectualism. Gestalt is the father of this. Other psychologists who have contributed to this are Jean Piaget, Bruner, Gergen, Vygotsky and others.

2.1.1 Piaget's Learning Theory

Piaget's learning theory is based on the achievements of research studies on how children develop mathematical concepts: Number and Space.

According to him; if a child is given the opportunity to interact with the physical and social environment, his knowledge and skills will increase with age. That's

why teachers need to be able to identify what a children can do at a certain age. Jean Piaget's research and theory have given a new twist to child psychology. Piaget's theory focuses on how to teach mathematics to children, rather than how to teach them. Therefore, Mathematics teachers should be familiar with Piaget's theory and its usefulness.

Basic Concepts of Piaget's Theory:

1) The child learns according to the environment in which he has grown up.

2) The child exercises and adapts himself to adapt to the new environment. As the child receives new experiences, the child fixes them on his brain.

3) The activities in the child's brain are organized into structures. Different mental functions are interrelated.

4) The most important concept is Egoism.
It means that a person sees the world from his own point of view and way.

For example in the eyes of a child a picture of horse can be called a dog.

5) As a child grows older, so does his ability to accept and think.

Stages of Cognitive development of a child:

Jean Piaget has decided to divided the intellectual development of a child into four different stages. These stages are as follows:

1) Sensory-Motor Period

The period upto 18 months from the birth of a walker is considered to be a sensory motor period. In this period, the walker is trying to adapt the environment in a very basic way. By the end of this period, the child develops the habit of moving the body as he wishes. In short, this level of intellectual development years to cognitive activity (e.g. seeing, hearing, touching, smelling and tasting) and gait activity (e.g. sucking, biting and trying to reach). In this period, walker's speech is not developed but his

action begin. The child can separate the mother, the father, his own and the stranger.

2) Pre-Operational Period

The conditioning a child from 1.5 years to 6 or 7 years of age is considered as pre-operational period.

- A child in this period can use own type of language like gurkha language for communication.
- A child in this period can point objects and recognize objects by signs.
- The child in this period can even think about things before and after what he has not seen.
- Even if a child in this period can count, but he cannot use it meaningfully.
- It is difficult for a child in this period to differentiate between groups and subgroups.

3) Concrete-Operational Period

This period starts in 6-7 year and lasts for 11-12 years.

Meaning of Concrete-Operation:

Concrete → Starting point for operation is real system of objects and relations.

Operation → Mental action started from a solid or real object can be changed to various other states and vice-versa.

- The child in this period develops the habit of classification. He begins to understand the relation between groups and sub-groups.
- Child already understands the causes and effects.
- Children are able to order the numbers; have the knowledge of place value.
- Children can do the opposite of any action.
- Knowledge related to conserving number, length, weight and volume is developed.

3) Formal Operational Period

This period starts from about 11-12 years.

- The children develop the power of imagination. He can perform mathematical operations without the aid/help of a solid object.
- Children can also think abstractly about things they have not seen.
- Children are capable of scientific thinking and formal mathematical logic.

→ Children can transfer the knowledge learned in one situation and use it in another unfamiliar situation.

9.1.2 ~~T~~Bruner's Learning Theory

American psychologist Jerome S. Bruner has developed in-depth teaching and learning theory in the field of learning psychology and perception. Bruner uses Piaget's theory of intellectual development to defend his own kind of learning theory. Since most of the examples in the learning theory he formulated are taken from mathematics, his learning theory is considered as an important guide in mathematics learning.

Basic Concepts of Bruner's Theory of Instruction

Bruner thinks that the process of education is more important than the product. In addition to this, how can children be taught more than what a child learns in learning? On what basis is learning done? Under what circumstances can it be taught? What can be taught, that is more important. Therefore, any teaching theory should have following four characteristics:

1) Pre-disposition to learn → Any teaching-learning theory that a child can learn and be eager to

Learn from the time he enters school.

ii) Structure of Knowledge → Any teaching-learning theory should emphasize the identification of ways in which students can organize the structure for easy acquisition of knowledge.

iii) Sequence → Any teaching-learning theory should identify the most appropriate order of presentation of mathematical concepts.

iv) Reinforcement → Any teaching-learning theory should be rewarded according to the ~~presenting~~ nature and depth of knowledge to be effective from the outside inwardly.

Levels of Intellectual Development

Bruner's learning theory focuses on the learning process and the use of teaching material. He classifies child learning into three levels, following Piaget's four stages of learning. He named the three successive stages of a child's learning: the enactive, the iconic and the symbolic presentation.

1) The Enactive mode of representation

The presentation made by hand is called enactive mode of representation. The first stage of every learning theory is the state of consciousness. In this stage, the learner uses the related teaching materials to learn mathematical concepts. Learning by tact is the specialty of this level. This is especially the learning without the use of words. For example, learning to ride a bicycle is an example of this.

2) The iconic mode of representation

The learner then enters the mental pictorial level. He makes learning the mathematical concepts of the first stage of his mental picture. Mental imagery helps the learner to move from the present situation to the coming situation. In this case, he does not have to use teaching materials.

3) The symbolic Mode of Representation

Finally, when the child enters the symbolic mode, he solves the concept he has learned by making mental pictures in the second stage. The student translates the pictorial representation of mathematical knowledge into mathematical language as indicated or as needed. In this way, mathematical concepts or knowledge are transferred from the student's conscious state to the symbolic representation.

Bruner's three conditions are similar to those of Piaget's intellectual development. In summary, the three successive stages of Bruner's learning theory can be expressed as follows:

- 1) The enactive level → The level at which the child manipulates the objects or things.
- 2) The iconic level → The level at which the child deals with the pictures or images of objects but he does not manipulate the objects.
- 3) The symbolic level → The level at which the child deals with symbols or numerals.

2.1.3 Gange's Learning Theory (Gange's Theory of Learning Mathematics)

The great psychologist and mathematician Gange studied mathematics at the University of Maryland from 1958 to 1962 as a professor of psychology. During this period, he presented a theory of mathematics learning related to mathematical achievement, topics, types of learning and its stages. Gange's learning theory is product oriented. This theory describes how to organize the necessary learning and learning programs to maximize the learner's learning skills.

Objects of Mathematical learning:

- i) Fact → Mathematical facts include mathematical symbols such as arbitrary conventions. for example, the number 3 is a mathematical sign three words.
- ii) Skills → Mathematical skills include the actions and methods that students and mathematicians love to do with speed and accuracy.
- iii) Concept → If a student is taught the concept of a triangle, he can draw a triangle from the given picture.

iv) Principle → The principle of mathematics is the order of mathematical concepts and the interrelationship between them.

Phases of Learning Sequence

Gagne classifies the eight types of learning into four learning phases:

1) Apprehending / Understanding Phase

This is the first stage of learning. In this, the student is alert to the stimuli related to the learning. The same subject presented in the same environment is perceived differently by each student due to the individual's differences, learning ability and understanding of mathematical knowledge. If the teacher presents the mathematical subject according to the nature of the teaching method and using educational materials, the students can easily accept it.

2) Acquisition Phase → Σ

In this phase, students acquire facts, skills, assumptions and theories of the presented mathematical subjects. If the teacher presents the subject in a proper and appropriate way, the student will learn new knowledge. He remembers that knowledge for a long time.

3) Storage Phase

At this stage, students begin to learn what they have learned in their brain. Various studies and researches on human storage capacity have revealed two types of memories: short-term memory and long-term memory. Short-term memory lasts for 30 seconds and long-term memory lasts for more than 30 seconds. For example, if you ask for someone's phone number from someone and forget the number after a while, it is a short-term memory. Similarly, if a student can memorize the part learned in Class 2 and use it when needed in Class 10, then it is a long-term memory.

4) Retrieval Phase

This is the fourth stage of learning. The ability to re-memorize a subject learned in mathematics and put it into practice is called recall/retrieval. In this phase of learning, students are able to apply previously learned and stored content as needed. Failure to recall stored content or ideas makes that knowledge mysterious. The main reason for this is that the learned ideas are not used from time to time.

2.2 Implications of different learning theories

2.2.1 Implications of Piaget's Theory to Math-Teaching

1) The following two bases should be considered when choosing or including textbooks in the curriculum:

a) The child should be mentally prepared to learn new ideas.

b) New ideas learned should help to prepare for the development of second condition.

2) Before teaching a child a new idea, he should see if he knows all the preconceptions needed to learn that idea.

3) A child should try to find out what they often do wrong and why. Practicing mistake in a child's thinking can help to correct them.

4) If mathematical operations are based on inverse operations, the child's ability to think becomes more variable. That's why we need to teach math pairs of inverse verbs (+, -, ×, ÷) together.

5) The student should be able to show

different relationships of the given problem. For example, the factors of 94 are = 2, 3, 4, 6, 8, 12.

- 6) When teaching mathematical problems, one should get the habit of solving them in more than one way. This develops in the student the habit of considering other possibilities when solving problems.

9.2.2 The Implications of Bruner's Theory to Math-Teaching

- 1) If a child has ~~the~~ enough knowledge about the learning process, he can easily learn Advanced mathematics.
- 2) The more a student acquires knowledge of basic concepts, the more he can apply this knowledge to new problems.
- 3) The basic knowledge of mathematics which is considered as the basis of its learning, provides a framework for the growth of meaningful learning of mathematics.
- 4) The teacher should encourage the students to find various solutions to the problems of mathematics, to find the simplest, most economical and effective solution and to use the symbolic notation effectively.
- 5) The child's knowledge of the structures of the text should be known. If he has the necessary knowledge of the structures of the text, it can be taught. But if he does not know its structure, it cannot be taught.

6) According to Bruner, if the child is not able to solve the given problem, he seeks other alternative solutions. So teachers should use the lessons learned earlier in the new lessons.

2.2.3 The Implications of Gagne's Theory in math-Instruction

1) In the process of teaching and learning mathematics, the teacher must first find out the achievement level of the student. Student should be aware of the mistakes they make and the reasons for them.

2) The teacher should discuss the subject with the student from time to time. Such activities help to keep the learned subject fresh in the brain for a long time.

3) If a student has a problem learning math, they can work with their classmate to solve it. If the problem is not solved then the problem is solved by presenting the problem to the teacher.

4) When teaching mathematics, the teacher should always teach the mathematical concepts learned earlier by relating them to the new

Mathematical concepts. This helps the student to identify mathematical concepts.

- 5) According to Garg, learning the theory is not tedious learning. It plays an important role in learning mathematics.
- 6) ~~Students~~ Students should be made active participants in problem-solving. This helps the students to find alternative solutions to the problem.

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Unit 3 Formulation of Instructional Objectives

3.1 Introduction to goals and Objectives

3.1.1 Goals

- A goal is a desired result you want to achieve, and it typically broad and long term.
- A goal of instruction is a statement of what the learner is to be like when he successfully completed a learning experience.
- Goals means achieving the targeted objectives.
- It uses non-technical word.
- Goals are derived from aim. An aim is attained after the achievement of many goals.

Selection of goals for mathematics Instruction:

What are the appropriate goals of mathematics when determining the educational objective of mathematics teaching? What kind of mathematics is needed to achieve these goals? What efforts should students make for them? Finally, how can students' progress be assessed? etc. should be taken into consideration.

When determining the appropriate goals for mathematics education, first of social needs, values, beliefs, national needs, student interest, abilities, mathematical knowledge, skills and various aspects of epistemology in the world.

3.1.2 Objectives

→ An objective is particular to how and in what way the instruction will influence the learner.

→ Objectives are statements that describe the end-points or desired outcomes of the Curriculum, a unit, a lesson plan or learning activity.

→ They are statements of expected or desired or intended outcomes.

ABCD's of Objective:

i) Audience → be able to identify who the learners are.

ii) Behaviours → What must the learner able to do after instruction?

iii) Condition → Under what conditions must the learner's performance take place?

iv) Degree → What standard must be set for the performance.

Types of Objective,

There are mainly two types of objectives:

1. General Objectives
2. Specific Objectives

1. General Objectives

- The general objectives are such type of objectives which is expected to be achieved at the end of the class or instruction.
- It is common objective which is to be fulfilled as a whole.
- It develops certain knowledge, skill and capacity in the learners.
- It can be achieved in long term.
- It is not clear.

Action verbs of general objectives:

- To appreciate, to understand, to remember, to feel, to know, to believe, to enjoy, to familiarize, to realize, to accept etc.

2. Specific Objectives

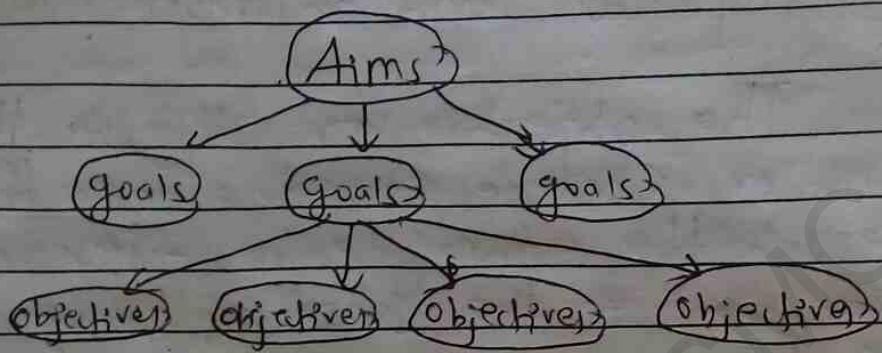
- Specific objectives are the particular expectations to be filled at the end of the class.
 - It aims at developing certain knowledge, skill, concept, and capacity that leads a learner to meet the expectation of general objectives at last.
 - It is SMART in nature:
- S = Specific, ~~A~~
- M = Measurable
- A = Attainable
- R = Reliable
- T = Testable / Time-bounded

Action verbs of specific objectives:

to match, to explain, to select
 to sketch, to use, to mention,
 to describe, to define, to discuss,
 to make, to write.

General Objectives	Specific Objectives
1. It covers wider scope.	1. It covers specific scope.
2. It cannot be attained in specific time & program.	2. It can be attained in specific time & program.
3. It helps to make specific objective.	3. It helps to attain general objectives.
4. It is not explicitly measurable.	4. It is measurable and attainable.
5. Easy to make & save time / labour & resource.	5. Difficult to make and needs much time, labour.
6. It takes long time to achieve.	6. It takes less time to achieve.
7. It is not clear, non-behavioural, non-observable, and difficult to judge judgments.	7. It is clear, simplified, and easy to judge achievements but avoid abstract behaviour.

Relationship between Aims, Goals and Objectives



- Aims → the most general level
- Goals → reflect the purpose with outcomes in mind
- Objectives → reflect the most specific level (e.g. educational outcomes).

2.2

Instructional Objectives and their Classification based on Bloom's Taxonomy.

The objective to evaluate the achievement or change expected from the students through the entire teaching-learning program conducted in the school is known as instructional objective.

The instructional objectives of mathematics teaching can be defined as follows:

- An instructional objective in mathematics is an expected learning outcomes from the instruction of mathematics (learning of mathematics) or the product of mathematics learning rather than the mathematics content or process learning.

More precisely, the instructional objectives in mathematics are the expected behavioural changes that a student/learner explains after having undergone a course of the subject.

Classification of Instructional Objectives based on Bloom's Taxonomy:

Efforts have been made by educators to classify instructional (educational) objectives at different levels. Among them, the classification of objectives mentioned in the book named

'Taxonomy of Educational Objectives' published by Benjamin S. Bloom in and his colleagues in 1962 has taken an important place in the world of education. The term 'Taxonomy' refers to the classification of objective.

For the first time, Bloom has divided student behaviour into three areas: thinking, feeling and acting. He divides the educational objectives of education into three parts namely:

Cognitive domain - objectives related to thinking area,
Affective domain - objectives related to feeling area, and
Psychomotor domain - objectives related to acting area.

Educational objectives are determined and constructed on the basis of these 3 types of areas. These objectives are equally important not only in mathematics teaching but also in all other subjects. In Nepal's educational programs and mathematics curriculum, importance has been given only for the purpose of cognitive domain field.

1) Cognitive domain (Bloom, 1956)

The cognitive domain is also known as development of thinking process.

If aims to include the objectives of knowledge which aim to develop the mental and intellectual capacity of learners.

Bloom classifies the objectives of cognitive domain hierarchically from simple to complex order as follows:

i) Knowledge Recall or

It consists of components like recall or memorization & recognition.

This level includes the purpose of Meaning memorized facts, mathematical terms, signs, formulas that have already been developed.

Action verbs:

- To recall
- To write
- To identify
- To measure
- To find

Example

At the end of class, students will be able to:

- Define general interest
- Write formula for area of triangle.

ii) Comprehension

It means the ability of learners to comprehend the taught contents.

It consists of behaviours / components like:

Translation, interpretation, exploration, organization.

Action verbs

- to translate • to construct • to explain
- to justify • to classify

Example

At the end of the class students will be able to:

- ~~write~~ Explain the concept of geometry.
- classify triangles according to given angle

i) Application

Practicing a learned thing in day to day life
is called application.

It is the application of abstract ideas, generalization of mathematics in specific, concrete and unfamiliar situations.

Action verbs

- to use • to solve • to compute • to show

Example

Student will be able to:

- Solve the problem of Algebra.
- find the square root of the whole square given by the composition.

ii) Analysis

To study the content by classifying the organization of content into different parts is considered as analysis.

The structure of mathematical facts is the

called analysis for different purposes.

Action verbs

- to debate • to compare • to separate

Example,

Students will be able to separate triangle from the combined figure.

v) Synthesis

To accumulate or synthesize various learned knowledge, skill and experience is regarded as synthesis.

The action of connecting any two or more facts is called synthesis.

Action verbs

- to combine • to summarize • to plan
- to figure out • to formulate • to produce

Example,

Students will be able to figure out the number system, to plan the syllabus of maths.

vi) Evaluation

To test the validity of any theory / work by evaluation.

To evaluate whether the teaching of content is on the basis of objectives or not is evaluation.

It is the highest level of cognitive domain.

Action verbs

- to evaluate • to judge • to choose

Example

Students will be able to evaluate the usefulness
of optional math course.

2) Affective Domain

Affective domain includes areas related to experience, feelings, interests, tendencies and beliefs. Krathwohl has divided the region into the following five levels:

i) Receiving

~~The~~ Learner's interest of receiving or attending any stimulus, activity and events is regarded as receiving or attending. At this level, students receive new ideas and thoughts.

Action verbs

- listening • paying attention • being interested
- experiencing • receiving • accepting

Example

Students will accept the partial method to find the square root.

ii) Responding

The active participation of learners' in teaching and learning activities is called responding. At this level, students respond to the knowledge they have acquired. They are taken as a reaction.

Action verbs

- answer • tell • fulfill • participate • respond
- Example → Students will ~~be able~~^{respond} to the square root subtraction method.

iii) Valuing

To respond towards some stimulus, events and activities is called valuing.

At this level, students express their belief in the knowledge and perceptions they have acquired.

Action verbs

- support • participate • reject • decide
- recognize • value

Example → Students will recognize the square root subtraction method.

iv) Organization

To accumulate different values into one is called organization.

At this level, students organize and generalize various mathematical facts.

Action verbs

- organizing • deliberating • Comparing
- Comparing • showing

Example → Students will consider different methods of deriving square root.

vi) Characterization

To decide about the values, various knowledge, skills, behaviour, and attitudes of learning is called characterization.

The objectives of character building and decision making fall into this category.

Characterization is the relationship between one's beliefs, thoughts and attitudes.

Action verbs

- setting records
- building
- establishing ideals
- analyzing errors
- ordering
- repeating

Example → Students will analyze and correct the compulsory Math errors of class 9.

3) Psychomotor Domain

Psychomotor domain includes knowledge, skills and capacity which are learned by physiological procedures. These activities and/or behaviours are carried out through the involvements of mental senses and physical adjustments.

Hoffer classified this domain as follows:

i) Perception

It is the first stage of psychomotor domain.

To perceive is necessary to learn anything.

Action verbs.

- distinguish
- explain
- confirm
- describe
- differentiate

ii) Set or Preparation

To prepare for certain stimulus is called set.

It includes mental, physical and emotional preparation.

Action verbs.

- start
- act
- response
- show

iii) Guided Response

To adapt or accept the direction or to perform the activities on the basis of rules and regulations for learning any motor skill is considered as guided response.

Action Verbs

- demonstrate • Construct • measure • combine

iv) Mechanism

Mechanism in learning means to perform the action as machine.

Action verbs

- apply → change • prepare • say • make
- organize

Example → Students will be able to change.

v) Complex Overt Response

To perform and apply the learned things as necessary is called complex overt response.

It is regarded as an ordinary response of complex tasks.

Action verbs

- to response • practice • try • move • activate
- change

Example → Students will be able to put the learning into the exam paper.

v) Adaptation

Application of learned things into the behavioral activities in terms of situation or condition is called adaptation.

Action verbs

- reconstruct
- adapt
- adjust

- change

Example → Student will be able to reconstruct
- of the geometrical instruments.

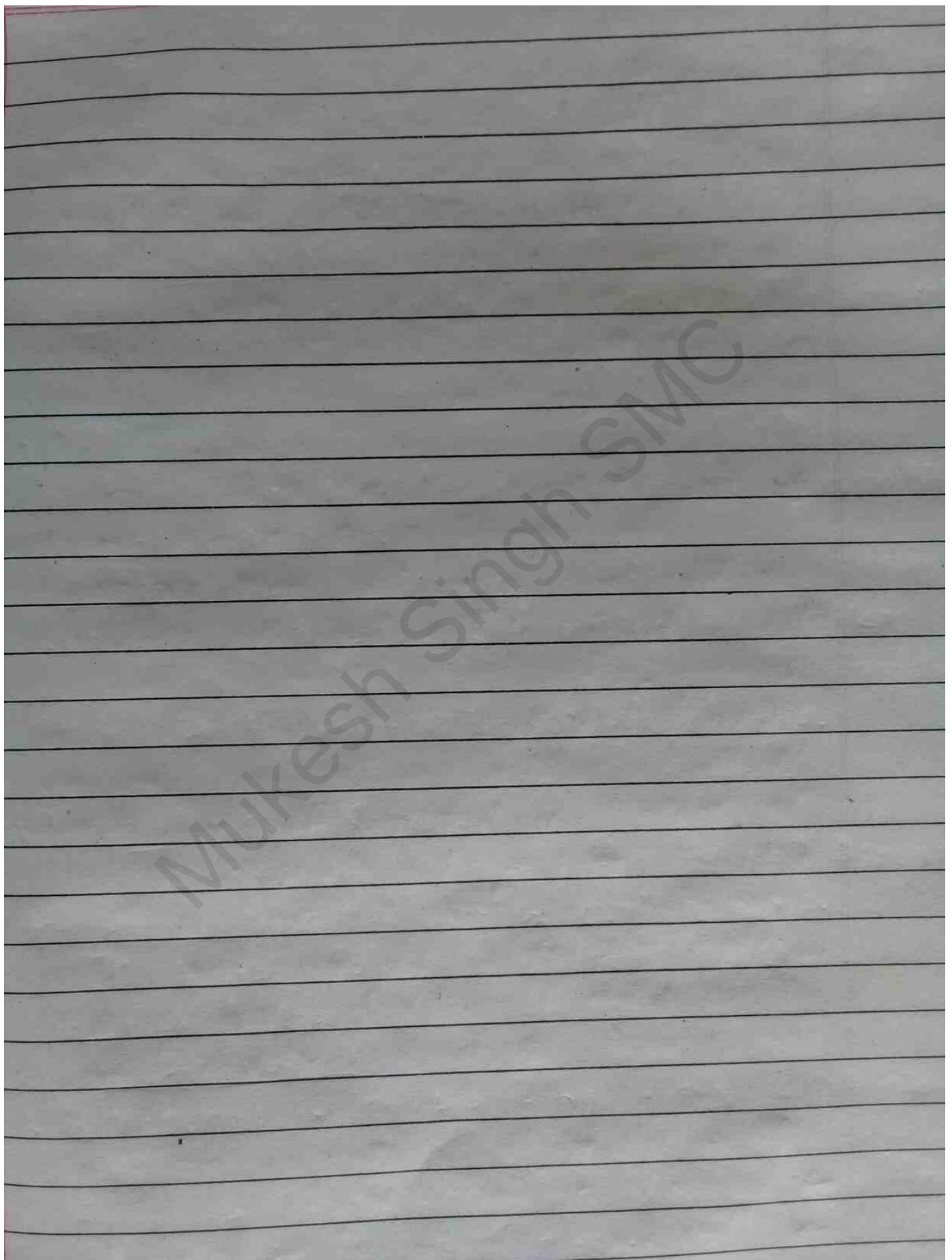
vi) Origination

In the process of teaching-learning activities, learner may perform their own creativity which is regarded as origination.

Action verbs

- create
- develop
- make

Example → Student will be able to create their own answer of the question.



Instructional Planning

4.1 Introduction

Instructional planning is the ability of the teacher to visualize and forecast into the future of what, why and how of the teaching-learning process.

Instructional planning is the preparation for teaching and learning, including: Construction of goals, objectives and instructional and assessment methodology.

It is the systematic planning, developing, evaluating and making the instructional process based on principles of learning and instruction.

It represents the big picture of "what to teach" and "how to teach" it.

Importance of Instructional Planning:

- Provides for logical sequencing and pairing lessons.
- Economizes cost, time and energy.
- Provides a variety of instructional objectives.
- Creates the opportunity for higher level of questioning.
- Guides teachers.
- Provides directions for the teacher.
- Prepares pupils/students for the daily activities.

4.2

Type of Planning

4.3

~~Importance~~

There are many types of instructional plans. In math education, a teacher should make the following 3 types of instructional plans:

1. Annual / Yearly Work Plan
2. Unit Plan
3. Daily Lesson Plan

1.) Annual / Yearly Work Plan

An annual work plan is a one-year instructional plan that includes how to teach the subject at the beginning of the academic session. This type of annual preparation is done by including how to teach any subject within an academic session.

In making such plans, the annual work schedule prepared by the school is taken into consideration. This is because the school's calendar clearly sets out the days of study other than the holidays as well as the general instructions required for teachers.

Materials needed to prepare annual plan:

→ Course of related subject

→ Teacher's guide based on related subject curriculum.

- Annual calendar prepared by the school.
- Other reference materials required for teaching.

~~Answers~~

2) Unit Plan

A unit plan is a plan prepared by a teacher based on how to teach a ~~lesson~~ unit of the subject he/she is teaching.

A unit plan is a detailed plan of lesson units for teaching and learning, including how to teach and complete a unit mentioned in a lesson or curriculum in terms of teaching.

The present definition also means that the unit plan is the plan made by including one unit of the subject to achieve the expected change in the learner by achieving the uniting objective (Sharma and Chhetri, 2023).

Preparation / Components / Requirements of unit plan

- One should study the purpose of the related text.
- One should get information about the estimated bell of the related subject.
- One should get information about the curriculum of the related subject.
- The school should look at the calendar and the annual action plan it has created.

→ Study the nature of the lesson and choose the appropriate method and content for the lesson.

→ The method of assessment should be chosen.

3) Daily Lesson Plan

A daily lesson plan is a plan that is made to effectively complete the daily reading of the subject you are teaching. This type of plan is designed to make the daily teaching activities successful.

The type of plan is made by including the answer to the questions, What to teach students in class? How much to teach? How to teach? What content to use? How to evaluate? etc. A lesson plan is a blueprint for a bell.

4.3 Importance of Planning

1) Importance of Annual Plan

- It makes teaching successful and systematic.
- The teacher keeps himself informed about the preparation and knowledge to be done.
- It helps in conducting educational activities of the school.
- It helps to develop the profession of the teacher and increase his professional skills.
- It is easy to collect necessary materials for teaching.
- Teaching helps to make learning better and easier.

2) Importance of Unit Plan:

- It provides the teacher with the instructions on how to complete a Unit by teaching.
- The teacher can fulfill his/her teaching responsibilities.
- It also helps in creating daily lesson plans and conducting daily teaching activities.
- It assists in collection of various materials required for teaching.
- Helps in the formation and selection of educational skills for teaching.
- Helps to advance the learning process by using learners' previous experiences.
- Helps ^{the} teacher to complete the teaching task on time.
- Helps in the development of professional capacity of teachers.

3) Importance of Daily Lesson Plan

- Such a plan is necessary to achieve the objectives mentioned in the course.
- This plan facilitates the successful conduction of daily teaching.
- Teachers need such a plan to bring efficiency in their teaching.
- Helps to make classroom teaching systematic.
- Helps in selecting the materials required for the lesson and choosing the educational strategy.
- It makes learning new subjects easier and simpler based on student's learning abilities.
- It helps in search and research of teaching skills.

2.4 Preparing different types of plans

1) Annual Plan

Sample of Annual Plan

School Name: Sukuna Senior School Subject Teacher: Raj Mehta

Subject: Maths Class: 9

Academic Session: 2022 Day of Teaching: 180

Month	Teaching day	Teaching Period	Unit	Estimated Period	Apology
Baisakh					
Tertha					
Chaitra					
Total		180		170	

Phase 2

Subject	Time allotted in the course	Estimated bell	bell / week
Group			
Arithmetic & geometry			
Algebra			
Geometry			
Trigonometry			
Total			

Phase 1

2) Unit Plan

Sample of Unit Plan

School name: Sakina Sec. School Teacher: Raj Mehta

Subject: Maths Class: 8

Teaching Topic: Sets

Topics (from text.)	Objectives: knowledge, skills and attitudes	Teaching materials	Educational Activities	Evaluation Process	Proposed homework
Take from unit					

3) Lesson Plan

Sample Daily Lesson Plan

Grade: 7

Unit - 1

Subject: Math

Date: 2023/12/25

Teaching Topic: Sets

Time: 45 min

Lesson Objective: At the end of the lesson, students will be able to:

- ① Define sets.
- ② Write the types of sets.

Phase

Major Activities

A = Anticipation

(Think Pair Share)

(10 min)

- Every student think about what may be set and what are its types (not in your copy)
- Share with your pairs.

B = Building up
Knowledge

Jigsaw : divide the students into groups.

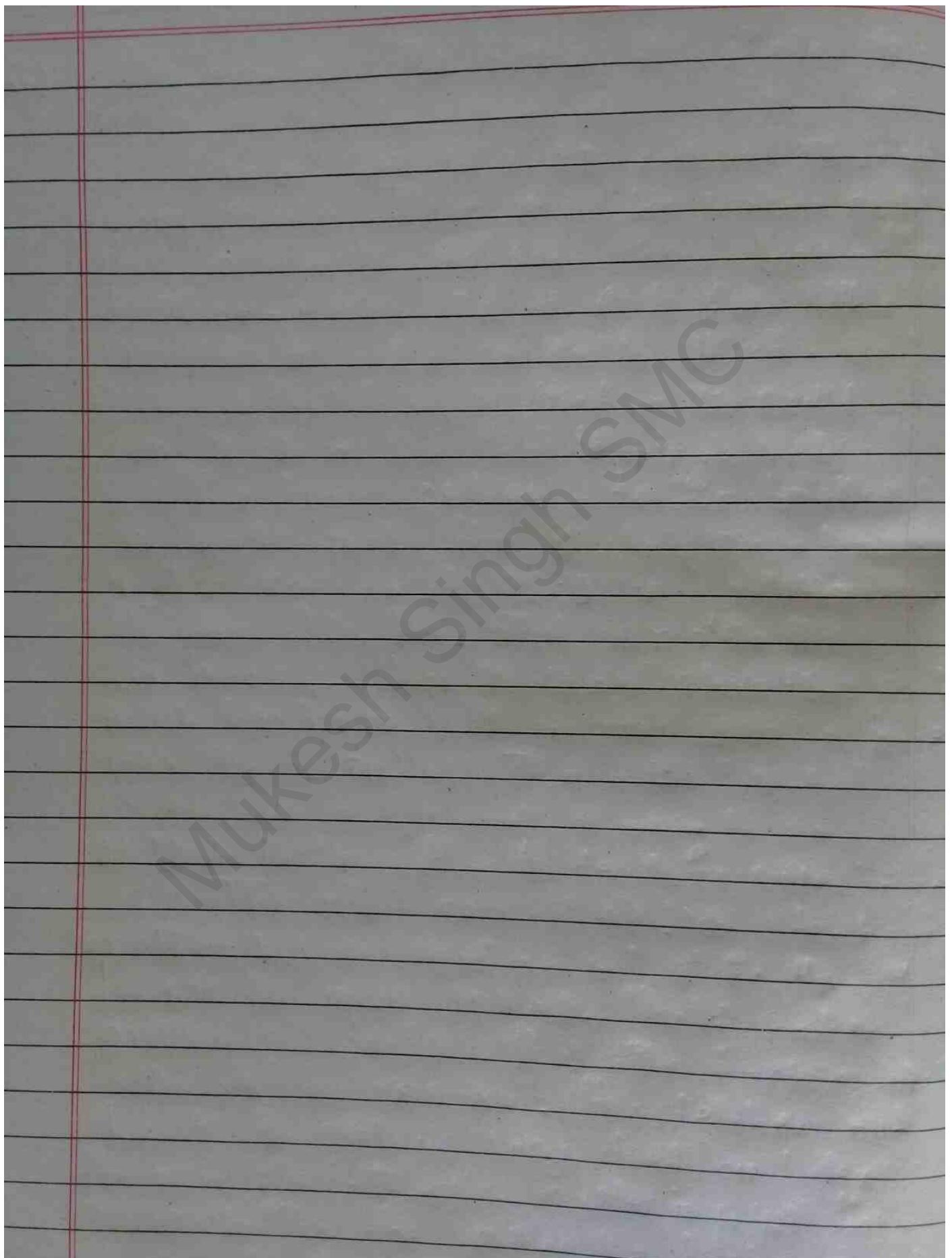
(25 min)

- Name the groups Singleton set, universal set, empty set, equal sets.
- Tell each group to define different types of sets with example figure.
- Call the group leader and say to present the list within 3 minutes and teacher provides feedback for each group.

C=Consolidation
(10 min)

(Quick Write)

- Attach the name of the sets on the board and say to quickly write the main examples and figures of sets.



Unit-5

Instructional Strategies

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Instructional strategies are techniques taught us to help students become independent strategic learners. These strategies becoming learning strategies when students independently select the appropriate ones and use them effectively to accomplish tasks or meet goals.

Instructional strategies can:

- motivate students and help them ~~form focus~~ attention.
- organize information for understanding and remembering.
- monitor and assess learning.

Every math teacher always faces fundamental questions like Why to study mathematics? What mathematics should be taught? How to teach mathematics?

Before studying the various methods of teaching mathematics, in order to teach mathematics in an effective way and meaningful way, it is ~~not~~ necessary to identify the various problems faced by the teacher in his teaching. In this case the task of teaching mathematics can be completed in a simple way by finding solutions to these problems.

5.1 Problems of Instructions in Mathematics

Good knowledge is required to solve any problem. There may be various problems that mathematics teachers face, during the teaching-learning process. Also some of the problems may be related to math education programs that have a direct or indirect effect on math teaching and learning.

The basic problem of teaching mathematics is how to make the students perfect in mathematical concepts, skills and relationships.

To do this, they must complete the four learning steps mentioned above. So each math teacher ~~must~~ faces four similar basic educational problems. They are:

1) Understanding (How to teach for understanding)

The most pressing problem of teaching mathematics in secondary school is the teaching of new subjects. This is such a problem of teaching that ~~the teacher's~~ skill and art are required. The teacher's first task is to explain, clarify, direct and develop the new ideas. Therefore, in order to fulfill their responsibilities, the mathematics teacher should not only be acquainted with their logical relationships in order to teach a new lesson, but

he should also know the prior knowledge and the educational ~~re~~ level of the students in order to learn new ideas or lessons. When teaching a new lesson, the teacher should always look at the lesson from the point of view of an immature student without looking at it with his experienced eyes.

2)

2) Assimilation (How to teach for assimilation?)

Students need to practice the concept ~~through~~ independently in order to gain a meaningful knowledge of the mathematical subjects learned in the first stage. Lesson learned in class should be practiced at home. Students gain meaningful knowledge through many days of practice. This state of learning mathematics is called the state of assimilation.

3) Permanence (How to teach for permanence?)

Another problem of mathematics teaching is how to maintain mathematical concepts, skills and relationships after initial understanding and full significance. If learning cannot be sustained, it is meaningless. The importance task of a math teacher is to perpetuate the new ideas, skills and relationships that the students have learned.

and prevent them from being forgotten.
To maintain the permanence of new ideas, relationships and skills, they should be practiced, reviewed and applied equally.

4) Transfer (How to teach for transfer?)

Another major problem in teaching mathematics is how to apply the mathematical concepts or patterns that the students initially realized in one situation to another unfamiliar situation. The most important goal of learning mathematics is the transfer of learning-teaching. Therefore, students should generalize the perception of the initial perception and use it wisely in unfamiliar places. Sometimes the talented students ~~use~~ can apply it only to a new problem only after the initial understanding of the concept and theory. But according to the rules of mathematical teaching, it should be used only after deep and familiar understanding. This is said to be the transfer of mathematical knowledge acquired by the student.

5.2 Different teaching methods used under different instructional strategies in mathematics classroom

The teaching-learning activities conducted in the process of making teaching-learning activities practical and effective are called teaching methods.

In the general sense, the organization of classroom activities adopted by the teacher to achieve the specified objectives and the format of the teacher's presentation is the teaching method.

There are various teaching methods used in teaching mathematics or we can say in teaching mathematics, some of them are as follows:

1) Lecture/ Expository method

This method has been very popular since the beginning of teaching. In general sense, the form of information expressed verbally is called lecture. Lectures are not good or bad in themselves. The lecturer or teacher should consider how to use this method effectively and when. In this, the teacher's knowledge of tone, posture, language and subject matter has a great influence on the interpretation of a text. It helps to know a lot of things in a short time. In order make the lecture effective, it seems necessary for the teacher to

give a lecture based on the following process:

Process / Steps of Lecture method:

i) Review

ii) Presentation

iii) Explanation

iv) Summarize / Conclusion

v) Assignment

Things to consider while adopting the lecture method:

i) The teacher should have a good knowledge of the subject matter.

ii) Teacher's speech should be clear, simple and understandable language.

iii) The teacher should have the art of making the student attractive in the classroom.

2) Laboratory method

Laboratory method is based on the principle of 'Learning by doing'. It is not enough to just read a book to learn something. By doing, we have to move forward from observation or material. Laboratory method requires a suitable location and environment. A mathematical laboratory can be a good place to learn mathematical knowledge, where

Students can learn mathematics by using educational materials and even through games. In fact, the main purpose of math laboratory is to develop the student's habit of thinking, asking questions, observing patterns and generalizing mathematics.

Advantages of laboratory method:

- i) This method is interesting and enjoyable for students.
- ii) Students develop skills and self-reliance.
- iii) Students can learn difficult subjects in a simple way.

Disadvantages of laboratory method:

- i) It may not be suitable for all schools and all students because it is very expensive method.
- ii) Skilled teachers are needed.
- iii) Not all subjects can be taught in this way.

3) Inductive Method

In today's developed mathematics, the history of complete mathematics can be read only after it was created by the inductive method and proved by the deductive method.

Mathematics is blind without inductive method, and lame without deductive method. The method of reading reaching a logical conclusion on the basis of observation and experiment is referred to as the inductive method. The effect of arguments that

go from certainty to the simple, from the solid to the emotional; or from the example to the formula is called inductive method.

Types of inductive method :

- i) Complete Inductive Method
- ii) Eminent Inductive Method
- iii) Scientific Inductive Method

Steps of inductive method:

- i) Observation
- ii) Generalization
- iii) Confirmation and formalization / Conclusion

Advantages of inductive method:

- i) This makes easier to understand mathematical principles.
- ii) It discourages the habit of memorizing.

Disadvantages of inductive method

- i) This method cannot be used in all cases.
- ii) It cannot be applied to all mathematical topics.

4) Deductive Method

Deductive method is the process moving from simple to certainty, from emotional to concrete, from formula to example. The exact opposite of the inductive method is the deductive method. In this, the teacher gives the student to solve the problem after giving information about the formulas related to the lesson to be started in the classroom and how to use it.

For example:

$$(a+b)^2 = a^2 + 2ab + b^2, \text{ then}$$

$$(2x+3)^2 = ?$$

Advantages of deductive method:

- i) They make the problem shorter and save time.
- ii) Increases students' memory.
- iii) Useful for practice and review.

Disadvantages of deductive method:

- i) Students develop habit of memorizing rather than understanding.
- ii) Students have to remember more unnecessarily.
- iii) Students cannot be active in this.

Inductive method

1. Goes from specific to general, from solid to sentimental or from example to formula.

2. This is the initial stage of all mathematics.

3. Opposite of deductive method.

4. This is the stage of establishing mathematical formulas.

5. This is the construction of mathematics.

Deductive method

1. Goes from simple to specific, from emotional to solid or from formula to example.

2. This is the final stage of overall mathematics.

3. Opposite of inductive method.

4. This is the stage of simplification of mathematical formulas.

5. This is the final form of mathematics.

5) Analytic Method

What needs to be taught in this method goes from the unknown to the known, from conclusion to the hypothesis. In this method, the student's thinking power and intelligence have a place. In this, the teacher works to instruct the students. The knowledge gained is permanent.

Because in it, the students learn by themselves. It clearly shows that the reason for each step and its justification for finding new mathematical facts and how to solve a problem.

Example:

If $a:b = c:d$ then

Prove: $ac + 2b^2 : bc = c^2 + 2bd : dc$

Advantages of Analytic method:

- i) They are logical methods.
- ii) Learning is permanent because of depth study.
- iii) Makes it easier to find mathematical facts.

Disadvantages of Analytic method:

- i) Not effective for every subject's ^{topics} mathematics.
- ii) It is a long method.

6) Synthetic method:

This method is the opposite of analytic method. In it, learning goes from the known to the unknown, from hypothesis to conclusions. A new thing is discovered from a given fact. Students do not have to think much about this method. This method is especially used in geometry.

Advantages of synthetic method:

- i) It is concise method.
- ii) It helps to remember something. It preserves memory.

Disadvantages of synthetic method:

- iii) Less development of thinking power.
- iv) Develops the habit of memorizing rather than understanding.

Analytic method

1. Goes from unknown to known.

2. This is the psychological method.

3. Starting from conclusion, goes towards the hypothesis.

4. Each stage has its cause and effect.

5. It develops ownership.

6. It is informal method.

Synthetic method

1. Goes from known to ~~known~~ unknown.

2. It is the logical method.

3. Starting from the hypothesis, goes towards the conclusion.

4. The stages are presented without any reason.

5. It develops the habit of remembering.

6. It is formal method.

7) Problem Solving Method

Problem Solving plays an important role in learning Mathematics. The solution to particular type of problem is a great help in inventing new knowledge and methods of mathematics. Problem Solving is a process in which the student solves the problem by choosing the right technique. Teaching is done on the basis of whether the student is more attracted or interested in solving the problem with this method. This method contains questions related to the problem. These questions point to a solution to the problem.

Polya divides the problem solving method into four main steps:

- i) Understanding the problem
- ii) Thinking of a plan
- iii) Carrying out the plan
- iv) Looking back

8) Guided ^{Discovery} Method

A guided discovery method is a method in which students complete the search by determining the objectives with the help of the teacher in the classroom. In this method, the problem is given according to the level of the student. Necessary environment and materials are provided for problem solving. The role of teacher is as a director. The teacher guides the student according to the ability of the student and the method of the given problem.

The steps of this method are as follows:

- i) Presentation of problem
- ii) Exploration ~~and~~ under the guidance of teacher.
- iii) Verification
- iv) Conclusion or generalization

Advantages of guided discovery method:

- i) There is active participation of students.
- ii) Knowledge gained from this method is permanent.
- iii) Students develop the power of to think and reason.

g) Project Method

The project method has been introduced as a traditional alternative. Even in this method, the principle of 'Learning by doing' is given priority. This method develops the student's ability to work on their own and the results are interesting. This method helps students understand the problem and lead to a specific purpose. In this method, the teacher gives the students problems in the classroom such as teacher gives general information and gives proper instructions to the student's actions. Students, especially if they go to in the wrong direction, give proper guidance in solving problems.

Type of project method: (~~Three types~~)

i) Individual project

ii) Group project

Steps of Project Method:

- i) Provide the problem situation.
- ii) Purposing
- iii) Planning the project
- iv) Executing the project
- v) Judging the project

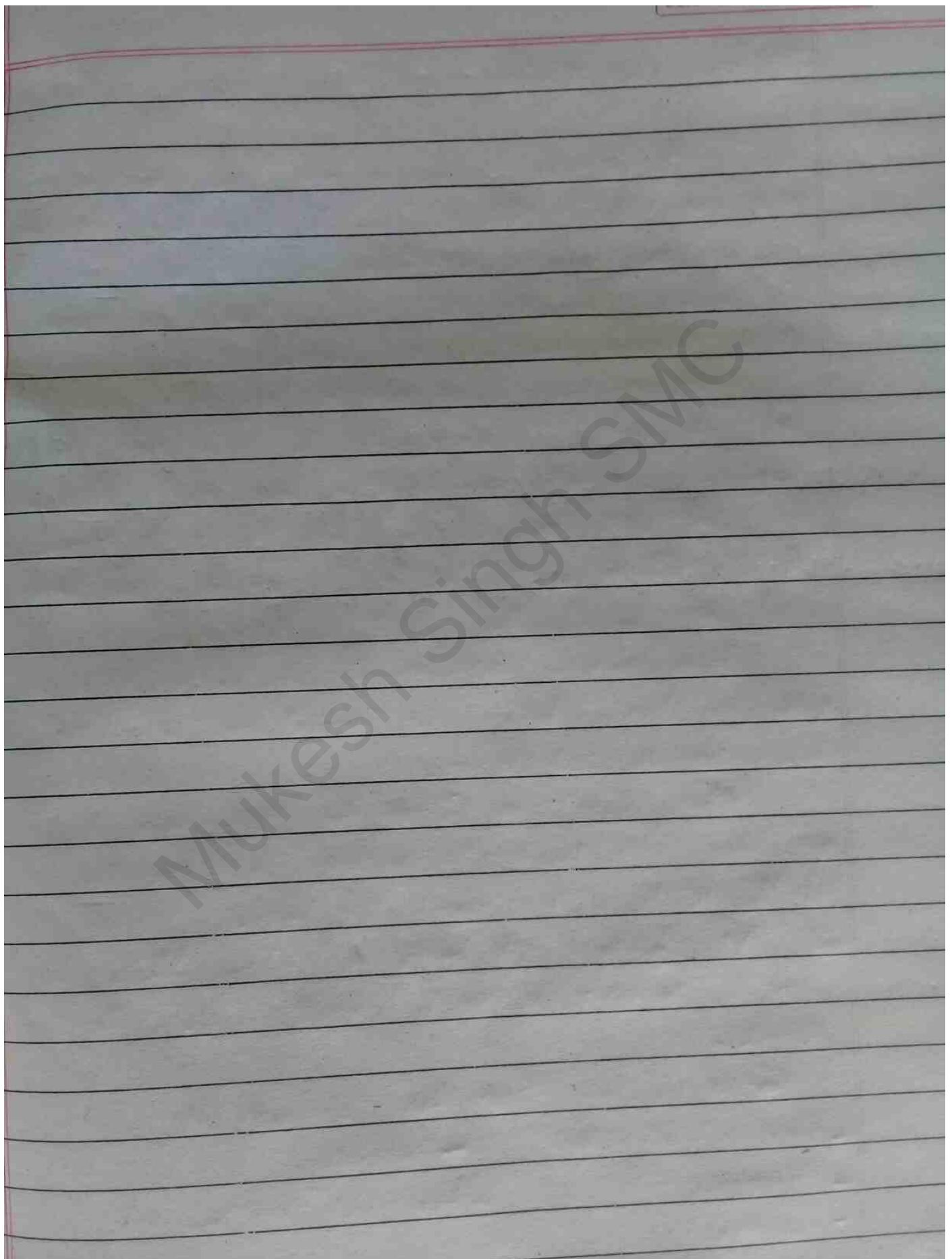
Advantages of Project Method:

- i) It is scientific and psychological.
- ii) It develops collaborative learning.
- iii) It develops confidence and self-discipline in the student.

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Disadvantages of Project method

- i) Difficult to implement at the school level.
- ii) Very expensive method financially.
- iii) Cannot be applied to all topics of Mathematics.



Unit-6 Evaluation

Ajanta

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6.1 Traditional vs Alternative Assessment

Assessment is a process by which information is obtained relative to some known objective or goal.

It is the systematic process of documenting and using the empirical data on the knowledge, skills, attitudes and behaviour beliefs. By taking assessments teachers try to improve student's learning.

A test is a special form of assessment. All tests are assessments but all assessments are not tests.

Some definitions of Assessment:

i) "Assessment involves the use of empirical data on student learning to refine programs and improve student learning."

- Allen (2004)

ii) "Assessment is the systematic basis for making inferences about the learning and development of students".

- Erwin (1991)

#1) Formative Assessment

Formative assessments refers to a wide variety of methods that the teachers use to conduct in-progress evaluations of student comprehension, learning needs and academic progress during a lesson, unit or course.

Formative assessment is the way day-to-day assessments to measure and explore pupils understanding of a topic.

Formative assessments are quizzes and tests that evaluate how someone is learning a material throughout a course.

Formative assessment is continuous, informal and should have a central and pivot role in every math classroom.

The goal of formative assessment is to monitor student learning and provide ongoing feedback to staff and students.

It helps students identify their strengths and weakness and target areas that need work.

Example of formative assessment:

- Group activities
- Quizzes
- Games
- Class Projects
- Presentations
- Survey
- Homework assignments

Challenges of formative Assessment:

i) Time Consuming and Requires resources

Formative evaluation is considered to be time consuming process if they are followed on a monthly, weekly or daily basis. It requires gathering of resources such as data, analysis, reporting etc.

ii) Timing Process

Planning and executing can be a tiring process and few recommendations cannot be implemented at all times.

iii) Trained and Qualified professionals required

Well qualified and trained individuals are required so that formative evaluation is carried out successfully and ended.

iv) Funding limitations

The intensity of formative evaluation is limited by funding aspect.

v) Result must be related to implementation

Result must be based on the context of the program rather than a complete program assessment result.

vi) Hard to assess every student

vii) Hard to get individual feedback

viii) Hard to keep data and track of each student.

Suggestions for the improvement of formative assessment:

- i) All learning must be assessed for impact and effectiveness.
- ii) Put instructional time on video as a flipped lesson and save time for assessment.
- iii) Well qualified and trained teachers are required.
- iv) Result must be based on the context of the program rather than a complete program assessment result.
- v) Considering the advantages and disadvantages, & the instructor can make a note of them and make their projects successful.
- vi) Try keeping a folder for each student.

2) Summative ~~Evaluation~~ Assessment And Its Use

- Summative assessment is the assessment of participants where the focus is on the outcome of a program.
- Summative assessments are evaluation of what someone has learned throughout a course.
- Summative assessment aims to evaluate student learning and academic achievement at the end of a term, year or semester by comparing it against a universal standard or school benchmark.

Example of summative assessment:

- Tests
- Reports
- Papers
- End of term projects

Uses of Summative Assessment:

- i) Used for determining the achievement of a candidate
- ii) Used for keeping academic records for future.
- iii) Used for identifying a gap in a candidate's learning.
- iv) Used for identifying possible training gaps as well.

Formative Assessment

1. Occurs throughout a chapter or unit.
2. Improves how students learn.
3. Covers small content areas.
4. Monitors how students are learning.
5. Focuses on the process of student learning.

Summative Assessment

1. Occurs at the end of a chapter or unit.
2. Evaluates what students learn.
3. Covers complete content areas.
4. Assigns a grade to students' understanding.
5. Emphasizes the product of student learning.

6.2 Measurement and Evaluation

1. Measurement

Measurement is the process of obtaining a numerical description of the degree to which an individual posse a certain characteristic.

- Test is used to gather information.
- That information is presentation in the form of measurement.
- That measurement is then used to make evaluation.

In education, the numerical value of scholastic ability, aptitude, achievement etc. can be measured and obtained using instruments such as paper and pencil test. It means that the values of attributes are translated into numbers by measurement.

Some definitions of measurement:

i) "Measurement is the assignment of numerals to objects and events according to rules". — S. Stevens

ii) "Measurement consists of rules for assigning numbers to objects in such a way as to represent qualities of attributes. — J. C. Nunnally.

Types of Measurement:

i) Physical Measurement → A measurement made by comparing a quantity with a standard unit.

ii) Mental / Psychological Measurement → the values of attributes are not translated into numbers by measurement.

Physical Measurement	Psychological Measurement
1. It is an absolute measurement.	1. It is a relative measurement.
2. The reference point is zero.	2. The reference point is group performance.
3. It has definite or certain order.	3. It has recognizable order.
4. The trait is directly measured.	4. The trait is indirectly measured, with the help of behaviour.
5. It is perfectly objective and valid.	5. It is subjective measurement but efforts to make it objective and valid.
6. It has great precision.	6. It has less precision.

2.) Evaluation

Evaluation is the process of making judgements based on criteria and evidence.

In education, evaluation is the process of using the measurements gathered in the assessment. Teachers use this information to judge the relationship between what was intended by the instruction and what was learned.

Some definitions of evaluation:

i) "Evaluation is the process of determining to what extent the educational objectives are being realized."
-(Ralph Tyler, 1950)

ii) "Evaluation is a systematic process of gathering, collecting, analyzing and interpreting information to determine the extent to which pupils are achieving instructional objectives."

-Norman E. Gravland and Robert L. Linn

iii) "Evaluation is a process of judging the values or something by certain appraisal".
-Gravell

Type of evaluation

i.) Diagnostic evaluation

This type of evaluation is concerned with finding out the reasons for students' persistent or recurring learning difficulties that cannot be resolved by standard corrective measures or formative evaluation.

The aim of diagnostic evaluation is to find out the cause of learning problems and plan to take remedial actions.

ii) Placement evaluation

In this type of evaluation, learner ~~take~~ entry behaviour or capability is assessed to find out whether the student possess knowledge, skills and attitudes needed to begin the course of instruction.

iii) Formative evaluation

It is the evaluation used to monitor students learning progress during instruction with the purpose of providing on going feedback to students and teachers regarding success and failure of teaching-learning process.

iv) Summative evaluation

This type of evaluation is given at the

end of the course or unit of instruction to find out which student to what extent has mastered the intent learning outcomes.

Comparison between Measurement & Evaluation

Measurement

1. Measurement is all about the numbers and being able to quantify the performance or the abilities.
2. Measurement is objective.
3. Scientific in nature.
4. Quantitative form of data.
5. Provides numerical data.

Evaluation

1. Evaluation aims to judge success or failure.
2. Evaluation is subjective.
3. Philosophical in nature.
4. Qualitative form of data.
5. Uses numerical data to provide the value added results.

6.3 Different types of tests

Concept of test

- Test is a systematic procedure for obtaining data or measurements on a particular behavior.
- A test is defined as a group of questions, or tasks to which learners are asked to respond orally in writing or sometimes even in pantomime (स्ट्रीम)
- Test is an instrument for measurement.
It measures the level of skill or knowledge that has been reached.

Few definitions of test:

i) "Test is defined as a series of questions on the basis of which some information & thought".
A.K. Singh

ii) "Test is a tool to measure language proficiency of students."
- Hughes

Type of tests:

There are several types of tests but we discuss only two here:

i) Diagnostic Test

This type of test is used to diagnose what a student knows and does not know.

Diagnostic testing actually happens at the start of a new phase of education, like when students will start learning a new unit. Teachers use diagnostic testing to ~~know~~ guide what and how they teach. Students are not expected to have mastered all the information in a diagnostic test.

Diagnostic testing can be helpful for parents. The feedback my kids receive on these tests lets them know what kind of content they will be focusing in on class and lets them anticipate which skills ~~for~~ or area they may have trouble with.

ii) Achievement Test

Achievement or progressive test measures the student's improvement in relation to their syllabus.

These tests only contain the items which the students have been taught ~~or~~ in the class.

Achievement tests can also be structured as quizzes, rather than individual tests. They can be answered by teams of students rather than individuals. They can be formulated as posters, presentations, assignments or research projects.

Structuring achievement tests in this way ~~for~~ takes into account the multiple intelligences and different learning styles of the students.

Mukesh Singh SMC

Unit-7
Teaching Selected Topics of
Different Branches of Mathematics

Ajanta

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7.1 Arithmetic

Teaching of Arithmetic:

Arithmetic:

- Unitary method, Direct and Indirect variation
- Chain rule
- Profit Loss
- Percentage
- Different, Addition, Subtraction, Multiplication.
- Double base and five base

The origin of the word "Arithmetic" is derived from the French word Arithmétique (Counting), later Latin and the Greek word Αριθμός. So, Arithmetic is defined as the subject of counting numbers.

According to Pythagoras, Arithmetic is the basis for all genres of mathematics. Knowledge of any concept of mathematics can be given from the example of arithmetic. Algebra is a generalized form of arithmetic. Meaningful study of arithmetic provides the foundation for taking mathematics to an abstract level.

This section presents methods for meaningful teaching of some of the important and new concepts included in Nepal's secondary level arithmetic.

The points that anyone should keep in mind while teaching arithmetic:

i) Mathematic verbs (+, -, ×, ÷, %)

ii) Since practical arithmetic, practical conditions are present as examples, creating practical situations where it is used to find and research from the search method.

iii) Before giving a new concept, they should have the necessary knowledge to learn that new thing, and to know whether there is a concept or not, they should be taught under the subject matter.

iv) Opposite verbs (+, -), (×, ÷), (cube & cube root) and (conventional and composite) numbers are to be taught together as they are related to one another.

v) To impart the required amount of knowledge of mathematical language words for each teaching mathematical numbers, names and symbols.

Things to Consider when teaching Arithmetic:

- i) Use both inductive and deductive words together.
- ii) Knowledge of mathematical language words are required for teaching mathematical numbers and symbols.
- iii) Give good knowledge of numbers and number names.
- iv) Teach Addition, subtraction, multiplication and division respectively.
- v) Addition and subtraction are opposite actions of each other, so teach together.
- vi) Multiplication and division are also opposite actions of each other, so teach them together.
- vii) Square and square root, cube and cube root, Conventional and Composite numbers are like opposite concepts to each other, so teach them together.
- viii) Before starting ~~any~~ the teaching of any new subject, it is necessary to know what is the pre-knowledge of the subject whether the concept has been developed in the student or not.

ix) As arithmetic is a practical mathematics, so teach by connecting the subject with the practical problem.

x) Mainly addition, subtraction, multiplication, division, different percentages are the basic concepts of arithmetic. Other subjects / topics should be taught based on these concepts.

xii) To teach problems related to

xiii) Find formulae by giving practical examples.

xiv) Give the concept of profit or loss percentage.

xv) Teach the problems related to VAT and discount from the concept of percentage.

7.2 Algebra (Teaching Algebra)

Like arithmetic, algebra is mathematics based on the operations of numbers. But algebraic Verbs use letters or symbols instead of numbers so they & the ~~mean~~ in abstract action. Algebraic problems can be represented geometrically.

Since arithmetic is related to a certain problem, algebra is related to its general form (formula) and geometry is related to general arithmetic or geometric representation of algebra, then algebra should be taught by relating it to these two subjects.

Topics under Algebra:

1) Polynomials

- Addition and subtraction of Polynomials.
- Multiplication and division of Polynomials

2) H.C.F and L.C.M of Algebraic expressions

3) Indices (law of indices)

4) Simple linear equations

5) Quadratic equation

6) Relation and function

7) Surds

8) Matrix

9) Vectors

10) Sequence & Series

Things to Consider while teaching Algebra:
(How to teach algebra?)

i) Algebra is a general form of arithmetic,
so algebra should be taught in relation to
arithmetic.

ii) Algebra should be taught using variables
or symbols related to certain examples of
arithmetic. If necessary, the help of geometry
should be taken providing geometrical illustrations.

iii) Especially in algebra, problem solving,
inductive ~~and~~ (analytical) analytical method can be
adopted.

iv) When teaching algebra, the teaching of
different polynomials: monomial and binomial,
algebraic terms, algebraic expressions,
polynomials, equal polynomials, and the verbs
between them: Addition, subtraction, ~~as~~ multiplication
and division should be taught through
examples.

v) When teaching algebra, exponents, rules of
exponents, multiplication and division of vectorial
expressions, LCM, HCF, even linear equations
should be taught sequentially by example.

vi) Finding unknown quantities, i.e. events, problems are calculated by expressing them in equations and expressions.

7.3 Teaching Geometry

Topics under geometry:

- Teaching Congruence
- Teaching Similarity
- Teaching Theorem
- Teaching Construction
- ~~Teaching Transformation geometry~~
-

How to make geometry interesting?

Most students face problems in school especially in Geometry class. Being a teacher, the most important thing for you is to make sure that the concepts are clear enough. Students face a number of difficulties in solving geometrical problems and hence turn in a below average result.

Here are few tips on how you can plan geometry lessons to teach geometry more effectively:

- i) Use exciting ways to teach
- ii) Strengthen the student's understanding of the principles of geometry
- iii) Enhance the problem solving skills of the students
- iv) Include motivating Topics
- v) Explore geometry dynamically
- vi) Use effective tools to assess the students

Useful tools for teaching geometry:

At the school level, teachers should use visual aids and manipulative materials to teach students different concepts of geometry in a meaningful manner way. It is very important to have such materials in every classroom while teaching the concept of geometry. For the study of geometry, each student should have a geometric tool box and teacher should have or make following materials:

- i) Blackboard and Colored chalk, ges board and rubber band, graph board, set square, meter scale, compass and one meter nylon thread etc.
- ii) Flannel boards and various geometric shapes, cardboard for fixing in it, patterns etc.
- iii) Various charts of geometric drawings prepared for all the students in the class, such as angles, triangles, quadrilaterals,
- iv) Pieces of paper for paper folding activities. Other materials required by the teacher as required.

Phase of teaching geometry:

After teaching geometry in a practical and experimental way at school level, three steps can be adopted in its teaching:

1) Observational Stage

In the first stage, in order to teach geometric concepts, one has to observe real objects or patterns related to it. Such materials should be allowed to be used by the student. For example, students should observe patterns of different angles on pieces of cardboard or geoboard, then give examples of angles.

2) Experimental Stage

Then a pictorial representation of that idea should be presented. Students should be asked to draw on the copy. Must be proven experimentally. For example, by measuring different types of angles, students can find different types of angles.

3) Theoretical evidence or Generalization

After observing any geometric assumption and gaining a clear idea from the experimental method, formal generalization or theoretical evidence should

be taught. For example, when two lines intersect at a point, the angles to the vertex are equal.