	The Pupil • likes his teacher of mathematics • exhibits enthusiasm in learning mathematics • promotes the activities of the mathematics club in the school • enquires about programmes in TV. on mathematics - reading materials in mathematics • listens with interest and enthusiasm to talks on topics in mathematics • helps students who are weak in mathematics • engages in recreational activities such as doing puzzles, reading mathematical articles etc. during leisure time.
	The pupil • accepts a proposition only when logically proved • examines all aspects of a problem • points out error boldly, if convinced • accepts errors without hesitation • respects the opinions of others • keeps an open mind and does not record any argument as final

Skills to be Developed in Mathematics

In mathematics the following skills may be developed. Some of these skills are not purely psychomotor, they have to be integrated with the classes of objectives under cognitive domain.

- Skill of drawing figures
- Skill of drawing graphs
- Skill of reading tables
- Skill of computation

Activity – (1)

Write an example Problem from any one Teaching method (1)

(minimum 2 Problems)

Mathematics

Table-3.11. GIOs and SOLs for various skills

GIOs	SOLs
1) The pupil develops skill in drawing figures	The pupil • draws fairly accurate free hand figures. • selects appropriate geometrical instruments • handles geometrical instruments with ease • measures with speed and accuracy • constructs according to the given specification • draws neatly and correctly
2) The pupil develops skill in drawing graphs	• selects appropriate scale • tabulates correctly • plots the points neatly and correctly • draws the graph neatly and correctly • interprets the graph correctly
3) The pupil develops skill in reading table	• reads the table correctly • reads the table with speed and accuracy
4) The pupil develops skill in computation	• does oral calculation with speed and accuracy • does written calculations with speed and accuracy • does written calculations neatly

The teaching of mathematics should facilitate the realisation of the objectives relating to all the three domains. The teacher has to select the objectives with utmost care so that they are attainable and measurable. The GIOs and SOLs are to be stated with reference to the topic/ lesson related for instruction to make it clear and specific.(See sample lesson plans in Chapter IX for more examples of GIOs and SOLs).

❖ ❖ ❖

(32)

(33)

Table-5.8: Closure: Components and Description

Skill Components	*Description of Behaviour*
Consolidation of major points	• Synthesising of the learning points into a meaningful whole. • Reviewing the content in a broader perspective Use of number of mediums – *Examples*: Blackboard Summary, Questions, A.V.aids, etc..
Application of present knowledge in various new situations	• Application in problem solving • Use of any medium. *Examples*: Questioning-oral or written, diagrams, charts maps etc.
Linking past knowledge with present knowledge	• Make the pupils review the past knowledge in the light of the present knowledge. • Use of a variety of approaches – questioning, summary statements, using nonverbal media like blackboard, charts etc.
Linking present knowledge with future learning	• Appropriate assignments related to the present knowledge

The skill involves using each of these components effectively while concluding a teaching point, unit or a lesson.

Appraisal Guide: Closure

Skill Components	*Very Poor*	*Poor*	*Average*	*Good*	*Very Good*
Consolidation of major points					
Application of the present					
Knowledge in new situations					
Linking past knowledge with present knowledge					
Linking present knowledge with future knowledge					

Conclusion

The microteaching sessions provide adequate opportunities for the teacher-trainees to equip themselves with the teaching skills necessary to become effective teachers.

❖ ❖ ❖

Activity 5

~~write~~ Every one must write one Teaching method

Methods of Teaching Mathematics

6

A mathematics teacher has a variety of methods and techniques available for use in teaching mathematics. The selection of a suitable method depends upon the objectives of the lesson, *needs* of the learner and the *nature* of the content.

Some methods are more appropriate for teaching students as a group whereas some techniques are specially designed for individualised instruction. These methods are discussed in detail in this chapter.

General Methods of Teaching Mathematics

The following are the methods which are suitable for classroom teaching of mathematics

– Analytic and Synthetic Methods
– Inductive and Deductive Methods
– Laboratory Method
– Lecture Method
– Lecture – Demonstration Method
– Heuristic Method
– Project Method
– Problem-Solving Method

6.1 Analytic and Synthetic Methods

6.1.1 Analytic Method

The word 'analytic' is derived from the word 'analysis', which means 'breaking up' or resolving a thing into its constituent elements. This method is based on analysis and, therefore, in this method we *break up* the problem in hand into its constituent parts so that it ultimately gets *connected with* something *obvious*, or already *known*. Therefore, it is the process of unfolding of the problem or of conducting its operations to know its hidden aspects. In this process we start with what is to be found out (unknown) and then think of further steps and possibilities which may connect with the known and find out the desired result. Hence in this method we proceed from *unknown to known*, from *abstract to concrete* and from *complex*

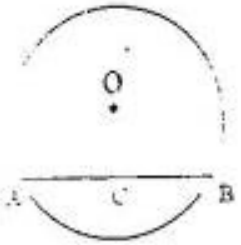
In analytic method, the argument is that "To prove that B is true if A is true, it is sufficient to prove that A is true"

The following examples illustrate how analytic method can be applied.

Example-1

Prove that from the centre of a circle, if a straight line is drawn to bisect a chord, it will be perpendicular to the chord

First perform the construction as provided in the statement. Then the analysis of the statements has to be followed



Q What is Given?

O is the centre of the circle and AB is a chord. The straight line OC from the centre bisects AB such that AC = BC

What is unknown?

To prove OC is ⊥ AB

Proof

To use the analytical method, we have to begin with the unknown

i.e. OC is ⊥ AB

How do you prove that OC is ⊥ AB?

If OC ⊥ AB, what is the measure of ∠OCA?

How do you prove that ∠OCA = 90°?

If ∠OCA = 90° what is the measure of ∠OCB? Why?

If ∠OCA = 90° then ∠OCB = 90° (supplementary adjacent angles)

How do you prove that ∠OCA = ∠OCB?

To prove ∠OCA = 90°, we have to prove ∠OCA = ∠OCB

How do you prove the equality of two angles?.

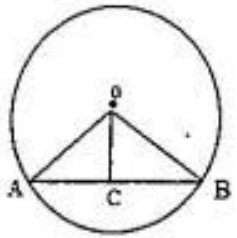
By proving the congruency of two triangles which contain these two angles.

Which are the two triangles containing the angles, ∠OCA and ∠OCB?

Not available in the figure, therefore, we have to construct them.

Which is the possible construction?

Join OA and OB.



Now which are the two triangles containing these two angles, ∠OCA and ∠OCB?

How do you prove the congruency of triangles OCA and OCB?

Do you find some equalities in the elements of these triangles, that enable you to prove their congruency?

Yes, AC = BC (given)

OC = OC (common)

OA = OB (radii of the same circle)

∴ By SSS postulate

Δ OCA ≅ Δ OCB.

∴ ∠OCA = ∠OCB = 90°

∴ OC ⊥ AB

Example-2

If $\frac{a}{b}=\frac{c}{d}$ prove that $\frac{ac+3b^2}{bc}=\frac{c^2+3bd}{dc}$

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

The unknown is $\frac{ac+3b^2}{bc}=\frac{c^2+3bd}{dc}$

$\frac{ac+3b^2}{bc}=\frac{c^2+3bd}{dc}$ is true

if $\frac{ac+3b^2}{b} = \frac{c^2+3bd}{d}$ is true

if $d(ac+3b^2) = b(c^2+3bd)$

if $dac+3b^2d = bc^2+3b^2d$

if $dac = bc^2$

if $da = bc$

if $\frac{a}{b} = \frac{c}{d}$ which is given to be true.

$\therefore \frac{ac+3b^2}{bc} = \frac{c^2+3bd}{dc}$

In analysis the reasoning is as follows 'C' is true if 'B' is true.

'B' is true if 'A' is true. But 'A' is true.

∴ 'C' is true.

Merits of Analytic Method

- It leaves no doubts in the minds of the students as every step is justified.
- It is a psychological method.
- It facilitates clear understanding of the subject matter as every step is derived by the student himself.
- It helps in developing the spirit of enquiry and discovery among the students.
- No cramming is necessitated in this method as each step has its reason and justification.
- Students take active role in the learning process resulting in longer retention and easier recall of what they learn.
- It develops self-confidence in the students as they tackle the problems confidently and intelligently.
- It develops thinking and reasoning power among the students.

Demerits of Analytic Method

- It is a lengthy, time consuming method and therefore not economical.
- With this method it is difficult to acquire efficiency and speed.

- This method may not be suitable for all topics of mathematics.
- In this method information is not presented in a well organised manner.
- This method may not be very effective for below average students who would find it difficult to follow the analytical reasoning

Applicability of Analytic Method

Analytic Method, though it has got certain limitations, is very effective for teaching how to solve complex mathematical problems, in proving theorems and riders and teaching many topics from algebra. This method is particularly useful for solving problems in arithmetic, algebra, geometry and trigonometry

6.1.2 Synthetic Method

'Synthetic' is derived from the word 'Synthesis'. Synthesis is the complement of analysis. To synthesise is to *combine* the constituent elements to produce something *new*. In this method we start with something already known and connect it with the unknown part of the statement. Therefore, in this method one proceeds from *known to unknown*. It is the process of combining known bits of information to reach the point where [illegible] becomes obvious and true. In synthetic method the reasoning is as follows "Since A is true, B is true".

The usual form of statements of proofs found in textbook are examples of synthetic method. Beginning with known definitions, assumptions and axioms, the sequence of steps are deducted and conclusions (unknown) are arrived at.

The following examples illustrate the use of synthetic method.

Example-1

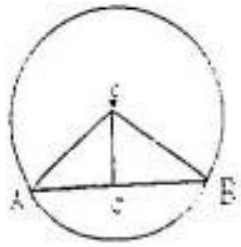
For an easy comparison with analytic method, the same examples that have been given for analytic method are dealt with using synthetic method.

Prove that the line drawn from the centre of a circle to the midpoint of a chord is perpendicular to the chord.

Given:

AB is a chord.

OC bisects AB



To Prove:

OC ⊥ AB

i.e. ∠OCA = ∠OCB = 90°

Construction

Join OA and OB. Why is not explained.

Proof

In $\triangle$s OCA and OCB

AC = CB (given)

OC = OC (common)

OA = OB (radii of same circle)

By SSS postulate

$\triangle OCA \cong \triangle OCB$

$\angle OCA = \angle OCB$

$\angle OCA = \angle OCB = 90°$ (Supplementary adjacent angles)

$OC \perp AB$

Thus the statement is proved.

In the above proof a number of questions remain unanswered in the minds of the students till the complete proof is given.

- Why do we join OA and OB and why not some other construction?
- Why do we take the $\triangle$s OCA and OCB?
- What is the necessity in proving the congruency of these triangles?
- Why not some other method?

Sometimes the pupils find it difficult to find answers to such questions even after proving and reproducing the proof a number of times.

Example 2

If $\frac{a}{b} = \frac{c}{d}$ prove that $\frac{ac+3b^2}{bc} = \frac{c^2+3bd}{dc}$

In synthetic method, one has to begin with the known i.e. $\frac{a}{b} = \frac{c}{d}$ and reach the unknown i.e. $\frac{ac+3b^2}{bc} = \frac{c^2+3bd}{dc}$

Proof:

$\frac{a}{b} = \frac{c}{d}$ (known)

Adding $\frac{3b}{c}$ on both sides we get

$\frac{a}{b} + \frac{3b}{c} = \frac{c}{d} + \frac{3b}{c}$

$\frac{ac+3b^2}{bc} = \frac{c^2+3bd}{dc}$ (unknown)

i.e., $\frac{ac+3b^2}{bc} = \frac{c^2+3bd}{dc}$

Thus beginning with the known, the unknown is reached. But why $\frac{+3b}{c}$ is added is *not* explained.

In synthetic method the reasoning is as follows.

A is true.

$\therefore$ B is true and

$\therefore$ C is true

Merits of Synthetic Method

- This method is logical as in this method one proceeds from the known to unknown
- It is short and elegant
- It facilitates speed and efficiency
- It is more effective for slow learners.

Demerits of Synthetic Method

- It leaves many doubts in the minds of the learner and offers no explanation for them.
- As it does not justify all the steps, recall of all the steps may not be possible.
- There is no scope for discovery and enquiry in this method.
- It does not provide full understanding.
- It makes the students passive listeners and encourage rote memorisation.

- If the student forgets the sequence of steps, it would be very difficult to reconstruct the proof/ solution.

Application of Synthetic Method

Synthetic Method is best suited for the final presentation of proofs of theorems and solutions to problems in a logical and systematic manner. Many teachers prefer this method for teaching mathematics. However, it is advisable to adopt synthetic method following analytic method.

Comparison of Analytic and Synthetic Methods

Analytic Method	*Synthesis Method*
▪ Analysis means breaking up into components	Synthesis means combining the elements to get something new
▪ Leads from unknown to known.	Leads from known to unknown
▪ A method of discovery and thought	A method for the presentation of discovered facts.
▪ Lengthy, laborious and time consuming	Short, concise and elegant.
▪ Valid reasons to justify every step in the sequence.	No justification for every step in the sequence.
▪ Encourages meaningful learning	Encourages rote learning
▪ Easy to rediscover	Once forgotten, not easy to recall
▪ Encourages originality of thinking and reasoning	Encourages memory work
▪ Is formational	Is informational
▪ A psychological method	A logical method
▪ Application of inductive reasoning	Application of deductive reasoning
▪ Informal and disorganised	Formal, systematic and orderly
▪ Process of thinking	Product of thinking
▪ Active participation of the learner	Learner is a passive listener

Conclusion

Though both analytic and synthetic methods seem to oppose each other, they complement and support each other. As Arthur Schultze has pointed out "Analysis is the method of discovery; synthesis is the method of concise and elegant presentation". Therefore, it is preferable to use a combination of both the methods, for the teaching and learning to be effective, interesting and complete. Analysis leads to synthesis and synthesis makes the purpose of analysis clear and complete. The analytic method thus serves the purpose of exhibiting and clarifying the reasons for the steps taken in the synthetic proof but does not itself

constitute a rigorous proof of the mathematical principle in question. Analysis helps in understanding and synthesis helps in retaining facts and presenting them in an orderly manner. The teacher while teaching can use analytic method and can encourage the students to present them in the synthetic method. The teacher may offer help for the analytic forms of the solution and leave the synthetic work to the students.

6.2 Inductive and Deductive Methods

6.2.1 Inductive Method

Inductive Method is based on induction. Induction is the process of proving a universal truth or a theorem by showing that if it is true of any particular case, it is true of the next case in the same serial order and hence true for any such cases. So the technique of making transition from particular facts to generalisations about these facts is known as the process of induction. Thus it is a method of arriving at a formula or a rule by observing a sufficient number of particular instances. If one rule applies to a particular case and is equally applicable to different similar cases, it is accepted as a general rule or formula. Therefore, in this method we proceed from *particular* to *general*, from *concrete* instances to *abstract* rules and from *simple* examples to *complex* formula. A formula or a generalisation is arrived at through inductive reasoning.

This method has been found to be very suitable for teaching of mathematics because many mathematical formulae and generalisations are the results of induction.

Example-1

Angle sum property in a triangle

The sum of the angles in a triangle is 180°.

When a student measures the angles of several triangles and finds that in each case the sum of the angles approximates to 180°, he has the background to generalise that sum of the interior angles in a triangle is 180°.

Example-2

The volume of a cone is one third of that of a cylinder

Volume of a cone $= \frac{1}{3}\pi r^2 h$. This can be derived by inductive method.

Take two containers one conical in shape and the other cylindrical in shape having the same height and diameter. Fill the conical vessel with [illegible] vessel. Repeat it with similar vessels of varying dimensions. It can be found that

...three full times to fill the cylinder. Thus leads to the conclusion that volume of the cone $= \frac{1}{3}$ of the volume of cylinder.

$$\text{volume of cone} = \frac{1}{3}\pi r^2 h$$

Many more examples can be listed where inductive method can be used effectively. A few are given below.

- Laws of indices
- Properties of parallelogram, rhombus etc
- Factorisation of quadratic expressions
- Derivation of the formula for simple interest, compound interest, recurring deposit etc.
- Transversal properties of parallel lines.
- Vertically opposite angles are equal.
- Angle in a semicircle etc.

Steps in Inductive Method

Inductive method follows clear and specific steps as under:

- Selection of a number of cases
- Observation of the case under given conditions.
- Investigation and analysis
- Finding common relations
- Arriving at generalisation
- Verification or application.

Merits of Inductive Method

- It helps understanding.
- It is a logical method and develops critical thinking.
- It encourages active participation of the students in learning.
- It provides ample opportunities for exploration and observation.
- It sustains the students interest as they proceed from known to unknown.
- It curbs the tendency for rote learning as it clears the doubts of the students
- It facilitates meaningful learning.
- It enhances self-confidence.

Demerits of Inductive Method

- Its application is limited to very few topics in mathematics where actual observation of the particular instances is possible
- This method is not suitable for higher classes because higher order mathematical principles cannot be generalised through the observation of concrete cases.
- It is a lengthy, time-consuming and laborious method.
- It is not absolutely conclusive as it might leave some doubts in the minds of the students regarding the validity of the generalisation arrived at through the observation of a few particular instances.
- This method only facilitates the discovery of the formula or the rule. A lot of supplementary work and exercises is necessary to fix it in the mind of the learner.
- It is not suitable for mathematically gifted students as unnecessary details and too many examples make the teaching dull and boring.

Applicability of Inductive Method

Inductive method is most suitable where

- rules are to be formulated
- definitions are to be formulated
- formulae are to be derived
- generalisations or laws are to be arrived at.

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While selecting inductive method for teaching, a teacher should check whether it is possible to present sufficient number of particular cases as instances of the generalisation to be arrived at. The student should be in a position to draw the conclusions without doubting the chance occurrence of instances and thus doubting the validity of the generalisation itself.

6.2.2 Deductive Method

Deductive Method is based on deductive reasoning. Deductive reasoning is the process of drawing *logical inferences* from *established facts* or *fundamental assumptions*. In this method the teacher presents the known facts or generalisation and draws inferences regarding the unknown, following a network of reasoning. Therefore, in deductive method one proceeds from general to particular instances, and from abstract to concrete cases. This approach is not suitable for exploration, but appropriate for a final statement of mathematical results.

In this method, we begin with the *formula*, or *rule* or *generalisation* and apply it to *a particular case*. It can be illustrated by the following examples.

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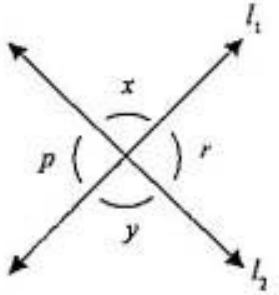
Example-1

When two lines intersect, the vertically opposite angles are equal. (statement of generalisation).

l_1 and l_2 are intersecting lines

x, y, are vertically opposite angles.

Similarly p, r, are vertically opposite angles.



The following inferences are drawn from the statement of the generalisation

$x = y$ (∴ vertically opposite angles)

$p = r$ (∴ vertically opposite angles)

Example-2

$a^m \times a^n = a^{m+n}$ (statement of the law)

Find $x^2 \times x^{10}$.

By applying the law we have, $x^2 \times x^{10} = x^{2+10} = x^{12}$

Whenever the teacher states a formula or a rule and asks the students to apply it to solve problems, the teacher is following the deductive method.

Steps in Deductive Method

Deductive method of teaching follows the steps given below.

- *Clear recognition of the problem*: A clear recognition of the problem statement provides the basic link for the thinking process and the solution to the problem.
- *Search for a tentative hypothesis*: The second step in deductive method is the search for a tentative hypothesis, a tentative solution to the problem.
- *Formulation of a tentative hypothesis*: The search for the solution leads to the formulation of a tentative hypothesis that appears to have promise as a possible or probable solution to the problem. The tentative hypothesis has its basis on certain axioms or postulates, or propositions or rules and formulae that have been accepted to be true.
- *Verification:* Finally the hypothesis that has been formulated is to be verified as the right solution to the problem at hand.

Merits of Deductive Method

- It saves time and labour for both the teacher and the student
- It enhances speed, skill and efficiency in solving problems.
- It is a short and elegant method.
- It helps in fixation of formulae and rules as it provides adequate opportunities for practice and revision
- It helps in increasing the memory power of the students, as the students are required to memorise a large number of laws, formulae etc.
- It completes the inductive method as probability in induction is reduced to certainty in deduction
- It is useful for higher classes

Demerits of Deductive Method

- It encourages rote memory as deductive method demands the use of certain laws, rules or formulae to be recalled by the learners from their memory.
- It does not clarify the doubts of the student regarding the generalisation and hence learning is incomplete
- It is not suitable for beginners.
- It does not encourage students' involvement in learning.
- It is not suitable for the development of thinking, reasoning and discovery.
- Since it is based on blind memory, once the formula or rule is forgotten, it is not possible to rediscover them.
- In this method the emphasis is on memory at the cost of intelligence and hence it is psychologically unsound.
- It taxes the pupil's mind as it puts more emphasis on memory.

Applicability of Deductive Method

Deductive method is suitable for giving practice to the student in applying the formulae or principles or generalisation which have been already arrived at. This method is very useful for fixation and retention of facts and rules as it provides adequate drill and practice. Deductive method is particularly suitable for teaching demonstrative geometry as it is primarily a deductive science in which truths stated in the form of theorems can be proved by showing that they are implied by other theorems which have already been proved earlier that have been stated and postulates and axioms that have been accepted. This method is not

...useful for teaching mathematics at higher classes. However, the deductive method is most effective when it is preceded by inductive method.

Comparison of Inductive and Deductive methods

Inductive Method	*Deductive Method*
• Based on inductive reasoning	Based on deductive reasoning
• Proceeds from	Proceeds from
Particular → General	General → Particular
Concrete → Abstract	Abstract → Concrete
• A psychological method	An unpsychological method.
• A method of discovery that stimulates the mental powers	A method of presentation that does not develop originality and creativity
• Both kinds of reasoning	Emphasis is on memory.
• Encourages meaningful learning	Encourages rote learning
• Most suitable for initial stages of learning	Suitable for practice and application
• Suitable for lower classes	Most suitable for higher classes
• Encourages participation of the students	Makes the student passive recipient of knowledge
• Lengthy, time-consuming and laborious	Short, concise and elegant
• Not absolutely conclusive, based on probability	Makes the probability a certainty
• Facilitates discovery of rules and generalisations	Enhances speed, skill and efficiency in solving problems

Conclusion

Induction and deduction are not opposite modes of thought. There can be no induction without deduction and no deduction without induction. Induction is the forerunner of deduction and deduction is the hand-maid of induction. Inductive method is a method for establishing rules and generalisation and deriving formulae, whereas deductive method is a method of applying the deduced results and for improving skill and efficiency in solving problems. Hence a combination of both inductive method and deductive method known as 'Inducto – Deductive Method' is most effective for realising the desired goals. It is advisable to begin with inductive method to derive formulae or establish generalisations for better understanding and end with deductive method for effective application, drill and practice. The validity of induction can be tested only by the principle of deductive logic.

6.3 Laboratory Method

Laboratory Method is a procedure for stimulating the activities of the students and to encourage them to make discoveries. In this method students are required to do some experiments or carry out certain activities in order to verify the validity of a mathematical generalisation, a law or a statement. It is the experimental portion of the inductive method or the practical form of the heuristic method. Therefore, in this method one proceeds from concrete to abstract. It is based on the psychological principles of learning such as 'learning by doing', 'learning by observation' and so on. Laboratory method is quite competent to relate the theoretical knowledge with the practical base. This approach makes the learning process more interesting, lively and meaningful.

The success of the laboratory method depends on an able and skilled mathematics teacher as well as the availability of a well-equipped mathematics laboratory. According to J.W.A. Young "a room specially filled with drawing instruments, suitable tables and desks, good blackboards and the apparatus necessary to perform the experiment of the course is really essential for the best success of the laboratory method". A well-furnished mathematical laboratory helps in providing stimulating and worthwhile experiences in clarifying the meanings of mathematical principles and for the acquisition of understanding and skills.

Merits of Laboratory Method

- It is based on the psychological laws of learning: law of exercise and law of effect.
- It is based on the principle of learning by doing.
- It stimulates the interest of the students to work with concrete material
- It provides an opportunity for the students to verify the validity of the mathematical rules through their application.
- Knowledge and skills acquired through experiments help in better understanding and longer retention.
- It provides for individual differences and best suited for average and below average students for thorough understanding of abstract concepts.
- It promotes self-confidence and self-reliance and a sense of achievement among the students.
- It provides opportunities for social interaction and cooperation among the students
- It develops in the child a habit of scientific enquiry and investigation.

merits of Laboratory Method

Laboratory method does not contribute much towards the mental development of the students.

It is an expensive method in terms of time, equipment, laboratory facilities and number of skilled and able teachers.

Only very few topics in mathematics can be taught through this method and hence it has limited applicability.

It is too much to expect the students to work independently and discover and verify mathematical facts like a mathematician.

It is not suitable for larger classes as the teacher has to give individual attention to each student.

It is suitable only for lower classes.

There is a dearth of textbooks written on the lines of laboratory method.

pplicability Of Laboratory Method

Laboratory Method is best suited for teaching mathematics at lower classes. This ethod does not provide much scope for teaching mathematics at high school and higher :condary classes. However, many topics in geometry, mensuration and applied athematics can be taught effectively through laboratory method. This method does not ontribute much towards the development of reflective thinking, reasoning and problem-olving skills which are the important aims of teaching mathematics. Whenever the teacher :lects the laboratory method, it should be integrated with other methods to yield esirable outcomes.

ome Sample Topics For Laboratory Method

Listed below are some topics from high school mathematics which could be reated through laboratory method.

1. Derivation of the formulae for the.
   i. Circumference of a circle, area of a circle.
   ii. Area of square, rectangle, parallelogram, and trapezium.
   iii. Area of triangle, right angled triangle, isosceles right-angled triangle.
   iv. Total surface area of cone, cylinder.
   v. Volume of a sphere.
   vi. Volume of a cone.
2. Expansion of identities such as.

$(a+b)^2$; $(a-b)^2$; $(a+b+c)^2$, $(a+b)(a-b)$; $(x+a)(x-b)$; $(a+b)^3$ etc.

3. Verification of
   i. properties of certain geometrical figures like parallelogram,rhombus etc.
   ii. angle sum property in a triangle
   iii. transversal properties
   iv. properties of vertically opposite angles formed by intersecting lines
   v. congruency postulates.
   vi. theorems relating to triangles and circles.

6.4 Lecture Method

Lecture method refers to the teaching procedure to clarify or explain to the students some ideas that have been presented or created as a problem. This method is most commonly used in colleges and not a very suitable method for teaching mathematics at high school classes. This method is teacher controlled and information-centred and in this method the teacher works as a sole resource in classroom instruction. As this method does not call for students' involvement in the learning process, students may get bored and lose interest in learning. In this method the students are provided with readymade information by the teacher. The teacher goes ahead with the subject matter at his own speed.

Guidelines for Preparing a Lecture

To make the lecture method effective, the teacher has to follow certain guidelines while preparing the lecture.

- Lectures should be carefully and systematically planned as the teacher plans for other methods.
- Objectives should be kept in mind while preparing the lecture.
- All pertinent and relative illustrative devices and demonstrations must be carefully incorporated in the lecture.
- The lecture should be carefully outlined.
- The appreciative experiences of the class and general principles of induction and deduction must be taken into account.
- The lecture should exhibit the thorough knowledge of the subject matter, its organisation, development, interpretation and application.
- Where the lecture involves narration or description, they should be coordinated with day-to-day life experiences of the students.
- Student participation should be encouraged by asking questions, clarifying the points and reviewing the keypoints at frequent intervals.

6. Mathematics is a study of structures:

A Mathematical 'structure' is a mathematical system with one or more explicitly recognized properties. Mathematics has got definite logical structures. These structures ensure the beauty and order of mathematics. Number system, group, field, ring vector, space etc. are all examples of mathematical structures.

7. Mathematics deals with Generalizations:

The generalizations of mathematics are very simple and obvious in comparisons with those of other domains of thought and activity in mathematics, various generalizations are made with the help of available data. Formulae, theorems, rules and regulations are examples to Generalisation.

8. Mathematics is logical:

According to Russell and whitehead, Mathematics is logic. Moreover they challenged to show the line of demarcation of Mathematics and logic. It studies the relationship between statements and draws logical inferences. Best example for this is Euclidian geometry.

9. Mathematics is a dynamic intellectual enterprise:

There is a difference in the dynamic nature of other sciences and mathematics. In other sciences, the people of one generation find something, while the next generation individuals find another thing by rejecting the old one. But in Mathematics, if one generation of individuals find something the next generation adds something more to it. The dynamic nature of mathematics should be reflected in the curriculum.

10. Mathematics deals with abstractness:

Abstractness is essential in mathematics with the help of concrete situations, high school students can be motivated towards abstractions and symbolic representations.

1.2 SCOPE OF MATHEMATICS

The aim of mathematics is the development of appropriate abilities, appreciations, and positive attitudes. We will remain too much handicapped in our life in case we remain ignorant of mathematics. The scope of mathematics is unlimited. It occupies all walks of life.

The scope of Mathematics is as follows: Mathematics plays its role in the following ways

a) In leading daily life
b) In performing any profession
c) In learning any subject
d) In developing technology
e) In developing intellectual powers
f) In meeting one's varying interests
g) In imbibing social and moral virtues
h) In preparing for future vocation
i) In becoming self dependent
j) In developing various skills

Hence, all the advantages and values of Mathematics could be considered as the scope of Mathematics and also the correlation of mathematics with sciences as well as social sciences could also be included in the scope of mathematics. Therefore, the scope of mathematics could be generalized as very vast and wide.

1.3 CONTRIBUTIONS OF THE FOLLOWING MATHEMATICIANS TO MATHEMATICS

1.3.1 PYTHAGORAS

Born: Approximately 569BC
Died: Approximately 500-475BC

Pythagorus is often refers to as the first pure mathematics. He was born in 569BC at samos Island in Greece. According to various writing's his death was happened between 500BC and 475BC in Metapontum, Lucania, Italy.

There is fairly good agreement on the main events of his life but most of the dates are disputed. His father was Mnesarchus while his mother was Pythais. She was a native of Samos. He had two or three brothers. Some of the Historians say that Pythagoras was married to a woman named Theano and had a daughter Daneo, and a son named Telauges; others say that theano was one of the students, not his wife, and never married.

Pythagoras was well educated and he played the lyre throughout his lifetime, knew poetry and recited homer. He was interested in Mathematics, Philosophy, Astronomy and music was greatly influenced by Pherekydes (Philosophy), Thales (mathematics and astronomy) and Anaximander (Philosophy, geometry).

Thales and his pupil Anaximander introduced mathematical ideas to him. He visited Thales in Miletus when he was between 18 and 20 years old. Thales did contribute to Pythagoras's interest in mathematics and astronomy and advised his to travel to Egypt to learn more of these subjects. Anaximander lectured on Miletus and basically Anaximander was interested in geometry and cosmology and many of his ideas influenced Pythagoras's own views. He also visited more other countries like Syria and Babylonia.

After his travelling he finally settled upon Crotona, a town on the southern coast of Italy about 529BC. There he founded a religious scientific and philosophical brotherhood. It was a formal school. The members were divided into two categories, probationers (or learners) and Pythagoreans. The Pythagoreans formed themselves into a kind of secret society with the idea of sharing all things and they were governed by a strict discipline binding themselves with an oath not to reveal the secrets and teaching of the school. Later on, the brother hoods were supposed to have mixed in politics and as a result it was eventually banned. Pythagoras fled to near by Metapontum and was murdered there about 497 B.C. His followers spread to other Greek centres and continued his teaching in the name of Pythagorian school.

Pythagoras never embodied his finding or doctrine in any treatise. Due to lack of good writing material he followed the custom of his time in passing his philosophy along by words of mouth. Later on his teachings were passed with some modifications by his disciples to the coming ones. It is difficult to separate the work of Pythagoras himself from what is available at present in the form of Pythagorean contributions.

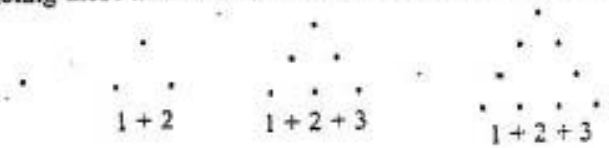
Some major contributions of Pythagoras:

1. He was the first discoverer that earth is a sphere in space.
2. He know that the plane space about a point may be filled by six equilateral triangles, four squares or three regular hexagons.

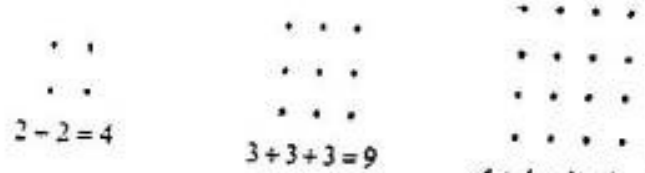
3. He proved the proposition relating to the sum of the angles of a triangle (180).
4. He discovered the proof on the theorem of a right angled triangle which bears his name, although it was known to Egyptians and Indians long before.
5. He constructed a polygon equivalent to one given polygon and similar to another and he could construct the five regular polyhedrons.
6. Sum of interior angles of a polygon is (2n-4) right angles and sum of exterior angles equal to four right angles.
7. He solved equations $a(a-x) = x^2$ by geometrical means.
8. Pythagoras studied properties of numbers which would be familiar to mathematics today, such as even and odd numbers, triangular numbers, perfect numbers etc.
9. However to Pythagoras numbers had personalities which we hardly recognize as mathematics today.

   Each number has its own personality. For example $10 = 1 - 2 - 3 + 4$ and these written in dot notation formed a perfect triangle.
10. Pythagoras was one of the first Mathematician to class all numbers as even or odd.
11. He pointed that any odd number (say $(2n + 1)$ can be expressed as the difference of two squares i.e. $2n+1 = (n+1)^2-n^2$.
12. He was acquainted with what are known as Triangular numbers and square numbers.

The numbers 1, 3, 6, 10 were called triangular because the dots depicting these numbers could be arranged as triangles.



Similarly the numbers 1, 4, 9, 16 ---- were called square numbers because the dots depicting these could be arranged as squares.



13. The name Mathematics was given by Pythagoras. Along with parabola, lying side by side equal, ellipses etc were introduced by him.
14. He studied properties of area and volumes and he was the first to prove that the circle contains a greater area than any plane figure with the same perimeter, while the sphere contains a greater volume than any other shape bounded by the same surface.
15. He is credited for making geometry a science by basing it on axioms, postulates and definitions and by setting down methods of proof.
16. Pythagoras for the first time was able to furnish a proof of the fact that $\sqrt{2}$ is incommensurable (irrational).
17. He made useful investigation into music and began the theory of music by measuring the cords of the lyre; a musical instrument. He found that the fifth and eighth of a hole can be produced on the same string by stopping at $\frac{2}{3}$ and $\frac{1}{2}$ of its length respectively.
18. He knew that there were five regular solids which lie exactly in a sphere namely tetrahedron, hexahedron, octahedron, dodecahedron and icosahedrons.

Conclusion:

Pythagoras was perhaps the most outstanding person in the history of ancient mathematics and his findings had a great influence not only on mathematics but on the lives of most of the ancient Greek thinkers. His work will always remember by the world as the torch bearer of the advancement in Mathematics.

1.3.2 EUCLID (325 B.C – 265 B.C)

An Egypt mathematician in 300 B.C, named Euclid is less known to is. He has gained the distinction of being the only man to summarise all the mathematical knowledge of his time. He is the most prominent mathematician of antiquity best known for his treatise on mathematics, 'The Elements'. 'The Elements' made Euclid, the leading mathematics teacher of all time. However, little is known of Euclid's life except that he taught at Alexandria in Egypt.

Alexandria was the meeting place of Greeks, Jews and Arabs. Here the Mathematics of the Ancients was perfected and treasured in the libraries. Ptolemy, the successor of Alexander, established a university and Euclid worked as a teacher in this university. He continued his teaching profession there for about 30 years. During this period he wrote several works, the most important being the Elements, which consists of 13 books.

Once Ptolemy asked Euclid if there were any shorter way to study geometry than through the thirteen books of the Elements, and Euclid replied that there was no royal road to geometry.

ABOUT the BOOK "THE ELEMENTS"

The Elements begins with definitions and five postulates. Postulates of Axioms, were called as 'common notions' by Euclid. The first three postulates are postulates of construction. The fourth postulate states that all right angles are equal. The well known fifth or parallel postulate states that one and only one line can be drawn through a point parallel to given line.

Contributions:

The Element's is divided into 13 books

1. Books 1 to 6 deal with plane geometry.
2. Book-1 and 11 deal with elementary theorems about triangles and parallelograms and ends with Pythagorean theorem.
3. Book three studies properties of circles.

4. Book four deals with problems about circles and is thought largely set out work of the followers of Pythagoras.
5. Book five lays out the work of Eudoxus. on proportion applied to commensurable and incommensurable magnitudes. Heath says that Greek mathematics can boast n o finer discovery than this theory, which put on a sound footing so much of geometry as depended on the use of proportion.
6. Book six looks at applications of the results of book five to plane geometry.
7. Book seven to nine deal with number theory.
8. Book seven is a self-contained introduction to number theory and contains the Euclidean algorithm for finding the greatest common divisor of two numbers.
9. Book Eight examines numbers in continued proportions now known as geometric sequences such (bx, bx^2, bx^3, bx^4).
10. Book nine proves that there are infinite numbers.
11. Book ten deals with the theory of irrational numbers and is mainly the work of Theaetctus Euclid changed the proofs of several theorems in this book so that they fitted the new definition of proportion given by Eudoxus.
12. Book Eleven to thirteen deal with three dimensional geometry. In book thirteen the basic definitions needed for the three books together are given.

    The theorems then follow a fairly similar pattern to the two dimensional analogues previously given in books one and four.
13. The main results of book twelve are that circles are to one another as the squares of their diameters. These results are certainly due to Eudoxus.
14. The Elements ends with book thirteen which discusses the properties of the five regular polyhedral and gives a proof that there are precisely five.
15. Besides the above work, Euclid also wrote a number of works Among them are

i) Phenomena – dealing with the celestial sphere and containing twenty-five geometric propositions.

ii) Catoprica - containing propositions on reflections from mirrors

iii) Sectio Canonis -a work on musical intervals.

Conclusion:

Euclid may not have been a first class mathematician but the long lasting nature of the Elements must make him the leading mathematics teacher of antiquity or perhaps of all time.

1.3.3 HYPATIA

Born: about 370 in Alexandria, Egypt

Died: March 415 in Alexandria, Egypt

Hypatiā of Alexandria was the first woman to make a substantial contribution to the development of mathematics. Hypatia was the daughter of the Mathematician and philosopher Theon of Alexandria and it is fairly certain that she studied Mathematics under the guidance and instruction of her father.

Hypatia and her father theon were probably the foremost Mathematicians in Roman Empire, and most likely the world, during their lifetimes, but that doesn't mean they were great Mathematicians in the same way as Euclid and Diophantus.

It is rather remarkable that Hypatia became head of the Platonist school at Alexandria in about 400A.D. There she lectured on Mathematics and philosophy, in particular teaching the philosophy of Neo-Platonism.

Her contributions:

1. Hypatia taught "higher" Mathematics and logic as a means of disciplining the mind and making one more open to the religious aspect of ancient philosophy, but only a special few were deemed worthy of such instruction.
2. Hypatia devoted herself, as a teacher, to preserve the knowledge of the past through a turbulent time. so she was much more than a geometry teacher.

"The hundredth part of the circumference of a circle seems to be a straight line. Our earth is an huge sphere, we can see only a small fraction of it, therefore it appears flat".

Conclusion:

In this way what has been contributed by Bhaskaracharya is unaccountable. In every sense he was a celebrated astronomer and mathematician. Though he died in 1185 in Ujjain, he shines like sun in the world of Mathematics.

1.3.7. SRINIVASA RAMANUJAN

Born: 22 December 1887 in Erode, Tamil Nadu.
Died: 26 April 1920 in Kumbakonam, Tamil Nadu.

Srinivasa Ramanujan was one of Indian's greatest Mathematical geniuses. He made substantial contributions to the analytical theory of numbers and worked on elliptic functions, continued fractions, and infinite series

His father worked in kumbakonam as a clerk. When he was nearly five years old, he entered the primary school in kumbakonam. In 1898, he entered town high school in kumbakonam and showed himself an able all round scholar.

Ramanujan came across a mathematics book by GS Carr called synopsis of elementary results in pure mathematics. This book, with its very concise style, allowed Ramanjan to teach him self Mathematics. The book contained theorems, formulae and short proofs. The book, published in 1856, was of course well out of date by the time Ramanujan used it. Ramanujan, on the strength of his good school work, was given a scholarship to the government college in kumbakonam in 1904.

The following year his scholarship was not renewed because Ramanujan devoted more and more of his time to mathematics and neglected other subjects. He continued his mathematical work. In 1906 amanujan went to madras where he entered Pachaiyappa's college. is aim was to pass the First Arts examination to admit to the university madras; but he passed in mathematics only.

He married on 14 July 1909, a nine year girl, Janaki Ammal. In he approached Ramachandra Rao, a founder member of the Indian hematical society for advice on a job.

Ramanujan continued to develop his mathematical ideas and began to pose problems and solve problems in the Journal of the Indian Mathematical society. He developed relations between elliptic modular equations in 1910. After publication of a billion research paper on Bernoulli number in 1911 in the Journal of the Indian Mathematical society he gained recognition for his work.

Dr. Hardy, a great mathematician of England, remarked about Ramanujan's work on numbers. Hardy brought Ramanujan to Trinity college, Cambridge, to begin an extraordinary collaboration. He met by Neville and spent two weeks in Neville's home before moving into rooms in Trinity college on 30th April. Right from the beginning, however, he had problems with his diet. Right from the start Ramanujan's collaboration with Hardy led to important results.

On 16th March 1916, Ramanujan graduated from Cambridge with a Bachelor of science by Research (the degree was called a Ph.D from 1920). Ramanujan's dissertation was on highly composite numbers and consisted of seven of his papers published in England. Ramanujan was elected a fellow of the Cambridge philosophical society and then three days later, the greatest honour that he would receive, his name appeared on the list for election as a fellow of the Royal society of London. He had been proposed by an impressive list of mathematicians, namely hardy, MacMahon, Grace, Larmor, Bromwich, Hobson, Baker Littlewood, Nicholson, Young, Whittaker, Forsyth and whitehead. He was elected fellow the Royal Society on 2nd may 1918 and then on 10th October 1918 as fellow of Trinity college Cambridge. The fellow ship to run for six years.

Ramanujan fell seriously ill in 1917 and got improvement a little by September. By the end of November 1918, Ramanujan's health had greatly improved. Ramanujan sailed to India on 27 February 1919 arriving on 13 March. However his health was very poor and, despite medical treatment, he died there on 26th April 1920.

Contributions to Mathematics:

1. In 1900, he began to work on his own on mathematics summing geometric and arithmetic series.
2. He made substantial contributions to the analytical theory of numbers and worked on elliptic functions and infinite series.

3. He was shown how to solve cubic equations in 1902 and he went to on to find his own method to solve the quartic.
4. By 1904, Ramanujan had begun to undertake deep research. He investigated the series (1/4) and calculated Euler's constant to 15 decimal places. He began to study the Bernoulli numbers although this was entirely his own independent discovery.
5. In 1904, he worked on hyper-geometric series and investigated relations between integrals and series. He was to discover later that he had been steadying elliptic functions.
6. Continuing his mathematical work Ramanujan studied continued fractions and divergent series in 1908.
7. Ramanujan continued to develop his Mathematical ideas and began to pose problems and solve problems in the journal of the Indian Mathematical society. He developed relations between elliptic modular equations in 1910.
8. Ramanujan independently discovered results of Gauss, kummel and others on hyper geometric series.
9. Ramanujan discovered a number of remarkable identities that imply divisibility properties of the partition function.
10. He worked on divergent series. He seen 120 theorems on divergent series to hardy in 1913.
11. Goldbach's conjective is one of the important illustrations of Ramanujan's contribution towards the proof of the conjecture.
12. Ramanujan and his associated has shown that every large integer can be written as the sum of at most four primes (2S = 2 + 5 + 7 + 11).
13. He worked on the unsolved Fermat theorem which state that a prime number of the form 4m + 1 is the sum of two squares.
14. His most famous work was on the number P (n) of partitions of an integer 'n' into summands. Mac Mohan had produced tables of the value of p(n) for small numbers n, and Ramanujan used this numerical data to conjecture some remarkable properties some of which he proved using elliptic functions.
15. He did great work on magic squares.

16. His Moctheta functions are using in preparing medicine for cancer.
17. 1729 is the smallest number which can be expressed as the sum of two cubes in two different ways $1729 = 1^3 + 12^3 = 9^3 + 10^3$ 1729 is called as Ramanujan number.
18. Ramanujan developed a formula for the partition of any number which can be made to yield the required result by a series of successive approximation.
19. A highly composite number is, in sense the very opposite of a prime number. A prime number has only two divisors-itself and unity cones.
20. On Ramanujan's work of "highly composite number", Hardy writes. The elementary analysis of highly composite numbers is most remarkable and shows very clearly Ramanujan's extraordinary mastery over the algebra of inequalities.

Conclusion:

In this way one can judge the merit and competency of Ramanujan as a first rate mathematician. Indian Government announced that birthday of Ramanujan is celebrated as National Mathematics day. The Indian postal authorities issued a stamp to celebrate the 75th anniversary of Ramanujan's birth.

1.4 CORRELATION OF MATHEMATICS WITHIN AND WITH OTHER SCHOOL SUBJECTS

Mathematics has played a very Important role in building up modern civilization by perfecting all sciences. Even though people have only a vague idea that all progress made by man is the result of scientific progress. Mathematics, which is a science by any criterion and which rightfully belongs to sciences like Physics, Chemistry, biology, medicine and engineering. "It is a science of all sciences and art of all arts". It is the pivot of all the sciences and arts

Correlation:

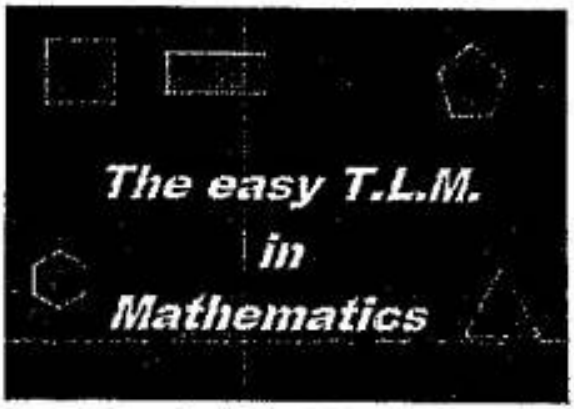
The word "Correlation" in education is usually taken to mean the teaching of different subjects with one another so that knowledge is contradiction are avoided and so that knowledge is revealed as a unity and not as a bundle of separate "Subjects". We have been teaching mathematics to our students in complete isolation by divorcing it from

Maths - Activity (3)

USEFUL TEACHING LEARNING MATERIALS (T.L.M.) FOR MATHEMATICS TEACHING IN MIDDLE SCHOOL CLASSES

Anil Sahu 9:55 PM

Mathematics Teaching Learning Material (T.L.M.) For Primary and Middle School Classes



www.anilsahu77.blogspot.com

In primary and middle school classes there are many concepts in mathematics related to our environment. It is very nice to arrange the teaching learning materials for those classes. Using teaching learning material is very useful to make Teacher's Presentation easy, effective and attractive. Teaching Learning Material makes the mathematical concepts easy and interesting. Let's talk about some geometrical terms and related T.L.M. that can be used and prepared easily in any school. There may be different innovative Ideas for smart math learning. How to make math learning smart and interesting?
In this article these are my own ideas. What are your experiences? Please share with this blog. If you want to get my links, please like my Google plus page "Innovative education". To know more please visit the page "About This Blog".

Useful Teaching Learning Materials (T.L.M.) for Mathematics Teaching in Middle School Classes

(46)

What is the role of T.L.M. in mathematics teaching?
Teaching Learning material is the great tool to teach the students. It simplifies the subjects and makes teacher's presentation interesting and attractive. Students learn better by examples and T.L.M. In an innovative classroom just like smart class, there are many opportunities for a teacher to arrange many teaching learning materials online. To know more about some useful and attractive teaching learning techniques visit other posts on this

Diana Azara 3 weeks ago - Shared publicly
This kind of teaching methods will help the students to get the concepts quickly
http://www.design01.com/academy-and-primary-school-website-design/

+1 - Reply

Augusto Lupokala 3 weeks ago - Shared publicly
good site to sharing and learning experiences

+1 - Reply

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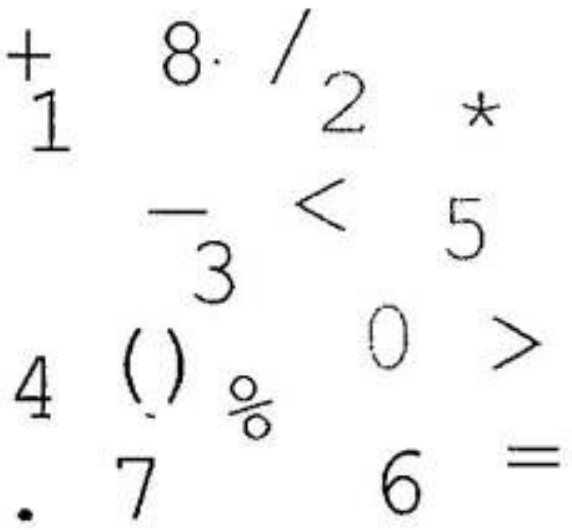

blog "Innovative education".

Ready-made Teaching Learning Materials

In many schools there are many ready made T.L.M. are available for teachers. Many schools have science and mathematics kits. They can purchase several ready-made teaching learning materials from market. This ready-made T.L.M. is very useful. Teachers can purchase many mathematical instruments for classroom presentation. These instruments and equipment are very helpful for teachers and students.

Mathematics Kit for Class:

It is a good idea to prepare "Mathematics Kit" in school. A mathematics kit should contain essential equipment used in classroom teaching. It may contain various models of math's instruments and equipment like scale, ruler, compass, geometry boxes, number line's model and such equipment. It should be easily available for students and teachers should encourage the students to use this kit. In a primary school teachers have many ideas for teaching learning materials like balls, pencils, seeds etc. They are very cheaper and easily available. There should be a separate box to put those learning materials.

Online Learning Resources for Mathematics:

There are several online tools for teaching mathematics. Teachers can find many awesome websites useful in their classroom. Even they can find many sites teach how to teach numbers. Now students can *learn by social networking websites*. Many Social and Educational websites are providing a facility to share educational content and ideas worldwide. The use of such websites is very helpful for teachers and students. Different learning software helps the teachers to make mathematics learning easy and funny. Teachers can use collaborative learning techniques within the classroom. It is very interesting to introduced project based learning. It is very helpful to use audio visual devices just like learning videos to explain the different hard topics in an easy way. Teachers can use different type's mathematics online learning games as powerful T.L.M. (Teaching Learning Materials).

The Geometrical Concepts in Primary and Middle School:

In primary and middle school syllabus in Madhya Pradesh (India) there are some basic concepts in mathematics like line, rectangle, square, triangle, circle, field, cone, perimeter and such type basic concepts. The textbooks are designed in such type to correlate these concepts with the environment. Use of sketch pens and color pencils are very useful to create the interest and attraction among the students in mathematics learning.

Easy T.L.M. That May be Used by Teacher:

It is very easy to use teaching learning materials in these classes. Teacher can use different type easily available teaching learning materials as matchbox for rectangle, scale for line. There are many teaching learning materials can be prepared by teachers using easily available materials. They can make different learning materials by card sheets, wood, wire, bangles, matchboxes, and so many materials easily available in environment. It is a nice idea to prepare a cloth sheet for numbers 1,2,3. When teacher uses collaborative techniques to make the teaching learning materials in classroom he can achieve many goals. An innovative teacher has a lot of innovative ideas for TLM. Just try to use TLM in your classroom and bring the new experience of mathematics learning with joy.

How to Prepare Mathematical Teaching Learning Materials in Class?

It is an easy and interesting activity to prepare mathematical T.L.M. and models in classroom. Teacher can provide it as a project for the groups of students. Teacher should facilitate the students to prepare the projects. Teacher can arrange the essential materials for students. When students learn how to prepare the T.L.M., they inspired to do such activities again and again.

Whiteboard as Powerful Teaching Learning Material:

Teachers use whiteboard in teaching the classroom. What are the smart and innovative ways to use whiteboard as effective teaching learning materials in mathematics teaching? Actually Smart and Active Teaching Learning Methodologies inspire the teachers to use more and more interactive teaching styles. These teaching methodologies ensure the student's participation in learning. Teacher can Facilitate the Students to use whiteboard to explain their problems, ideas and practices. When students use whiteboard they can learn better and they will be able to remember the concepts for longer time. Teacher can plan How to Use Whiteboard for students. He can use whiteboard as interactive teaching learning material. Many educational websites are providing learning games and multimedia lessons on mathematics. Teachers can display these multimedia lessons on white boards by the computers and projectors.

Smart and Innovative Teaching Learning Materials for Smart Classes:

In modern classrooms where we are planning to use internet and multimedia devices to make classroom learning easy, interactive and interesting it is very nice to use internet based teaching learning material to make mathematics learning smart and innovative. What is the internet based learning materials? Internet provides several opportunities to make teaching interesting and interactive. Online Learning Games are the best example for this. There are many learning games for students to make mathematics learning easy and interesting. Smart School Class is very suitable for using these learning games better. Students learn better by games and interactive teaching techniques.

In this article these are my own ideas. What are your experiences? Please share with this blog. If you have some smart and innovative ideas about Teaching Learning Materials, feel free to share your experiences with this blog. If you want to get my links, please like my Google plus page "Innovative education". To know more please visit the page "About This Blog" www.anilsahu77.blogspot.com.