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ECLECTICISM IN PEDAGOGY OF MATHEMATICS : AMALGAMATION OF I.C.T. & AVANT-GARDISM IN TEACHING OF MATHEMATICS AT SCHOOL LEVEL

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Abstract

Mathematics has aptly been called the Queen of Sciences. Its ubiquity can be easily traced in every walk of life. It is an integral part of school curriculum. In developed countries, innovative methods and techniques are being adopted as a supplement in transacting mathematics curriculum in the wake of paradigm shifts in Pedagogy of Mathematics at school level. It is however a matter of regret that despite its ubiquity and utility in daily life, mathematics is not being taught in its true spirit in our country. Logical thinking, spirit of enquiry, faculty of reasoning, scientific attitude etc. are not emphasized. Adoption of ICT and Avant-Gardism in Pedagogy of Mathematics is in a nascent phase in our country. The present paper discusses the pedagogy of mathematics in the context of Eclecticism besides giving valuable suggestions pertaining to the use of same in the field of Teaching and Pre-service Teacher Education programme.

***Keywords**: Avant-Gardism, Eclecticism, Pedagogy, ICT.*

Introduction

The word *mathematics* comes from the **Greek** (*máthēma*), which, in the ancient Greek language, means "that which is learnt", "what one gets to know", hence also "study" and "science", and in modern Greek just "lesson". The word *máthēma* is derived from (*manthano*), while the Modern Greek equivalent is (*mathaino*), both of which mean "to learn". **Mathematics** (from Greek μάθημα *máthēma*, "knowledge, study, learning") is the study of topics such as quantity (numbers), structure, space, and change. Another meaning of the word Mathematics, in Greek, is *"inclined to learn"*. It may, however, be broadly defined as the scientific study of quantities, including their relationships, operations and measurements expressed by numbers and symbols In simple words, mathematics deals with the study of numbers and their various calculations. The most important skills in mathematics are careful analysis and reasoning and thus, 'Logic' is the floor on which the structure of mathematics is built.

Some definitions

"Mathematics is the language with which God wrote the Universe."

- ***Galileo Galilei***

"Mathematics is the science of quantity."

- ***Aristotle***

"Mathematics is the science that draws necessary conclusions."

- ***Benjamin Peirce***

"All mathematics is symbolic logic."

- ***Bertrand Russell***

Mathematics is a science of structure, order and relation that has evolved from counting, measuring and describing the shapes of objects. It deals with logical reasoning and quantitative calculation. Since the 17^{th} century, it has been an indispensable adjunct to the physical sciences and technology, to the extent that it is considered the underlying language of science.

Importance of mathematics in everyday life

Mathematics pervades every walk of life. In this world of today, nobody can live without mathematics for a single day. Mathematics is intimately involved in every moment of everyone's life. There is a definite need of mathematics in anybody's life-long planning and day-to-day planning. Be it footing the bills (telephone, electricity, restaurant, online shopping), paying rent/fare, salary perk, opening and maintaining bank accounts, depositing fee, or other expenses mathematics is the core. Even the most ordinary citizen has got to calculate his wages and buy things from the market. A person be it a mere housewife, farmer, tailor, laborer, carpenter or booking clerk, vendor, salesman, mason, accountant, some basic knowledge of mathematics is absolutely necessary.

The entire atmosphere is surcharged with mathematics. The prices, rates, discounts, commissions, rebates, interests, taxes, shortages, production, distribution, inflation etc. are the issues with which everybody is intimately concerned. Shut out mathematics from the daily life and all civilizations come to a standstill. There is no escape from mathematical intricacies of life and livelihood. Mathematics is a very useful subject for most vocations and higher specialized courses of learning.

At a psychological level, exposure to mathematics helps in developing an analytical mind and assists in better organization of ideas and accurate expression of thoughts. At a more general level, far away from dealing with the higher mathematical concepts, the importance of mathematics for a common man is underpinned whenever he visits banks, shopping malls, post offices, insurance companies or deals with transport, business transactions, imports and exports, trade and commerce.

Aims of teaching mathematics (Sidhu, 1995)

1. To enable the child solve mathematical problems of daily life.
2. To develop the mathematical skills like speed, accuracy, neatness, brevity, estimation etc.
3. To develop logical thinking, reasoning power, analytical thinking and critical thinking.
4. To develop the power of decision making.
5. To develop scientific attitude and scientific temperament.
6. To recognize the adequacy or inadequacy of the given data in relation to any problem.
7. To develop ability to analyze, to draw inferences and to generalize from the collected data and evidences.
8. To develop heuristic attitude and to discover solutions and proofs with the own independent efforts.
9. To develop the techniques of problem solving.
10. To develop mathematical perspective and outlook for observing the realm of nature and society.
11. To develop the learner's power of expression.
12. To enable learner understand and enjoy popular literature.
13. To develop the habits of concentration, self-reliance and discovery.
14. To bring about an all-round, harmonious development of the personality of the child.

Values associated with teaching of Mathematics

Knowledge of educational values helps the mathematics teacher to avoid aimlessness in teaching. Value is the springboard of aim and vice-versa. Mathematics education contributes towards the acquisition of the following values:

1. **Knowledge And Skill** - Its provision is the practical or utilitarian value.
2. **Intellectual Habits And Power** – Its provision is the disciplinary value.

3. **Desirable Attitude And Ideals** – Its provision is the cultural value.

a) Practical value – Counting, notation, addition, subtraction, multiplication, division, weighing, measuring, selling, buying and many more are simple and fundamental processes of mathematics which have got an immense practical value in life. A common man can get on sometimes very well without learning how to read and write but he can never pull on without learning how to count and calculate. Even **Napoleon** said, *"The progress and the improvement of mathematics are linked to the prosperity of the state."*

b) Disciplinary Value – According to **John Locke**, *"Mathematics is a way to settle in the mind a habit of reasoning."* It is exact, true and to the point knowledge and therefore, creates a discipline in the mind. If taught in the right sense, it develops reasoning and thinking powers more and demands less from memory. Moreover, it develops a scientific attitude, in the learner's mind.

c) Cultural Value – It has been truly said that "Mathematics is the mirror of civilization". It helped man overcome difficulties and hardships in the way of his progress. Modern civilization owes its advancement to the progress of various occupations such as agriculture, engineering, surveying, medicine, industry, navigation, railroad building etc. These occupations build up culture and are its backbone. Mathematics is also a pivot for cultural arts such as music, poetry and painting.

Besides the above major and fundamental values, there are a few other values as under:

1. Development of concentration
2. Attitude of discovery
3. Quality of Assiduity and art of economical living
4. Development of the power of expression

It is rightly said that, ***'Mathematics is the king of all subjects'***. The Education Commission (1964-66) recommended mathematics as a compulsory subject for all school students. The National policy on Education NPE-1986 also emphasizes that mathematics should be visualized as the vehicle to train a child to think, reason, analyze and articulate logically, apart from being a specific subject it should be treated as concomitant to any subject involving analysis and reasoning. Thus, mathematics enjoys a unique status in a school curriculum. Yet many school students find difficulty with learning of mathematics and fail in mathematics. A major reason for the failure is that the teachers quite often pay no attention to

the basic concepts and generally adopt methods of solving questions with crammed up formulae.

FIGURE 1: CORRELATION OF MATHEMATICS WITH OTHER ACADEMIC SUBJECTS

Meanings of Key terms

Eclecticism - is the principle or practice of choosing or involving objects, ideas, and beliefs from many different sources (*Collins English dictionary*). It is a conceptual approach that does not hold rigidly to a single paradigm or set of assumptions, but instead draws upon multiple theories, styles, or ideas to gain complementary insights into a subject, or applies different theories in particular cases. Methods, beliefs, ideas, etc. that are eclectic combine

whatever seem the best or most useful things from many different areas or systems, rather than following a single system (*Cambridge English dictionary*).

Avant-gardism (from French, *Avant garde*) – refers to what is innovative or novel or experimental or inventive, that which deviates from the conventional.

I.C.T. (Information & Communication Technology) – I.C.T. is an umbrella abbreviation in that in encompasses many things such as computer based applications, internet, multimedia, animation, e-content, digital content etc.

Velleman and Moore (1996) report that in order for any multimedia system to be successful, these channels must be in balance; using each for what it does best and not letting one channel dominate over the others. One of the greatest benefits of the first communication channel, video, is its ability to take students beyond the classroom. Video can focus our attention through editing, and can manipulate time and space through time-lapse, slow motion, microscopic, or telescopic views. When used with a proper strategy, a video presentation can be more appealing and compelling than direct observation. Animation is another communication channel of multimedia. Animation can be defined as making objects on the screen change or move in real time. Research has shown that motion on the screen is important to holding viewer attention. Because of this, animation plays a major role in multimedia design. A third channel of multimedia is narration. A spoken narrative can be very effective in attaining attention when illustrated with animations and accompanied by an outline of key points. Finally, one of the last multimedia channels is sound. Its apt use enriches the multimedia environment. The literature reveals several ways of conceptualizing the way in which technology can improve learning. These include: technology as a cognitive tool (*Jonassen, Peck and Wilson, 1999*), the computer as a mental and computational device (*Tessmer and Jonassen, 1998*), the computer as a tool for teaching students (*Robleyer, 2008*), the way that the computer acts in the acquisition of cognitive skills (*Pappert, 1980*) and the use of computers as a tool for enhancing student learning (*Schoenfield, 1987*).

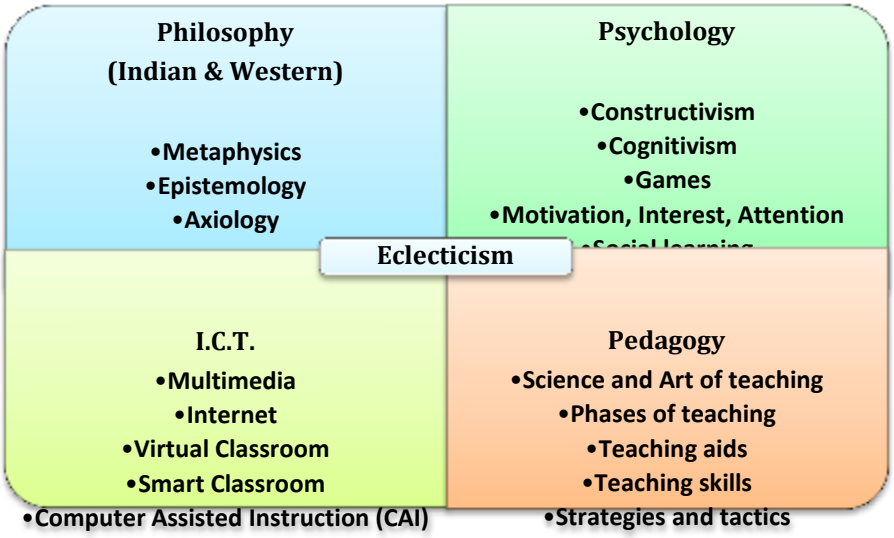


FIGURE 2: ECLECTICISM ARISING OUT OF DIFFERENT SCHOOLS OF THOUGHT

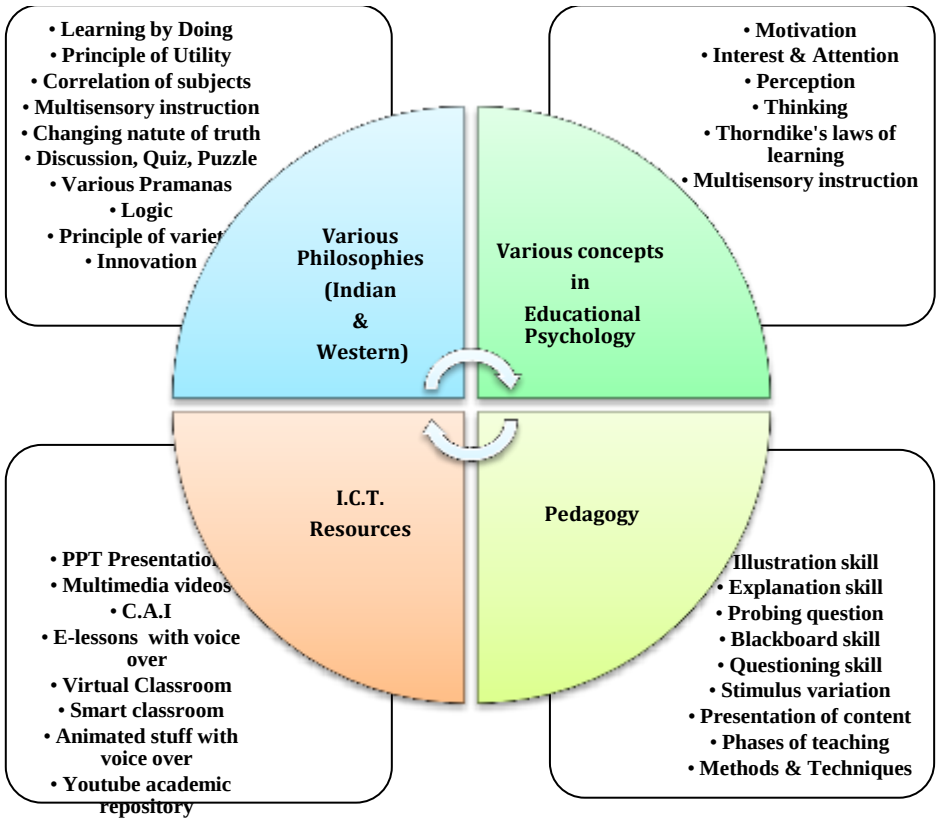


FIGURE 3: CONCEPTS FROM VARIOUS DISCIPLINES CONTRIBUTING TO ECLECTICISM

Review of related literature (At a glance)

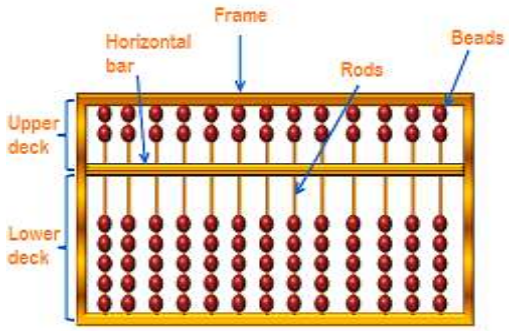
Miyan (1991) in his report on the *Fourth Survey of research in Education* made a concluding remark – "The quality of researches in mathematics leaves much to be desired……What is needed is a proper selection of problems, especially in the area of methods of teaching and measuring multidimensional outcomes among students as a result of teaching exercise." **Nalayini (1991)** examined the effectiveness of using number games to teach arithmetic. In eight (8) of the comparisons made, five (5) have shown significant improvement due to supplementary use of number games. **Wagh (1991)** has developed a multimedia instructional system for remedial purposes for fractional numbers and has expectedly found that this package leads to better understanding than the conventional remedial methods. **Lalithabai (1993)** study highlighted the role of numerical ability especially the abstract reasoning factor, in higher level of achievement in mathematics. **Sinha (1993)** advocating the usefulness of usage of Angular method in improving Class VI school students' skill in simple addition found that the angular method was more effective than the traditional method. **Busama (1993)** has studied the effect of simulation technique in teaching mathematics and found that it is more effective than the traditional method of teaching mathematics. **Dash (1996)** attempted to study the effects of instructions using innovative self learning activity sheets on the problem solving behavior of class III children leading to mastery level performance. The remedial intervention in solving different types of problems on multiplication and division was found to be effective. The average performance of children after remedial instruction was significantly higher than the same before the instruction while they took significantly less time to complete problems after remedial instructions as compared to before instructions. **Deshmukh, V. (1997)** conducted an experiment in the use of educational technology for teaching mathematics concepts. This experiment was designed to develop alternative strategies and support activities as well as instructional material to facilitate learning of the unit 'vulgar fraction' for class V students. The researcher concluded that the learner learns what the teacher does. As the learning needs of pupils vary, a teacher needs alternative approaches. Learning through games gives joy and reduces stress. **Paria (1999)** attempted to search the origin of errors committed by the higher secondary students in some selected topics. He found that the main errors identified were conceptual computational difficulty in selected topics. Students faced difficulty in applying the law of indices. The errors originated

due to certain teacher and learner factors. The teachers were often unaware of the necessary and sufficient background knowledge of students before teaching a particular mathematical topic. Students often failed to remember formulae key concepts and other relation of earlier topics. This ignorance prevented them from understanding the current topics properly. Sometimes, students were not conversant with or did not know the theory, basic principles and their operations. Moreover they often made mistakes in applying them.

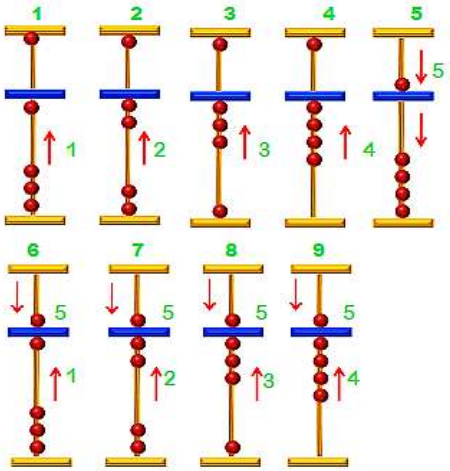
Disquisition

Basic mathematical operations using Abacus – It should be mainly used at lower primary level. The Eclecticism is as follows:

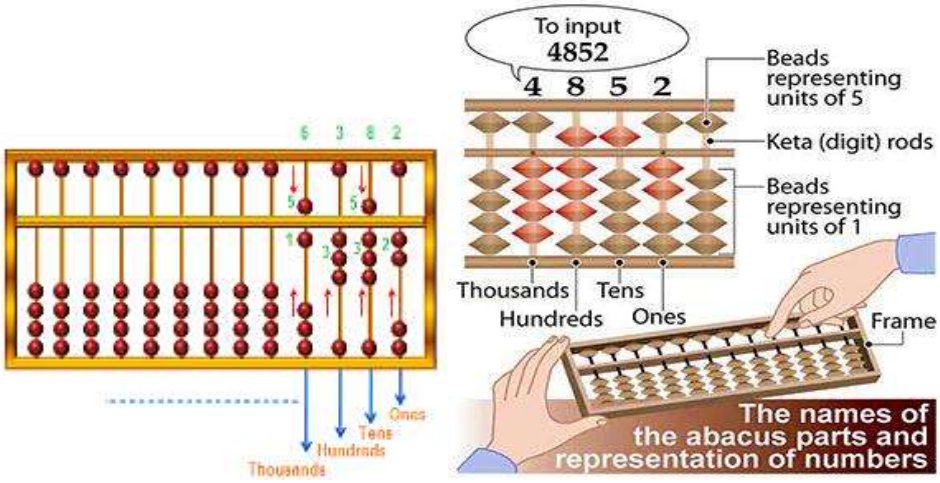
- Principle of interest
- Multisensory learning
- Principle of utility
- Innovation
- Motivation
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Demonstration
- Perception
- Learning by doing
- Aesthetics



Parts of Abacus



Counting single digit number

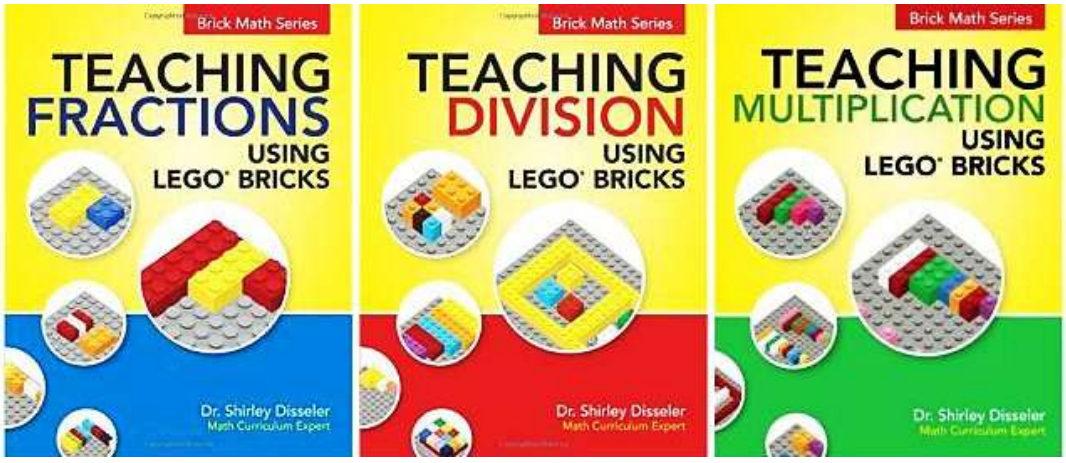


Counting multi digit number **Holding and using Abacus**

FIGURE 4: PARTS OF ABACUS AND ITS BASICS

Basic mathematical operations using Lego bricks - It should be mainly used at lower primary. The Eclecticism is as follows:

- Principle of interest
- Multisensory learning
- Principle of utility
- Innovation
- Motivation
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Perception
- Learning by doing
- Demonstration and Explanation skill
- Aesthetics
- Principle of variety
- Attention
- Affective domain
- Cognitive domain



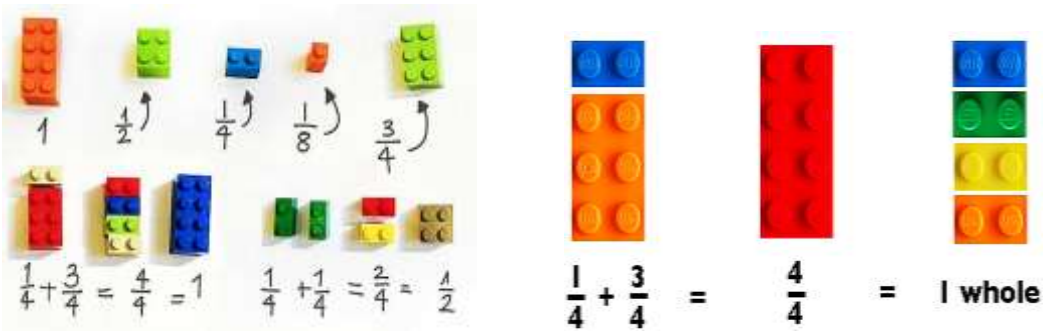


FIGURE 5: MULTIPLICATION USING LEGO BRICKS

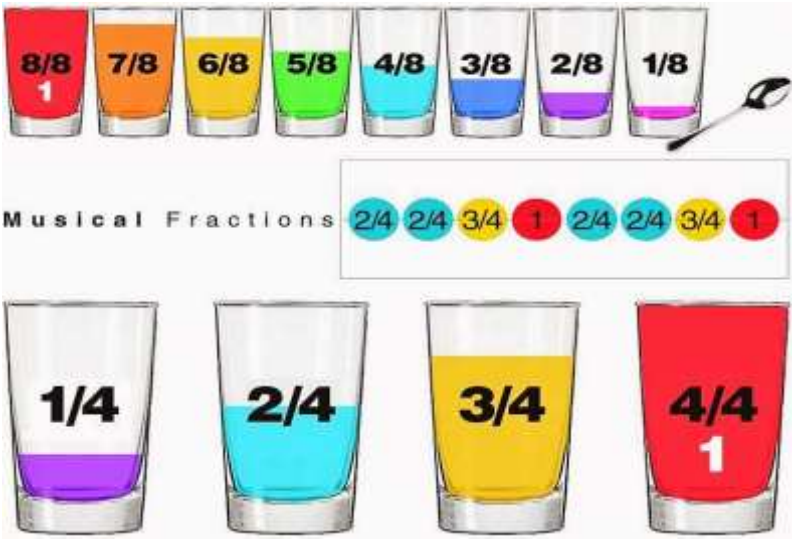


FIGURE 6: AMUSING ACTIVITY EMPLOYING USE OF FRACTIONS

Mathematics kit (NCERT)

In keeping with the spirit of ***'Learning by doing'***, the *National Council of Educational Research & Training* (NCERT), New Delhi has developed **Mathematics kit** for upper primary stage based on some of the concepts from the newly developed NCERT mathematics textbooks. The kit includes various kit items along with a manual for performing activities and playing games. The kit broadly covers the activities in the areas of number system, geometry and mensuration. It helps to motivate the child learn mathematics by getting involved in handling various concrete manipulants *(viz. geoboard, plastic strips, half & full protractor, abacus, dowels, rubber bands, cutouts of different geometrical shapes, fly-screws, counters of different colors, dice numbered 1 to 6 etc.)* in various activities. This is also related to *Multisensory learning***.**

Confucius aptly remarks, ***"I hear, I forget. I see, I remember. I do, I know."***

The Eclecticism is as follows:

- Principle of interest
- Multisensory learning
- Principle of utility
- Innovation
- Motivation
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Perception
- Learning by doing
- Demonstration and Explanation skill
- Aesthetics
- Principle of variety
- Attention
- Affective domain
- Cognitive domain

Tangram (An amusing beauty of mathematics)

It is a Chinese geometrical puzzle consisting of a square cut into seven pieces which can be arranged to make various other shapes. The seven pieces are:

1. 2 large congruent right triangles
2. 1 medium right triangle
3. 2 small congruent right triangles
4. 1 square
5. 1 parallelogram

Of these seven pieces, the parallelogram is unique in that it has no reflection symmetry but only rotational symmetry, and so its mirror image can be obtained only by flipping it over. Thus, it is the only piece that may need to be flipped when forming certain shapes. The mathematics teacher should make the students realize the importance of mathematics ***(geometry)*** and appreciate the beauty ***(affective domain)*** of just 7 puzzle pieces ***(number)*** that result in a large number of amusing figures ***(permutation and combination)*****.** Add to this, the teacher ought to demonstrate the steps of making **(*craft work*)** the tangram puzzle pieces and then instruct **(*explanation*)** the students make ***(psychomotor domain)*** the puzzle pieces on their own ***(learning by doing)*** as well as show **(*illustration*)** them some sample figures made from arranging the 7 pieces in different orders and orientations ***(creation of interest)*** post which the students be given opportunity to make as many thematic figures as they can by applying logical thinking and reasoning ***(cognitive domain).***

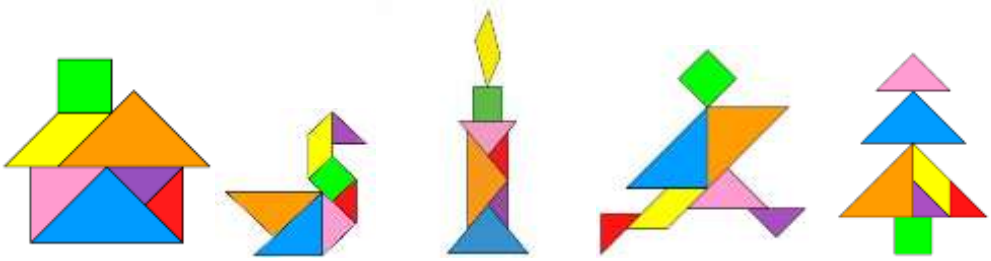


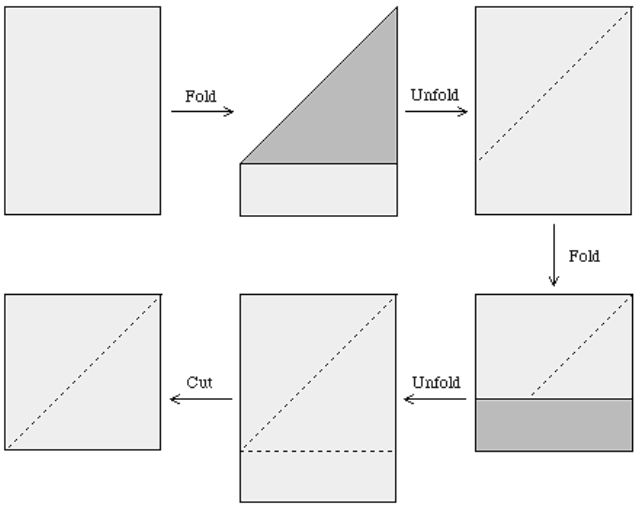
FIGURE 7: TANGRAM SEVEN PUZZLE PIECES MAGIC

Materials required

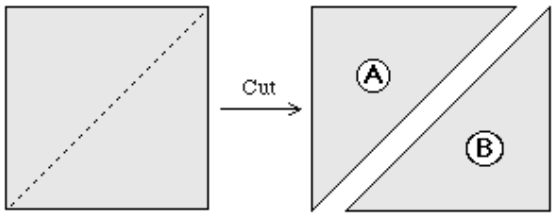
- A rectangular piece of paper suitable for folding
- A pair of scissors
- A ruler (optional)

Steps of making tangram puzzle pieces

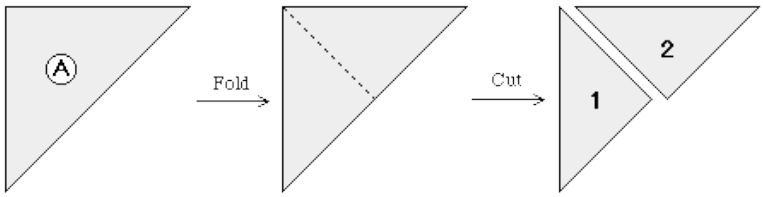
1. Fold a rectangular piece of paper so that a square is formed. Cut off the extra flap.



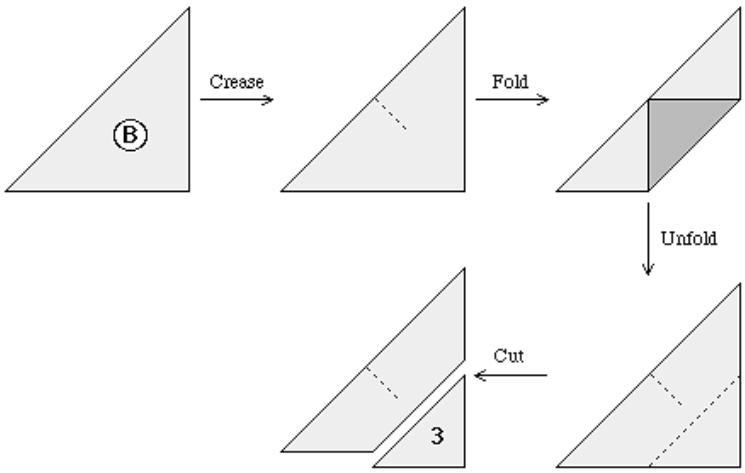
2. Cut the square into two triangles.



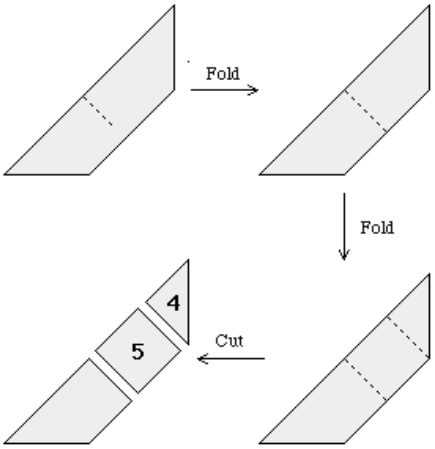
3. Take one triangle and fold it in half. Cut the triangle along the fold into two smaller triangles.



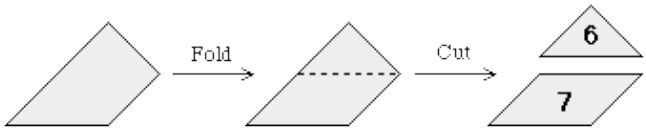
4. Take the other triangle and crease it in the middle. Fold the corner of the triangle opposite the crease and cut.



5. Fold the trapezoid in half and fold again. Cut along both folds.



6. Fold the remaining small trapezoid and cut it in two.



Tangram – It should be used preferably at upper primary level. The eclecticism is as under:

- Principle of interest
- Principle of utility
- Multisensory learning (if taught using multimedia)
- Opposition to bookish knowledge
- Learning by doing
- Motivation & attention
- Innovation
- Social learning
- Demonstration & explanation skill
- Logical thinking

Multiplication by Lattice method – It should be used preferably at upper primary level. The eclecticism is as under:

- Principle of interest
- Principle of utility
- Multisensory learning (if taught using multimedia)
- Opposition to bookish knowledge
- Learning by doing
- Motivation & attention
- Innovation
- Social learning
- Demonstration & explanation skill
- Logical thinking

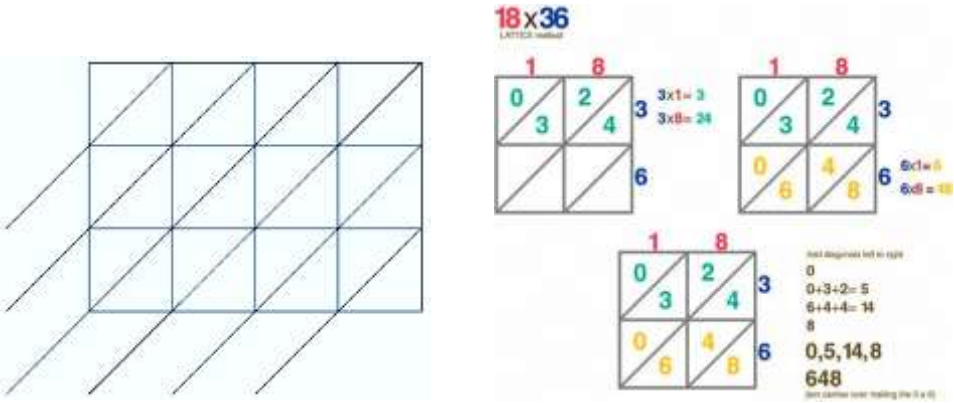


FIGURE 8: LATTICE METHOD OF MULTIPLICATION

IDIOMS BASED ON CARDINAL AND ORDINAL NUMBERS - It should be started from upper primary level onwards. The eclecticism is as under:

- Principle of interest
- Principle of utility
- Multisensory learning (if taught using multimedia)
- Opposition to bookish knowledge
- Motivation & attention
- Innovation
- Social learning
- Correlation of subjects
- Explanation skill

NUMBER IDIOMS (Cardinal Numbers)

- **Catch-22**: a no-win situation
- **At sixes and sevens**: confused
- **A dime a dozen**: cheap and/or plentiful
- **Dressed to the nines**: very well dressed
- **$64,000 question/million-dollar question**: a very important question
- **It takes two to tango:** said of a situation in which two parties are both responsible
- **On cloud nine**: very happy
- **Three R's**: reading, writing, and arithmetic (alluding to the first consonant sound of each word)
- **Twenty-four seven**: all the time, from the count of twenty-four hours and seven days (usually written 24/7 and sometimes extended to 24/7/365 to refer to the number of days in a year)
- **Take five -** take a short break
- **Two peas in a pod**: said of two people who are very similar
- **High-five**: a gesture two people exchange by slapping hands with their arms extended upward
- **Behind the eight-ball**: in a difficult situation (from the pool ball numbered 8 as an obstacle)

NUMBER IDIOMS (Ordinal Numbers)

- **At the eleventh hour**: at a late stage or the last possible moment
- **First come first served :** those who are first to arrive will be the first
- **To be in seventh heaven**: to be very happy
- **5th/Fifth wheel :** someone who has no role , who is not needed
- **4th state :**usually the press/mass- media
- **6th sense :** a special faculty/feeling besides the five senses

Multimedia videos / Animated E-lessons with voice over - These are in consonance with:

- Principle of interest
- Multisensory learning
- Principle of utility
- Innovation
- Motivation and attention
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Illustration + Explanation
- Perception + Aesthetics

FIGURE 9: SCREENSHOTS OF VIDEOS ON VARIOUS TOPICS (Higher secondary level)

(Source - Learnoid)

Logical Correlation of mathematical concepts:

At higher secondary level, logical correlation of different mathematical concepts should be taught to students so as to develop their power of logical thinking. Quicker methods of solving questions based on *time & work, pipes & cisterns, speed, time & distance, mixtures,*

mensuration, profit & loss, ratio, percentage, fractions, simple & compound interest, H.C.F. & L.C.M. etc. by logically employing correlation of concepts should be taught to the students (higher secondary level). This is in consonance of *Principle of Utility,* as this very concept of correlation comes in handy in various competitive examinations. Reasoning and not cramming must be laid stress on.

CORRELATION OF CONCEPTS	
	1) Concept of L.C.M. employed in solving questions based on TIME & WORK, PIPES & CISTERNS.
	2) Concept of RULES OF FRACTION employed in solving questions based on PROFIT & LOSS, SPEED, TIME & DISTANCE.
	3) Concept of RATIO and PROPORTION used in solving questions based on AGES, MIXTURES, SALARY etc.
	4) Concept of ALLIGATION RULE used in solving problems based on MIXTURES.
	5) RULE OF SUCCESSIVE PERCENTAGES used to solve problems based on PROFIT, LOSS & DISCOUNT, MENSURATION, COMPOUND INTEREST.
	6) Concept of MTWE (Men, Time, Work, Efficiency) employed to solve problems based on TIME & WORK.
	7) Concept of PERCENTAGE employed in solving questions based on TIME & WORK, PIPES & CISTERNS, SPEED, TIME & DISTANCE.

FIGURE 10: CORRELATION OF MATHEMATICAL CONCEPTS

Vedic Mathematics – It should be used at Upper Primary/Secondary/Higher secondary level and is related to the following:

- Principle of interest
- Principle of utility
- Innovation
- Motivation
- Attention
- Cultural values
- Logical thinking
- Social learning
- Multisensory learning (ICT)
- Explanation + Illustration skill

In the wake of current scenario, ICT can be used as a supplement to teach Vedic mathematics in the form of PPT presentation, Multimedia videos, E-lesson with voice over (**Multisensory learning**). The teacher should however be a guide on the side.

FIGURE 11: SCREENSHOTS OF VEDIC MATHS MULTIMEDIA VIDEO

(Source - Learnoid)

Multiplication of numbers (ranging from 6 to 10) using the hands – It should be mainly used at lower primary level and is related to the following:

- Principle of interest
- Multisensory learning (If taught using Multimedia)
- Principle of utility
- Innovation
- Motivation
- Demonstration + Explanation skill
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Illustration
- Perception

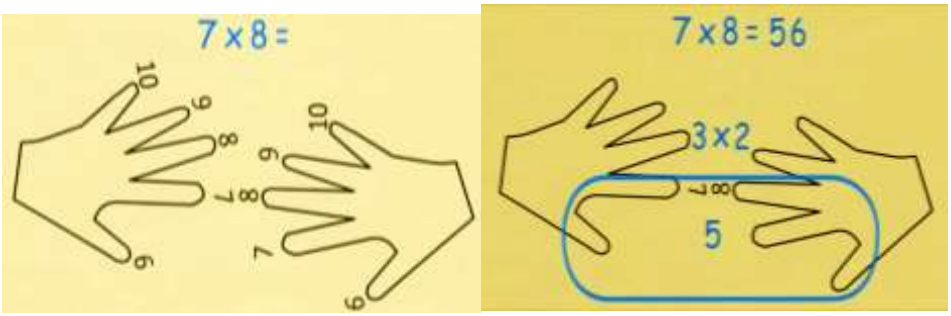


FIGURE 12: SCREENSHOTS OF VEDIC MATHS MULTIMEDIA VIDEO

Multiplication using lines (Chinese method)

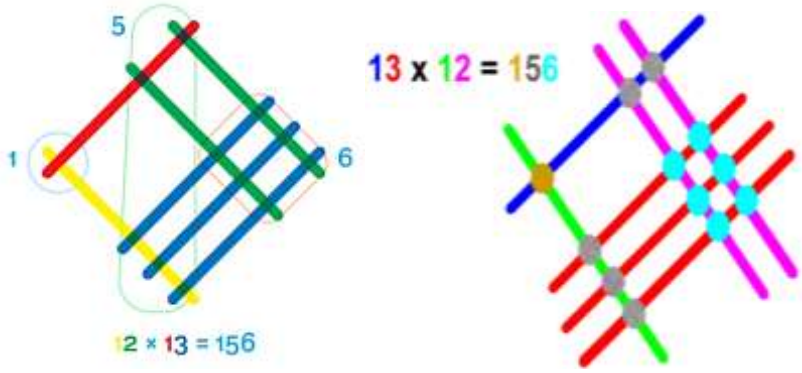


FIGURE 13: MULTIPLICATION USING LINES

Using Application software in Teaching-learning process

Microsoft PowerPoint (application software) can be made use of in the process of teaching-learning process of mathematics provided the teacher employs a right and balanced blend of strategy and pedagogy to achieve pre-determined instructional objectives. If possible, the mathematics teacher ought to teach the basics of PowerPoint pertaining to its use in preparing different types of charts, presentations on mathematics, creating data tables etc. **MS-Excel** can be made use of in employing mathematical operations and functions on the data, preparing charts.

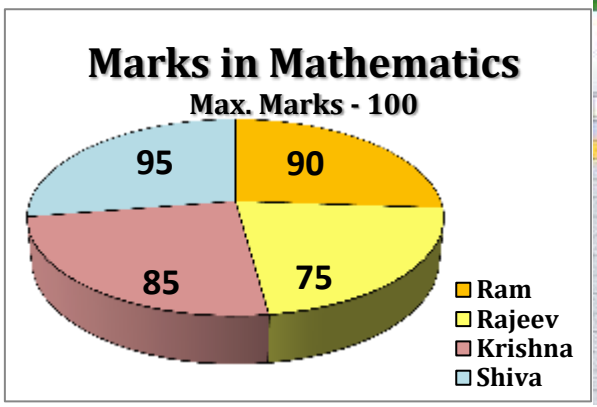
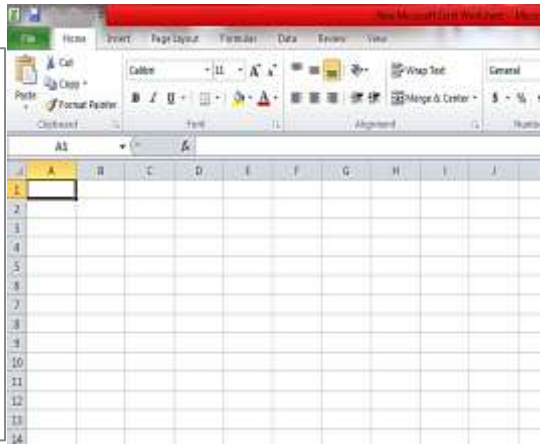


CHART IN POWER POINT



SCREENSHOT OF EXCEL

The Eclecticism is as follows:

- Principle of interest
- Multisensory learning (If taught using Multimedia)
- Principle of utility
- Innovation
- Demonstration + Explanation skill
- Logical thinking
- Social learning
- Opposition to bookish knowledge
- Illustration
- Perception
- Motivation

Anecdotes of Great Indian mathematicians – It should be preferably used from upper primary level onwards. The same applies to eminent Western mathematicians. This is in consonance with:

- Principle of interest
- Multisensory learning (If taught using Multimedia)
- Principle of utility
- Motivation
- Explanation skill

- Social learning
- Opposition to bookish knowledge
- Illustration
- Cultural values
- Affective domain
- Perception

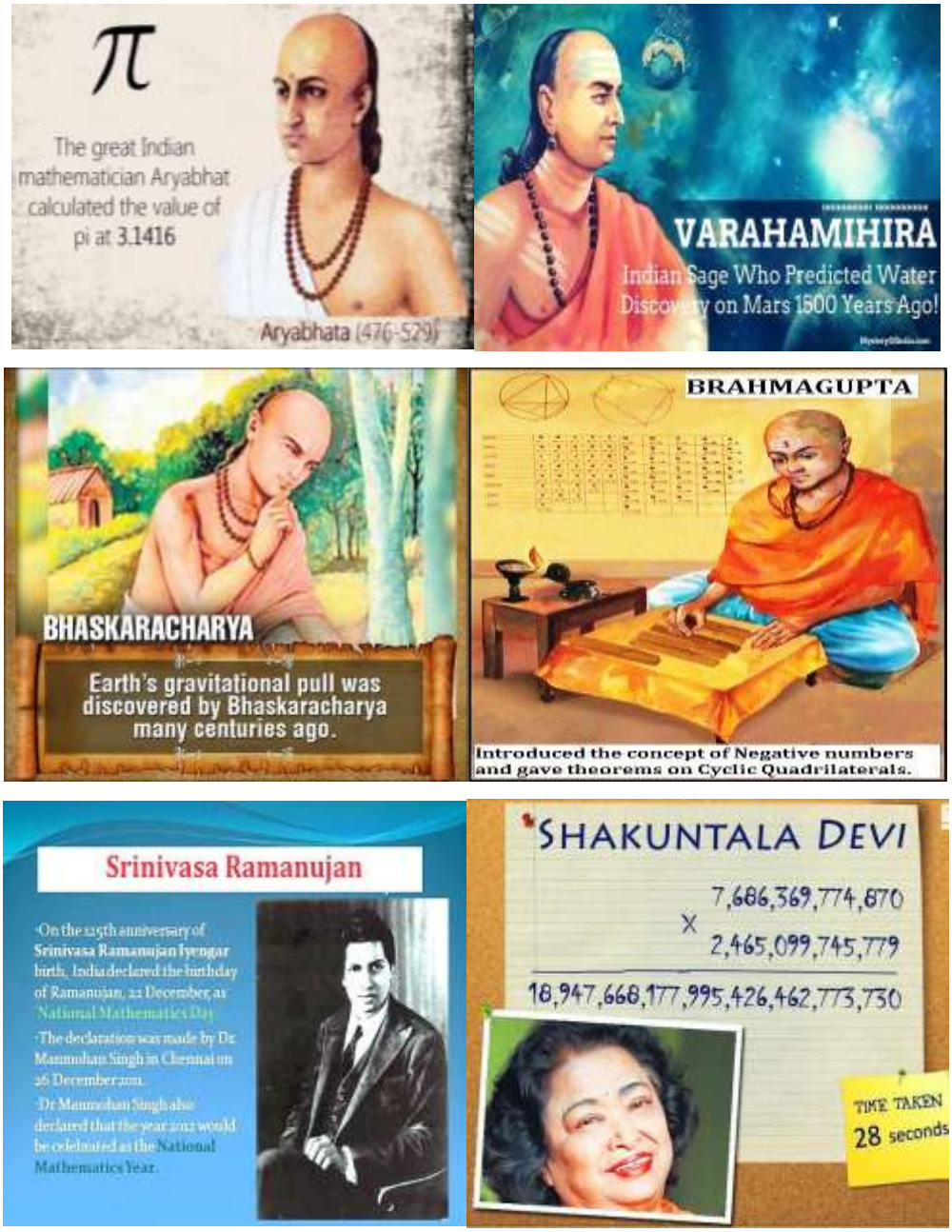


FIGURE 14: GREAT MATHEMATICIANS OF INDIA

ORGANIZING CO-CURRICULAR / EXTRACURRICULAR ACTIVITIES

In addition to routine teaching, co-curricular / extracurricular activities should be organized from time to time so as to infuse learning of mathematics with variety and fun. Some of these activities are:

- Mathematics quiz
- Number games
- Thematic workshops and orientation programmes
- Thematic poster making competition
- Talk shows by motivational speakers (Subject experts)
- Mathematics puzzles
- Mathematics Olympiad

Activity	***Situations related to Activity***
Quiz competition	Mathematical rules, results, formulae, Properties of numbers
Projects	Contribution by Mathematicians (Indian and Western)
Seminars	Applications of Mathematics, talks on Ancient Mathematics etc.
Discussion	Concept of Pi, Presence of Mathematics in real world and nature, significance of mathematics in music
Mathematics Clubs	Preparing models , Paper folding activity (Origami)
Assignments	Solving problems, proving theorems
Field trips	Visit to banks, Insurance companies
Self study	Library, internet, resource centers
Scholarship exams	Mathematics Olympiads, Mathematics Training and Talent Search (MTTS), Advanced Training in Mathematics etc. all funded by NBHM (National Board for Higher Mathematics)

FIGURE 15: SCREENSHOTS OF MATHEMATICS AND SCIENCE OLYMPIAD PAPER

Digital Classroom Providers

In the wake of paradigm shifts in the pedagogy of various school subjects, several digital classroom providers have emerged in the recent times in India viz. ***Educomp, Extramarks, Pearson Education, Classteacher, Smartlec, Radix Smartclass, etc.*** These have revolutionized the concept of teaching and learning.

FIGURE 16: SCREENSHOTS OF SMART CLASSROOM

Courtesy*: **Extramarks™** & **Educomp™***

Some noteworthy suggestions

i) The teacher should resort to the use of innovative techniques of teaching mathematics as and when required. *This should be in keeping with the mental level of the students and the relevance to the curriculum.*

ii) The teacher should try his/her level best to create and maintain the interest of the pupils towards the learning of mathematics. This is in consonance with the ***Law of Effect*** as propounded by Thorndike.

iii) Students be provided ample opportunity for practice after every learning session in the classroom. Mathematical computations can be improved only by ample practice / exercise. This is in consonance with the ***Law of Exercise*** as propounded by Thorndike.

iv) To prevent students fall prey to *Math phobia*, teachers should create an environment in which the pupils do not feel threatened in the learning of mathematics.

v) Students should be given sufficient time to jot down important notes, clarify their doubts (if any) and express their own valuable ideas in the mathematics class.

vi) Workshops related to the use of Innovative techniques (of teaching Mathematics) should be conducted from time to time for the mathematics teachers for equipping them with the efficiency and ease of using the relevant techniques to be employed in the mathematics classroom. Unless the teachers have a good command over the subject and the use of innovative techniques, they won't be able to quench the inquisitive thirst of the students.

vii) The structure and systematic organization of the subject matter plays an important role in learning. The teacher should study the learner's reaction every time in order to see whether the material is organized systematically or not. This is in accordance with the ***Gestalt Theory*** **of learning.**

viii) For developing insight, motivation in the form of cues is also necessary. The teacher should use different techniques in the classroom. This is in accordance with the ***Gestalt Theory*** **of learning.**

ix) The insight of the learner is based upon the past experiences. So in order to develop insight in them, the teacher should relate the previous knowledge with the present knowledge of students by proper lesson planning. This is in consonance with the ***Gestalt Theory*** **of learning.**

x) Use of ***fixing devices*** must be an integral part of the learning of mathematics. This gives confidence to the learners and consequently to the teacher.

xi) The pupils should be given a rich experience of the numbers through a number of useful computations (based on innovative methods) as this will result in the enhancement of their Number sense.

xii) The teacher should not teach at a very fast pace. It is better to teach some part resulting in successful learning than teach a lot with no learning at all. Teaching at a slow pace helps students comprehend the material being taught in a better way.

xiii) The teachers ought to use appealing teaching aids as and when required keeping in mind the various principles of using teaching aids (***Illustration and Demonstration***). For more promising results, teachers can make effective and efficient use of Smart classroom(s) and

other such aids as multimedia videos projection, e-lessons with voice over, PPT presentation projection, YouTube academic repository. This ensures Multisensory learning.

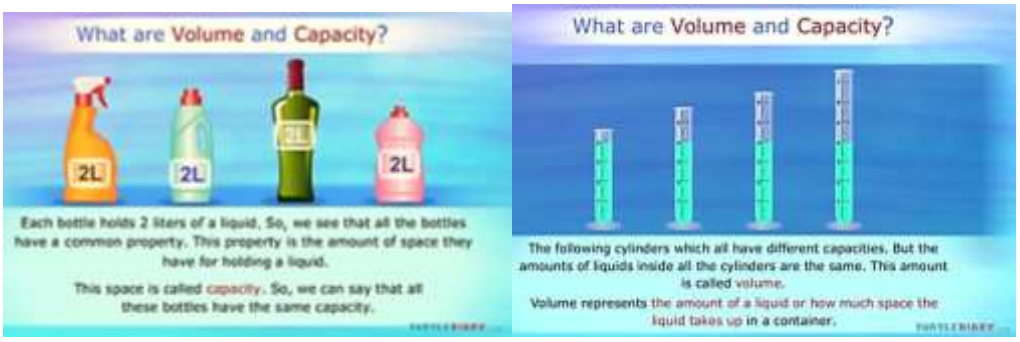


FIGURE 17: CONCEPT OF VOLUME & CAPACITY ILLUSTRATED

xiv) The teacher ought to have a favorable attitude towards the Eclectic tendency. He/she must have an incessant zeal to learn as well as teach, embrace the pedagogical innovations and get adapted to the effective use of technology (ICT) in teaching of mathematics.

Conclusion

It has been rightly said that variety is the spice of life. Even Nature manifests itself in the form of mathematics and variety. Change is the law of Nature. The 21st century has been witnessing paradigm shifts in pedagogy of mathematics especially at school level. Avant-gardism in teaching of mathematics is the need of the hour. While teaching mathematics one should use the teaching methods, strategies and pedagogic resources that cater to the needs of the class which is a heterogeneous blend of students and are much more fruitful in gaining adequate responses from the students. The nature and quality of instructional material, the presentation of content, the pedagogic skills and philosophy of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics. The present era is the Competitive Era. Competitive Examinations have taken the world by storm. And there is no denying the fact that Mathematics has become the basis of most of the competitions, viz. Bank probationary officer exam, Bank clerical exam, L.I.C. (ADO) exam, MBA entrance exam, Hotel Management entrance exam and the likes. The spectrum of the questions usually asked in these so called competitions ranges from upper primary level to secondary level. Quantitative and numerical ability form the core of these competitions. Those who are very poor in basic mathematical concepts or those from non-mathematical background find it tougher to get through these exams, with the result that they resort to haphazard methods and techniques, in order to get through.

It won't be an exaggeration to say that, the way Mathematics is usually presented before the students and taught today in most of the average schools, makes them a kind of 'slave' before this king (mathematics). This feeling develops a kind of dislike in the students towards mathematics and they start fearing mathematics, a phenomenon known as ***'Mathsphobia'***. The consequence of all this is that the student lags behind in the mastery of basic mathematical concepts. *What needs to be said here is that the basic mathematical concepts should be made clear to the students during their school stage. It is here when the use of innovative mathematical techniques comes in handy. These help in improving mathematical skills of a child, enhancing confidence building, providing sense of achievement, problem solving capability, creativity, concentration and mental endurance. Besides this, innovations also help develop interest and attention of the pupils towards learning mathematics.* Avant-gardism in pedagogy of mathematics is the need of the hour. Most of the teachers of mathematics keep in mind only ***cognitive domain*** while teaching mathematics and neglecting ***affective domain*** and ***psychomotor domain***. In fact, the teacher must make every sincere and fruitful endeavor in creating interest in and a favorable attitude towards learning of mathematics, especially at school level. A spark of interest may get fanned into a flame of enthusiasm (***affective domain)***. In addition to this, laboratory work or other valuable and activity work in mathematics must also be laid stress on (***psychomotor domain***). Suffice it to say, the mathematics teacher ought to try his / her best to ensure a balanced blend of all the domains of learning. Last but not least, mathematics at all levels must be taught in its true spirit keeping into consideration the different aims of teaching mathematics.

References

Ramani, P. & Patadia, H. Computer assisted instruction in teaching of mathematics. IOSR Journal of Humanities and Social sciences. Vol. 2, Issue 1(Sep-Oct. 2012), pp. 39-42. Retrieved July 15, 2017 from http://www.iosrjournals.org/iosr-jhss/papers/Vol2-issue1/G0213942.pdf?id=5639

Ogochukvu, N.V. (July 2010) Enhancing students interest in mathematics via multimedia presentation. African Journal of Mathematics and Computer Science Research Vol. 3(7), pp. 107-113. Retrieved July 21, 2017 from http://www.academicjournals.org/AJMCSR

Khongji, P. & Nongbsap, W. Some innovations in teaching of Mathematics. International Journal of Science & Research (IJSR). Vol. 4, Issue 7 (July 2015), pp. 1345-1349 Retrieved August 10, 2017 fromhttp://www.ijsr.net/archive/v4i7/SUB156635.pdf

http://nime.hbcse.tifr.res.in/articles/09_Rakhi_Banerjee.pdf

Tangram. Retrieved August 26, 2017 from https://en.wikipedia.org/wiki/Tangram

Scavo, T. Constructing your own set of Tangrams. Retrieved August 26, 2017 from http://mathforum.org/trscavo/tangrams/construct.html