

MEANING, NATURE AND SCOPE OF MATHEMATICS

Meaning of Mathematics

Mathematics is a systematized, organized and exact branch of science. It is the study of quantitative and qualitative aspects of the whole universe. It is the branch of science that deals with the study of numbers, notations, quantities, measurements etc., and how they effect each other.

Mathematics is often abbreviated maths (British English) or Math (American

English). The word 'mathematics' comes from the Greek word (máthema) which means science, knowledge or learning: mathematikós (mathematikós) means fond of learning. The major disciplines within mathematics first arose out of the need to do calculations in commerce, to measure land and to predict astronomical events. The ancient Hindus called it 'Ganita' meaning "there by the science of calculations". Mathematics deals with relationship between magnitudes of quantitative and qualitative facts. Mathematics is the numerative and calculative part of human life and knowledge. It helps the person to give an exact interpretation to his ideas and to

reach on certain conclusions.

Teaching of Mathematics

Bhargavas Standard Illustrated Dictionary "Mathematics is the science of

Space and number." Webster's New world Dictionary defines mathematics as the "Science dealing with quantities, forms etc. and their relationships by the use of numbers and symbols." Locke "Mathematics is a way to settle in the mind a habit of reasoning."

Roger Bacon "Mathematics is the gate and key of the sciences..... Neglect

Of mathematics work injury to all knowledge, since who is ignorant of it cannot

Know the other sciences or the things of the world. And what is worse, men who

Are thus ignorant are unable to perceive their own ignorance and so do not seek a

Remedy.”

Galileo, “Mathematics is the language in which God has written the universe.” Galileo appreciated, “The great book of nature can be read only by those who know the language in which it has written. And this language is mathematics.”

Comte defined mathematics as “the science of indirect measurement.” Lindsay believed that “Mathematics is the language of physical sciences and certainly no more marvellous language was ever created by the mind of man.”

Richard and Herbt “Mathematics is taken as a chest filled up with so many valuable tools, concerning with the operations like measuring, weighing, counting etc. and helps in proper understanding of nature’s work and complicated problems of life by converting them into its language of signs and symbols.”

Gauss Stated “Mathematics is the queen of sciences and arithmetic is the

Queen of mathematics.”

Mathematics, therefore, is the branch of science that deals with the study of numbers, notations, quantities, measurements etc. and how they effect each other. Mathematics empowers us to understand the information loaded world in which we live, in a systematic and organized manner. NPE (1988) stated, “Mathematics should be visualized as the vehicle to train a child to think, reason, analyse and to articulate logically.”

1.3 NATURE OF MATHEMATICS

The nature of any discipline has significant impact on its pedagogy. Mathematics reveals hidden patterns that help us to understand the world around us. Mathematics is the subject which provides an

opportunity for the training of the mind to close thinking, stirring up a sleeping and unstructured spirit. Its nature can be made explicit by analysing the chief characteristics of mathematics:

1. A Study of patterns and order: Mathematics is a study of patterns and order dealing with numbers, geometric objects, forms, algorithms and change etc. 2. Mathematics as language: Mathematics has its own language and symbols
2. Meaning, Nature and Scope of Mathematics
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6. That cuts short the lengthy statements and puts them briefly, accurately and in the exact form. This language must be acquired just like any other language and there is need for translating this language into one's own mother tongue. Almost all the mathematical statements, relations and operations are expressed using mathematical symbols. E.g. +, -, x, %, <, >, E, S, 2, Σ, |, U, etc. Math language and symbols can be used to state different laws and formulas e.g. $a+b=b+a$, $a \cdot b = b \cdot a$ $\forall a, b \in \mathbb{R}$ (It means the addition and multiplication of two real numbers is independent of the order in which they are combined.)
- 7.
8. Mathematics is...
- 9.
10. Order
- 11.
12. Theoretical
- 13.
14. Practical
- 15.
16. An Art
- 17.
18. A Language
- 19.
20. Process of Thinking
- 21.
22. 3. Mathematics as an exact science: Mathematics is an exact science which involves high cognitive abilities and powers. According to Courant, "Mathematics as an expression of the human mind reflects the active will, the contemplative A science where laws. Reason and the desire for aesthetic perfection. Its basic elements are logic and Capable of accurate intuition, analysis and construction, generality and individuality. Quantitative
- 23.
24. Are
- 25.
26. 4. Pure and applied mathematics: Mathematics is of two types pure and applied. Pure mathematics deals with theories and principles without regard to their application to concrete things while Applied Mathematics is the practical side of pure mathematics. Applied

mathematics tries to model, predict and "explain things in the real world e.g. one area of applied mathematics is fluid mechanics which analyses how fluids are affected by forces. Other examples of applied mathematics are statistics or probability theory. On the other hand, Pure mathematics is separate from the physical world. It solves problems, find facts and answer questions that don't depend on the world around us, but on the rules of maths itself.

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28. 5. Helps in interpretations and results: Mathematics helps in drawing conclusions and interpreting various ideas and themes. Its conclusions are'

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Certain, well graded and from simple to complex. 6. Conversion of abstract into concrete form: Mathematics is the tool specially suited for dealing with abstract concept of any kind. Mathematics

Involves conversion of abstract concepts into concrete form. 7. Helps in solving problems: Mathematics helps in solving the problems of our life and disclosing the realm of nature. According to Benjamin Franklin, "What science can there be more noble, more excellent, more useful for men, more admirable, high and demonstrative than that of Mathematics."

8. Intellectual development: Mathematics provides opportunity for the intellectual gymnastic of man's inherent powers. It can be treated as an intellectual game with its own rules and abstract concepts. From this viewpoint, mathematics is mainly a matter of puzzles, paradoxes and problem solving-a sort of healthy mental exercise.

9. Correlated with science: Mathematics as an applied science is helpful for the expression of other sciences e.g. useful in Chemistry, Physics, Biology. Different concepts can be taught in correlation with concepts of mathematics. 10. Universal language: Mathematics is a universal language. It remains same in the whole universe. It can be verified at any time, at any place.

11. Number of characteristics: Mathematics has number of characteristics e.g. accuracy, certainty of results, originality, exactness. In mathematics the results are either right or wrong, accepted or rejected. There is no midway possible between right and wrong. 12. Understanding of culture and civilization: Mathematics is the embodiment

Of aesthetic treasure. Mathematics helps in the development of sense of

Appreciation among children. Maths helps in clear understanding of the culture

And development of our civilization. 13. Self-evaluation: Mathematics helps in self-evaluation. This characteristics helps in the development of sense of appreciation, self-confidence and self- reliance.

14. Clarity of thoughts: Mathematics does not leave any doubt in the mind of the learner about theories, principles, concepts etc. 15. Training of senses: Mathematical knowledge is based on our sense organs.

That's why it is exact and reliable. 16. Development of scientific attitude: It is not only useful for different branches of science but also helps in its progress and organization. So it helps in developing scientific attitude among students.

17. Structure of mathematics: To understand more about nature of mathematics, we should perceive relationships between its constituents. We should know about "undefined terms and then use these undefined terms to 'define' new "terms and then develop axioms' using these terms that form the foundations of mathematical theory. By applying inductive reasoning, one can arrive at generalisations known as propositions. We established the truth of these

Albert Einstein God does not care about our mathematical difficulties. He integrates empirically...

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VALUES OF MATHEMATICS

Values plays an important role in teaching of any subject. These are the values that help the educationist to determine the objectives of teaching of a particular subject. It helps in convincing about the real purpose of teaching the subject. It influences teacher's and students' behaviour and attitudes towards the subject. As someone says Mathematics may not teach us how to add love or hate minus. But it gives us every reason to hope that every problem has a solution." With the studies of mathematics we can inculcate so many values. Some of the values of mathematics

Are:

Practical or Utilitarian value

Cultural value Disciplinary value

Social value

Moral value

Intellectual value

Aesthetic value

Recreational value

International value Vocational value

5.1 PRACTICAL OR UTILITARIAN VALUE

Maths is closely related with everyday life. Its importance is next to our mother tongue. In the words of Young, "Whenever we turn in these days of iron, steam and electricity, we find that mathematics has been the pioneer and guarantees the results. Were its backbone removed, our material civilization would inevitably collapse". Mathematics is the abstract key which turns the lock of the physical universe.

One can survive without reading and writing but he cannot lead a successful life without the learning of mathematical concepts like number system, counting, four fundamental rules, estimation etc. Any person ignorant of mathematics will be at the mercy of others and will be easily cheated. Profit and Loss, Ratio and Proportions, Percentage are some basic concepts which are useful in daily life situations.

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Basic competence in mathematics helps to understand and interpret information that appear in media e.g. daily newspapers contain lot of news item pertaining to data relating to population growth rate, infant mortality rate, growth, rain and temperature, rate of industrial growth, agricultural production etc. To measure is to know with the help of mathematical numbers, we accumulate our economic evaluations like per capita Income so it helps us to evaluate whether our economy is diminishing or upgrading. If you cannot measure it, you cannot improve it.

We use mathematics from morning till evening. From a coolie to finance minister. Everybody uses mathematics. Even clerk, carpenter, even an housewife all uses concepts of mathematics. All sections of the societies doing various occupations such as scientists, engineers, managers, Cartographers, meteorologists, geologists, businessmen, craftsmen, technicians, carpenters all use mathematics.

Mathematics facts have same validity and truthfulness in any culture and civilization. Mathematics is correlated with many subjects like Chemistry, Physics, Psychology, Economics and many more. Bacon has rightly said, "Mathematics is the gate and key of the sciences". Mathematics forms the basis for all scientific and technological advancement. Our modern civilization has been built up by the use of calculus and higher mathematics. If it were not for the use of Calculus and Differential Equations the construction of sky scrapers, bridges and subways, railway line, telephones and telegraphic cables etc. would not have been possible.

Mathematics is equally ingrained in nature. Creation of nature and mathematics are closely related. The sun, earth, stars and our planets are certain geometrical shapes. Even the simplest phenomena of nature cannot be understood without sound knowledge of mathematics. Frobel has rightly said, "Mathematics stands forth as that which unites, mediates between man and nature, inner and outer world, thought and perception, as no other subject does."

5.2 CULTURAL VALUE

The essence of culture of a civil society is in the mode of living of its members. The culture reflects how they live, behave, dress, eat, drink, rear their children and maintain their social relationship. Mathematics is an essential part of our culture and deserves a place in the school curriculum. One can enjoy its elegance and beauty like Fine Arts. Hogben has rightly said, Mathematics is the mirror of civilization". For the lovers of maths, there is a beauty, fun and joy in problem solving and mathematics provides a window for looking at the world. When we understand the problem then it is easy for us to solve problems one by one. It makes us happy and creates the feeling of desperation for mathematics which can be inculcated only by math teachers. As we look in our ancient history, we see the relationship between students and its teachers resembles with guru and his child. From that era cultural values deponent. If we see the history of mathematics, it portrays the culture and civilization of a nation and vice-versa. The progress of our civilization is mainly due to the progress of various (Fax)

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Occupations such as agriculture, engineering, industry, medicine, navigation, rail road

Building etc. These occupations build up culture. Mathematics makes direct or indirect contribution to the development of all occupations. Mathematics also helps in the preservation and transmission of our cultural traditions. Books are the main sources of information depicting the past performances of one's race and culture. By studying these books, mathematics teachers can transmit the cultural knowledge to the coming generation. Therefore the changes in the modes of living and there by the culture has been continuously influenced by the

Progress in Mathematics. The history of mathematics shows how mathematics has influenced civilization and culture at a particular time. Progress in mathematics of Greeks and Egyptians in the past led to their cultural advancement and the progress of their civilization. Mathematics is a pivot for cultural arts such as music, fine arts, poetry and painting Perhaps that is why the Greeks, who were the greatest geometers of their times, were quite adept in fine arts. In the words of J.W.A. Young, "were its backbone removed our material civilization would inevitably collapse." Way

5.3 DISCIPLINARY VALUE Mathemating

Problemang The habit of carefully analysing the situation before decision making could be very helpful in complex life situations where decision making becomes very difficult As mathematics deals with facts, which are accurate and precise, there is no scope for uncertainty or vagueness. This makes the mind of the learner more broad and open. He enjoys a universal acceptance, without any barriers of countries, languages, climate etc. The knowledge of mathematics helps the members of the society to organize his ideas more logically and express his thoughts more accurately and explicitly. It trains the members not to take things for granted or rely on tradition or authority but rely on reasoning.

"Mathematics is a way to settle in the mind a habit of reasoning." – Locke Mathematics is an exact and definite science. Every student of mathematics has to reason properly without any prejudices or unnecessary biases. Reasoning in mathematics has the characteristics of simplicity, accuracy, objectivity, originality etc. Besides reasoning, mathematics has the following disciplinary values:

- (a) Development of the power of concentration: Concentration of mind can be learnt by the study of mathematics.
- (b) Development of inventive faculty: The solving of a difficult problem in mathematics is just like making a discovery.
- (c) Will Power: Mathematics develops patience and perseverance in the students. It strengthens their will power.

5.4 SOCIAL VALUE

Mathematics helps in the proper organization and maintenance of a fruitful social structure. It plays an important role in the proper settling of social institutions.

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(such as banks, co-operatives, railways, post offices, insurance companies, industries, transports, navigation. Traders

Effective business transactions, exports and import, trade and commerce and communication cannot take place without mathematics. E.g. without knowing the values of numbers, it is not easy for traders and investors for trading. They accumulate their profit, losses and stock terms according to the numbers. So mathematics with their numbers value innate social culture. As all the business or all terms of business depend on mathematics. Thus smooth and orderly functioning of the civil society is ensured by mathematics. "The progress and the improvement of mathematics are linked with the Share Marta

Prosperity of the state." – Napoleon

The success of an individual in a society depends on how well he is able to become a part of the society and what contributions he can make towards the progress of the society and how well he can be benefited by the society. Mathematics is the backbone of our social system because:

(i). In order to organize, systematise and even regularize our changing society, we have to seek help from many facts and figures offered by the study of mathematics. E.g. the knowledge about population explosion in India comes from the reports prepared by the Registrar-General, Census Operations, Govt. of India.

(ii) Our society has high regard for the understanding of mathematics which provides processes, relationships, inter-disciplinary approaches. When mathematics makes its contribution in the advancement of science and technology, society draws huge benefits. Its contribution is evident in the

Field of atomic energy, space research and satellites etc.

(iii) Mathematics rests on originality and creativity, it certainly develops a scientific outlook for the observation of nature and our changing society. India has become the only country ever to reach the red planet on their first attempt. It took 10 months to get there and costs \$75 million dollars.

5.5 MORAL VALUE

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The study of mathematics helps an individual in his character formation in many ways. It develops in him a proper attitude, as there is no space for prejudiced feeling, biased outlook, discrimination and irrational thinking.

It aids him in objective analysis, correct reasoning, valid conclusions and impartial judgement. These moral values inculcated in the individual, help him to become a successful member of his society. "Work must be either right or wrong the mistake must be discovered."

The qualities like truthfulness, honesty, purity of thoughts and cleanliness, forgiving, justice, punctuality, duty-boundness, patience, self-control, self-respect, self confidence, respect for others are inculcated by doing and studying mathematics.

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“Mathematics does furnish the power for deliberate thought and accurate statement and to speak the truth....gossip, flattery, slander, deceit-all speak from a slovenly mind that has not been trained by mathematics.” – Dutton

5.6 INTELLECTUAL VALUE

Mathematics is created by human beings. It was not carved on tablets and handed down by God. The most brilliant members of our species have exerted and continue to exert, the noblest effort to give us this mathematics. Until Newton and Leibnitz finally uncovered it for us, no human eyes had ever gazed upon it. The study of mathematics helps us to develop all our intellectual powers like power of imagination, memorization, observation, invention, concentration, originality, creativity, logical thinking and systematized reasoning. Every problem in mathematics is an open challenge to the faculties of the mind and a systematic and organized exercise for one’s mental health. There is no other subject in the curriculum like mathematics that makes students’ brain active. Mathematics is like a whetstone and by its study one learns to think distinctly,

Consecutively and carefully.”- Hubsch

“Mathematics is the subject that provides an opportunity for training the mind, to close thinking, stirring up a sleeping and unstructured spirit.”-Plato Mathematics develops our intellectual abilities. It develops all the following domains of our mind:

Intellectual Value

Cognitive

Affective

Conative

“Mathematics is primarily taught on account of the mental training it affords

And only secondarily on account of the knowledge of facts it imparts.”-Schultze

5.7 AESTHETIC VALUE

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- poetry Painting, muse

We study mathematics because it is one of the best disciplines known to man. One of the most compelling aesthetic feature of mathematics is its refined austerity. Its unadorned gracefulness is unique among the arts. Infact, part of the very essence of mathematics is its precision. As according to Jerry P. King, “Mathematics is precise or it is nothing.” Mathematics is enriched with its aesthetic appeal. The elegance and gracefulness of mathematical relationships touches our emotions, Likewise the art of mathematics touches our soul as poetry touches the soul of the poet much like music and art can reach inside the psyche and make us feel truly alive. We encourage children to read for enjoyment, yet we never encourage them to do mathematics. The difference between the poet and the mathematician is that Fax)

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The poets tries to get his head into the heavens while the mathematician tries to get the heaven into his head. When we go through the biographies of great mathematicians, we see that almost all of them were attracted to this divine discipline by realizing its beauty. They were not studying of mathematics, but worshipping it. The fineness, the harmony, the symmetry everything adds to its beauty. Music or art are simply the outcome of this eternal beauty. The beauty of Leonardo da Vinci's drawing of human body emphasised ratio and proportion. Even we can see aesthetic value in Egyptian pyramids. "Music is a hidden exercise in arithmetic of a mind unconscious of dealing

With numbers." – Libnitz "Mathematics sharpens the minds of the people in the same way as some stone sharpens the tool."-Hubsch

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5.8 RECREATIONAL VALUE

Mathematics gives a variety of recreational opportunities to grown up people as well as children. Mathematics entertains people. Various puzzles, games, riddles, etc. of mathematics gives people recreation and entertainment. These activities sharpens the minds of the students, frees them from the prejudice and superstitions. We should encourage children to read for enjoyment yet we never encourage them to do mathematics for fun. These activities help students in their problem solving, reflective learning and many more skills for enjoyment. Every child is an artist, the problem is how to remain an artist even after he or she has grown up.

The modern video-computer games are all developed through proper use of mathematics. The significance of this type of recreation is that, this enables one to develop his imagination, sharpen his intellect and draw satisfaction to his mind. The human brain is an organ that improves with exercise. The study of mathematics thus gives sufficient exercise to the brain of an individual. It makes the person free from stress level when he engages himself in that activities. When a student indulge himself in these activities it creates fun in his mind as well as positive attitude towards mathematics 2

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5.9 INTERNATIONAL VALUE

Mathematics is a universal language because the principles and foundations of mathematics are same all over the world e.g. $10+10= 20$. It is same no matter where you are in the world. A circle is always a circle and its circumference is always calculated in same way. Mathematics has international value in the sense that is helpful in creating international understanding and brotherhood. Its history reveals that there was a time when our ancestors were not able to count even more than one. So, the history and benevolent of love started from our epic times. Therefore, as far as the potential of knowledge and intellectual development is concerned we all human beings-the inhabitants of all countries, the followers of all the religions and member of all the races are the same and therefore, it is unwise to think superior or inferior to any of the other race, religion, culture or nation.

5.10 VOCATIONAL VALUE

The main aim of education is to help the children to earn their living and to make them independent. To achieve this aim, mathematics plays an important role. At present the vocational value of engineering, technology, management, information technology has become more important and prestigious. The knowledge and proficiency in these vocations is possible only through mathematics. E.g. an architect can not become a good designer without the study of geometry and measurement. Every business and vocation involves gain and loss, percentage, buying and selling, purchase, interests of all kinds, loans, shares etc which can be properly managed if we have sound knowledge of mathematics. Therefore, it can be said that each and every person needs mathematical knowledge for their earnings and livelihood. Vocational value is also called bread and butter value. That's why a student of mathematics who has sound knowledge, can earn maximum and be proficient in his profession. Someone has rightly said, "Mathematics is a great motivator for all humans. Because its careers starts with zero but it never ends.

Conclusion

Learning by doing

Psychological Value In the end, we can say that mathematics plays a pivot role in our life. It emerges with practical value of mathematics. It teaches us how to play with numbers. It commensurates us with the recreational value, vocational value and international value, moral value, social value and many more. So that we come to know that mathematics have a cumbersome and vast procedure. It is not only related with numbers but it also introduces us with many more values.