

STEM Education: why math is so important?

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Abstract- Elementary mathematics was a part of the education system in the most of the ancient civilization. This formal education was only available to male children with sufficiently high status, wealth and caste. But today's, India's education system is often cited as one of the main contribution to the economic rise in India. Mathematic education is a form of critical thinking skills in order to prepare a student for modern society. Mathematics is also an interdisciplinary language and tool which helps to represent communicate about and solve problems in many disciplines. Mathematics provides a powerful and universal language related to real life context. A child uses mathematical language when communicating ideas, reasoning thoughts, and finding both orally and in writing. Mathematics creates an individual to possess an all-round development for a better world. Mathematics is said to be the queen of Science.

Index terms- STEM (Science, Mathematics, Engineering and Mathematics)

I. INTRODUCTION

Albert Einstein once said, "Pure Mathematics in its way a poetry of logical ideas. Mathematics is the most beautiful and most powerful creation of human spirit". Mathematics is in every occupation, every activity we do in our life. Math plays an important role for students in problem solving skills. Math benefits a child in learning and understanding. Different levels of maths are taught at different ages and in somewhat different sequences in different countries [1]. Throughout most of History, standards for mathematic education were set locally, by schools, teacher depending on the levels of the pupil. STEM is an approach to learning and development of a child in areas of Science, Technology, Engineering and Mathematics. STEM education focus on Math, and it creates critical thinkers, helps to increases

scientific literacy and enables a child to be innovators using various modern technology.

Play is fun and important part of children's learning and development. Through play, introduce the child to STEM education. It is said a curriculum that is STEM based help students to learn real situation of life, by using Maths and Science. Both these subjects are interesting and help in tackling the new challenges with an eco-friendly environment where students can take a deeper dive into understanding, discovering, learning mathematical problems at their own pace. In today's world of education, if STEM education is used [2], by parents, teachers then, it will help a child to connect, select and make proper decisions for right career and have a bright future.

II. STEM INITIATIVES

STEM skills must begin in every toddlers where activity is like asking questions, working together with parents, playing and solving creative game puzzles. Questioning encourages a child to expand their thoughts rather than giving them a Yes or NO answer [3]. Toddlers have interest to discover new things and explore new challenges. Every child has a keen curiosity in them. India too follows STEM education where we do have various APPS like Byju's Learning, Vedic Mathematics, Abacus Learning and many more.

Today's students are the leaders of tomorrow. It is clear that STEM field influences virtually every component of our everyday life [4]. If students take occupation in STEM related careers, then there will be fast growing development and there will be the greatest potential for job growth. This is the best way to ensure that students are exposed to the right educational career. Students are extremely curious

and impressionable, and to keep spark an everlasting desire.

III. AIM

Teaching mathematics well is an important component of a comprehensive STEM program. The aim of teaching maths at a very tender age is to permeate maths learning in our day to day activities [5]. The experience of learning maths for children during their formative years is extremely important. We must foster a natural and curious environment for learning maths through play way method.

STEM aims at appreciating the usefulness, power and beauty mathematics. Children must enjoy, develop patience and persistence when solving problems [6]. Every child must develop the knowledge, skills and attitudes which are necessary to pursue further studies in mathematics. Mathematics also aims at developing critical appreciation of the use of information and communication technology, it helps to have better analytically and reasoning abilities. Mathematics uses curiosity also use inductive and deductive reasoning which are always a part of problem solving [7].

IV. OBJECTIVES

Mathematics education has attempted to achieve a variety of different objectives in different cultures and countries. Elementary mathematics is taught using STEM education. In the initial stages, maths is taught at a greater depth using fewer topics [8]. This helps in systematic reasoning in define the feature of mathematics. Through the use of reasoning one must recognize, evaluate and select various STEM learning activities[9].

Stem focuses on things like curiosity, applying skills in real world situations and fostering creativity and critical thinking in addition to its core subjects. The main objectives of Mathematics is as follows:

A) Knowledge and Understanding:

Knowledge and understanding is the driving force in rapidly changing globalized economy and society. Mathematics is a subject that inspires young minds to evolve and plays an impact on an individual's mind-set. They are the fundamental to studying mathematics and form the base from which a child can explore concepts and develop problem-solving

skills [11]. The students should be able to grasp the five branches of Mathematics:

- a. Number
- b. Algebra
- c. Geometry
- d. Trigonometry
- e. Statistics and Probability.

B) Investigating Patterns:

It allows students to experience the excitement and satisfaction of mathematical discovery. It gives an opportunity to apply math knowledge and various techniques to solve problem. Investigating patterns helps in recognizing mathematical patterns, using general rules and drawing conclusion consistent with findings [12].

C) Communication in Mathematics:

Students should be able to communicate ideas using appropriate mathematical language (notification, symbols, Terminology) in both oral and written explanation. Students are encourage to use ITC tools to enhance communication of mathematical ideas. ITC tools can include: screenshots: graphing: spreadsheet: database: drawing: word processing software.

D) Reflection of Mathematics:

Students from middle school are encouraged to reflect upon their findings and problem-solving processes. It explains whether the results make sense, explain the importance of their findings and suggest improvements to the methods when necessary. Students are required to share their thinking with teachers and peers to examine different problem solving strategies.

V. STEM LEARNING POTENTIAL



Figure1: STEM learning potentials

Cognitive skills is simple but effective ways to some great brain ideas. If teaching is done using technology then there is a profound impact on students motivation and classroom behaviour, tutors must encourage students to work together using the three hour method and must have inculcate observational learning which should be associated between the events that occur together among students shown in figure2. A child develops his own way of learning. Learning can be flexible where a child is taught in traditional classrooms, online and the child gets his chance for interaction as per figure1 [13].

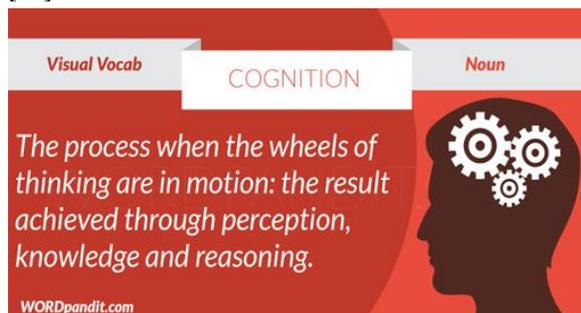


Figure2: Cognitive process [5]

Cognitive skills trains the brain in many ways:

- Helps to improve memory.
- Focuses on logical thinking.
- Teaches to gain attention through meditation.
- Acquirer knowledge through visual processing.
- Understanding the processing speed of today’s life.

VI. OBSERVATIONS

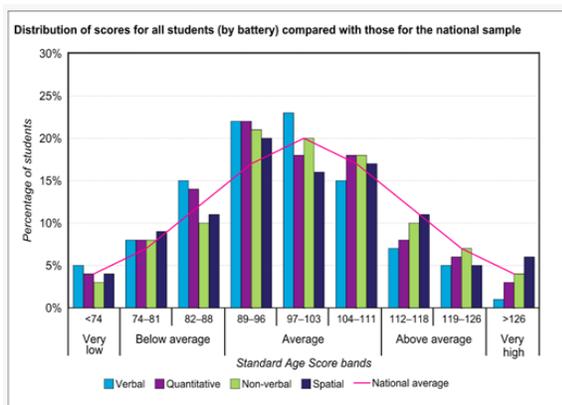


Figure3: Graph on aptitude of students

Quant aptitude is the most requisite for clearing competitive exams. Quantitative aptitude includes

related to logic and expressions where numerical ability relates to number. Quantitative contains numerical ability plus logical ability bases questions and a child needs to manage the numbers fast with right logic. Verbal ability is related to words, sounds and speaking, while non-verbal communication is related to measures the ability to analyse and evaluate written material. It requires to read, understand passages and answer in few minutes [14].

Spatial intelligence is an ability to comprehend 3D images and shapes. It refers to visual thinking. It deals with multiple intelligence and the ability to visualize with the mind’s eye. The primary function is solving puzzles, figuring out maps, using reasoning skills to draw conclusion.

The above graph in figure 3 helps us in understanding the children’s abilities at different IQ levels. The graph also gives us the average of children at the national level [15].

VII. Types of ‘M’ IN STEM

STEM education is a focus of many policy makers, business and industrial leaders. As mathematics educators, it is incumbent on us to be advocates of STEM education because advocacy for mathematics education let us make one thing abundantly clear, “We support STEM education.” Maths is much more than its dictionary definition, the abstract science number, quantity and space, maths is much more than algebra, geometry or even calculus [1]. Maths is a means and foundation to solid development of skill learning, logical reasoning.

A] Algebra:

It is an area of maths which focuses on the rules of operation and relations, and the construction and the concepts that arises from them. Subject within algebra include terms, polynomials, equations and algebraic structure. Pre-algebra is often taught at mid-school level and introduces the basic concepts of polynomial and variables thus bridging the gap between arithmetical and advance Algebra. [14].

Elementary Algebra is the beginning level of algebra and introduces the concepts of variables representing numbers. In high school students learn the complexity of the subject and increases the great levels and incorporates elements power root, polynomials, quadratic equations, co-ordinate

geometry, probability, matrices and basic advance trigonometry [13].

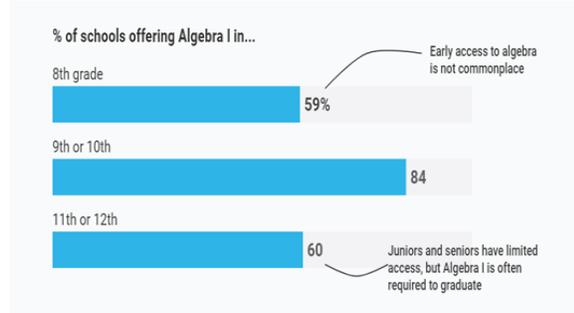


Figure4: Statistics of Algebra at school level

The above bar graph in figure 4 shows the availability of algebra to students in School/High school. The students offered algebra at lower levels is less than at high school level and it decreases at Junior and Senior levels as many of them drop out from Maths [8].

B) Geometry

Geometry is an area of mathematics concerned with questions of size shape and relative positions of figures and properties of space [6]. Geometry deals with measurements such as volume, length angles, proves, areas, circumference etc. Geometry also overlaps trigonometry surviving as a more specializing areas of maths.

It is taught as early as 8 grade as an honour’s class, though it becomes a fundamental part of general curriculum. Elementary geometry builds the general Arithmetic students learnt in elementary and middle-school. Geometry lessons are often taught in a form of queries, requiring step-by-step proof which a student must develop [1].

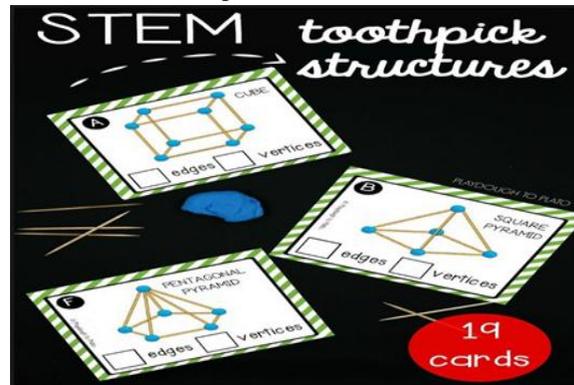


Figure5: STEM easy practice in geometry

The above figure 5 shows how STEM practice can be used to teach students geometry in an innovative

way. Such practices needs to be taught to children to help them grow their interests further. This clears concepts and might bring them more closely towards STEM education [5].

C) Trigonometry

Trigonometry comprises what is sometimes known as algebra-3. Along with pre-calculus, it constitutes the latter part of the student’s secondary schools, mathematics education. Trigonometry focuses on the study of triangles specifically, the relationship between sides and angles, as well as trigonometric functions and motion of waves.

D) Calculus

Calculus is one of the higher level of Mathematics and it is only taught in higher secondary school. The level of complexity in this area of Mathematics is very advanced and incorporates all levels of algebra, trigonometry and pre-calculus [11].It focuses on limits, functions, derivatives, integrals and infinite series. Calculus requires solid foundation of Mathematics for students to grasps various concepts. Pre-calculus is the most common and widely taught form of calculus. It is usually not taught as a normal curriculum before ‘11’ or ‘12’ grade in high school [7].

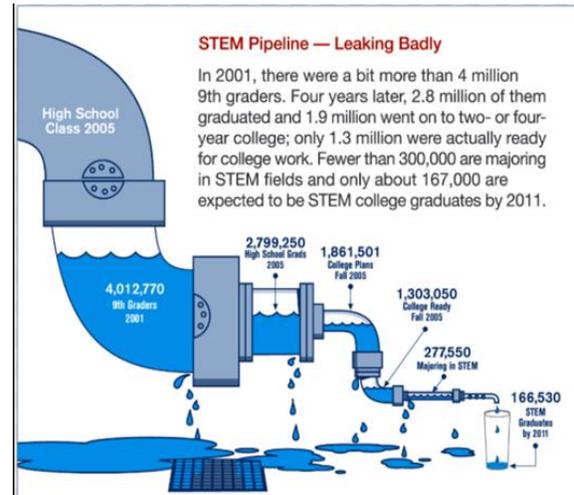


Figure6: Drop in STEM Calculus

The above representative shows how STEM Calculus is dropped as the class grade increases and the years are passing. This is a very serious problems as the number of skilled graduates in STEM education are dropping as STEM teaching practices are not used ad equated by school teachers [15].

VIII. RECOMMENDED ACTIONS FOR MATHEMATICS FOR STEM EDUCATORS

A] Leaders and policy makers should:

- When adopting and developing STEM education programme make a solid commitment to a strong mathematics and science programs.
- Allocate adequate time, provide enough instructional materials, skill tutors to support and teach mathematics is important.
- When implementing STEM activities it should ensure that students have access to deep teaching facilities that leads to development of foundational knowledge and skills of Mathematics.
- It makes sure of quantitative reasoning and mathematical scientific thinking [9].
- Finally when STEM activities and programmes are inclusive, it always brings discipline of Maths in teaching.

B] Mathematics and Teachers of STEM should:-

- Teach according to professional recommendation on effective teaching techniques for mathematics such as National Council of teachers of Mathematics (NCTM)
- Whenever mathematics is included in STEM activities make sure that mathematics is taught in different ways that support and develop mathematical thinking and quantitative reasoning.
- To support STEM education within mathematics programme,
- Teachers must look for opportunities must integrate and teach children to tackle mathematic problems in relevant setting.
- When a teacher teaches STEM or teaches mathematics, a teacher must follow primary disciple and encourage children to solve mathematics activities and also to grasp its content.
- Moreover this will help in the child assessment and increase his thinking ability [3].

C) Program/Curriculum Developers should:

- When developing programmes and materials for mathematics make use of meaningful applications.

- When offering STEM activities in informal educators (like summer camps, after school sessions etc.) recognized that the activities should not only be fun but also engaging the child's time but also should be related to instructional goals and grounded in practical and realistic understanding of what is involved in pursuing an interest in an topic or field involved.
- Informal educators should co-ordinate STEM programs with the day-today school academic programmes [2].

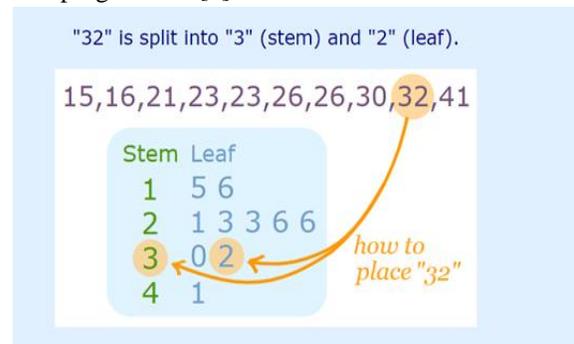


Figure7: Definition of STEM and leaf plot activity.

A plot where each data value is split into a “leaf” (usually the last digit) and a “STEM” (the other digit) as shown in figure4.

For example “32” is a split into “3” (STEM) and “2” (leaf). Shown in figure 7.

The “STEM” values are listed down, and the “leaf” values are listed next to them. This way the “STEM”sSSSSS grows the scores and each leaf indicates a score within that group [11].

- This activity has used STEM in making a child understand maths effectively. A simple technique can help a child solve challenges, math sums, develop critical thinking and increase communication skills.
- National Council Teachers of Mathematics (NCTM) use such understanding methods in making connections and also prepares a child to solve maths problems in class and at home. [10].It gives a child a deep understanding of mathematics and develop high quality of maths education.

IX. CONCLUSIONS

In summary math is not only important for success in life, it is all round us. The laws of mathematics are evident throughout the world. Math homework can help us to tackle problems in other areas of life. Some

may complain that mathematics is boring or complicated, but the truth is that life would have no meaning without the usage of maths. Students must have a positive attitude towards mathematics. The late Shukantala Devi an Indian writer who was popular known a human computer once said, "Without mathematics there is nothing you can do, everything around you is mathematics. Everything around you is numbers. She was right".

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