Role of Mathematics in the Development of Society

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Roger Bacon (1214-1294), an English Franciscan friar, philosopher, scientist and scholar of the 13th century, once stated:

> *"Neglect of mathematics works injury to all knowledge, since he who is ignorant of it cannot know the other sciences or the things of the world."*

For appreciating the role of mathematics in the development of the society or in a broader term the world in totality we need to have a better understanding of the following;

- What is mathematics?
- What is the importance of mathematics?
- What is development?
- Is there any need of Mathematics in the Changing World?
- What is the role of mathematics in the development of Society?

What is mathematics?

What is mathematics?' The answer to this question is of course complex; there are elaborate elucidations, some excellent, on the subject but inevitably, even the best accounts give incomplete answers.

Mathematics is a branch of science, which deals with numbers and their operations. It involves calculation, computation, solving of problems etc. Its dictionary meaning states that, 'Mathematics is the science of numbers and space' or 'Mathematics is the science of measurement, quantity and magnitude'. It is exact, precise, systematic and a logical subject.

Mathematics reveals hidden patterns that help us to understand the world around us. Now, much more than arithmetic and geometry, mathematics today is a diverse discipline that deals with data, measurements and observations from science, with inference, deduction, and proof; and with mathematical models of natural phenomena, of human behavior, and of social systems.

It may also be defined as, 'Mathematics is the study of quantity, structure, space and change; it has historically developed, through the use of abstraction and logical reasoning, from counting, calculation, measurement, and the study of the shapes and motions of physical objects. There are many definitions of mathematics but no one definition of mathematics is universally accepted. Some of them are as follows:

Angels

"Mathematics is a science whose subject matter is special forms and quantitative relationships of the real world".

Pierce

"Mathematics is the science, which draws necessary conclusion".

Locke

"Mathematic is a way to settle in the mind of children a habit of reasoning".

In a simple way we can say that mathematic has originated from numbers and number system is a special field of it, from which other branches of mathematics are developed. It is a systematized, organized and an exact branch of science.

Importance of mathematics

The literal meaning of mathematics is "things which can be counted" now you can think that counting has vital role in our daily life; just imagine that there were no mathematics at all, how would it be possible for us to count members of the family, number of students in the class, rupees in the pocket, runs in a cricket match, days in a week or in a months or years? On a basic level you need to be able to count, add, subtract, multiply, and divide.

At a psychological level, exposure to mathematics helps in developing an analytic 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 underpinned. A common man is being increasingly dependent upon the application of science and technology in the day-to-day activities of life, the role of mathematics has undoubtedly been redefined. Mathematics is around us. It is present in different forms; Right from getting up in early hours of the day to the ringing of an alarm, reading time on a watch, rounding a date on a calendar, picking up the phone, preparing a recipe in the kitchen, to wait for the counts of whistles of the cooker, manage the money, travel to some place, to exchange currency at a ticket outlet while availing a public conveyance or checking up the mileage of your car, halting at the filling station, attending to a roll call at school, getting scores in the class exams, even meet new friends the list is just endless if one goes on to note down the situations when our computational skill, or more specifically, simple mathematics comes to play a role, almost every next moment we do the simple calculations at the back of our mind. Of course these are all done pretty unconsciously without a thought being spared for the use of mathematics on all such occasions.

Even when we think of role of mathematics in our recreational activities, we surprisingly have a list that runs quite long: video games, computer games, puzzles, riddles, hockey, cricket, kho- kho, kabaddi, football, basketball etc. A cricket captain once said that if he got his field placement right, half the job of getting the other team out would be done. And what does field placement require? An astute sense of the game and of space; all the above games require an instinctive awareness and utilization of space. While doing crosswords, we need to see length of the words we fill in, the matching of the common letters, and so on. What about board games like chess? While playing, you need to think of a winning strategy. For this you need to construct the possible movement at any instant, giving the conditions under which the different pieces are allowed to move. In Ludo, Chaupad, Trade, and other such games, the players use a lot of mathematics. It scares us to certain extent to think of a life without any knowledge of calculation or computation, or in other words mathematics.

Mathematics helps the man to give exact interpretation to his ideas and conclusions. It is the numerical and calculation part of man’s life and knowledge. It plays a predominant role in our everyday life and it has become an indispensable factor for the progress of our present day world.

Even nature also embraces mathematics completely. We see so much of symmetry-around us and have a deep sense of awareness and appreciation of patterns. Observe any natural thing and find out symmetry or pattern in it. Change of day into night, summer into winter etc. In plants there are

innumerable examples of symmetry, shapes, patterns, etc. Such examples exist in animals, in objects, in pictures and other things. The sun rises and sets at specified moment. The stars appear at fixed time. Mathematics runs in the veins of natural sciences like Physics and Astronomy. This subject is inextricably incorporated with world and the natural phenomena.

Importance of mathematics can be understood by the definition given by Galileo. He defined mathematics as *'a language in which God has written the world'*.

What is development?

The term development can be understood as:

i) Advancement of knowledge.
ii) A process in which something passes by degrees to a different stage ,especially a more advanced or mature stage
iii) Systematic use of scientific and technical knowledge to meet specific objectives or requirements
iv) Extension of the theoretical or practical aspects of a concept, design, discovery or invention.
v) Process of economic and social transformation which is based on complex cultural and environmental factors and their interactions.
vi) Process of adding improvement to a land, such as grading, subdivision drainage, access roads and utilities.
vii) The act of developing or disclosing that which is unknown; a gradual unfolding process by which anything is developed, as a plan or method, or an image, gradual advancement or growth through a series of progressive changes; also, the result of developing, or a developed state.

We live in a time of extraordinary and accelerating change i.e., a new phase of development. New knowledge, tools, and ways of doing and communicating mathematics continue to emerge and evolve. Calculators, too expensive for common use in the early eighties, now are not only commonplace and inexpensive but vastly more powerful. Quantitative information available to limited numbers of people a few years ago is now widely disseminated through popular media outlets.

Now we will see that what is the role of mathematics in the development?

To understand the role of mathematics in the development, first we have to see the need of mathematics in the developed or changing world.

The Need for Mathematics in a Changing World

The need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase. For example:

- **Mathematics for Life**:

Knowing mathematics can be personally satisfying and empowering. The underpinnings of everyday life are increasingly mathematical and technological. For instance, making purchasing decisions, choosing insurance or health plans, and voting knowledgeably all call for quantitative sophistication.

- **Mathematics as a part of Cultural Heritage:**

Mathematics is one of the greatest cultural and Intellectual achievements of human-kind, and citizens should develop an appreciation and Understanding of that achievement, including its aesthetic and even recreational aspects.

- **Mathematics for the Workplace**:

Just as the level of mathematics needed for intelligent citizenship has increased dramatically, so too has the level of mathematical thinking and problem solving needed in the workplace, in professional areas ranging from health care to graphic design.

- **Mathematics for the Scientific and Technical Community.**

Although all careers require a foundation of mathematical knowledge, some are mathematics intensive. More students must pursue an educational path that will prepare them for lifelong work as mathematicians, statisticians, engineers, and scientists. In this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures. A lack of mathematical competence keeps those doors closed.

Generally it is an assumption that mathematics is only for the select few. On the contrary, every one needs to understand mathematics. All students should have the opportunity and the support necessary to learn significant mathematics with depth and understanding.

There is no conflict between equity and excellence. Principles and Standards call for a common foundation of mathematics to be learned by all students.

This approach, however, does not imply that all students are alike. Students exhibit different talents, abilities, achievements, needs, and interests in mathematics. Nevertheless, all students must have access to the highest-quality mathematics instructional programs. Students with a deep interest in pursuing mathematical and scientific careers must have their talents and interests engaged. Likewise, students with special educational needs must have the opportunities and support they require to attain a substantial understanding of important mathematics. A society in which only a few have the mathematical knowledge needed to fill crucial economic, political, and scientific roles is not consistent with the values of a just democratic system or its economic needs.

What is the role of mathematics in the development of a society?

A society, or a human society, is a group of people related to each other through persistent relations, or a large social grouping sharing the same geographical or virtual territory, subject to the same political authority and dominant cultural expectations. More broadly, a society may be described as an economic, social, or industrial infrastructure, made up of a varied collection of individuals.

Mathematics occupies a crucial and unique role in the human societies and represents a strategic key in the development of the whole mankind. The ability to compute, related to the power of technology and to the ability of social organisation, and the geometrical understanding of space-time, that is the physical world and its natural patterns, show the role of Mathematics in the development of a Society. The society consists of its members (human being), who make government and organize the natural resources to develop infrastructure. The human beings are the one who develop the society. Therefore, we will discuss the role of mathematics in the development of an individual as well as the development of the society.

To understand the role of mathematics in the development of an individual and of society, we need to discuss the following;

At Personal Level

i) Social Development

ii) Intellectual Development

iii) Vocational Development
iv) Moral Development
v) Spiritual Development
vi) Cultural Development

At Societal Level

i) Education system
ii) Economics
iii) Infrastructure
iv) Science and development
v) Medical science
vi) Agricultural field
vii) Cultural and Morality
viii) Living standard

First we will discuss the role of mathematics at Personal Level;

i) Role of Mathematics in Social Development

Man is a social animal and human life depends upon the co-operation of each other. Group work helps social skills. The ability to work together on tasks with others can build various social skills. In order to live a social life, mathematical knowledge is needed, because of the give and take process, business and industry depends upon the knowledge of mathematics. The change in the social structure with regards to the modern facilities like mode of transport, means of communication and progress in the field of science and technology is due to mathematics only. In this way mathematics has played an important role in not only understanding the progress of society but also to develop the society.

ii) Role of Mathematics in Intellectual Development

Mathematics teaching is very important for intellectual developments there is no other subject in the curriculum likes mathematics which make students brain active. Problem solving helps in the development of mental faculties. Mental work is needed to solve mathematical problems. If a child,

has a mathematical problem her/his brain becomes active in solving that problem. Each problem of mathematics posses such sequence which is necessary for constructive and creative process. In this way, all-mental abilities of child are developed through mathematics.

Moreover, mathematics makes the man very calculating so that she/he cans economies time, money, speech, thought etc. It develops a strong will power, patience and self-reliance. It, also develop the faculty of discovery and invention.

iii) Role of Mathematics in Vocational Development

The main aim of education is to help the children to earn their living and to make them self-independent. To achieve this aim mathematics is the most important subject than any other. It (this aim) helps to prepare students for technical and other vocations where mathematics is applied e.g. engineering, architecture, accountancy, banking, business, even the agriculture, tailoring, carpentry, surveying, and the office work requires the knowledge of mathematics.

iv) Role of Mathematics in Moral Development

Morality is the important phase of life, which is most, affected by time, person, situation and place. As a subject, mathematics can added to students moral development since mathematical knowledge is helpful in character and personality development. It develops all those quantities which a person of strong character must posses. Child develops qualities of cleanliness, reality.

v) Role of Mathematics in Spiritual Development

Mathematics main potential here seems to be regarding developing the skills of reflection and possibly, for the more receptive, a sense of the beauty of a solution. One gets pleasure in solving mathematical problems, especially when she/he gets the correct answers to her/his problem .At that moment every child feels satisfied, confident and self- reliance. The aesthetic quality of an elegant solution is something that may be lost on a dedicated “mathematics hater”. So the child gets encouragement, satisfaction and happiness in attaining remarkable achievements. Therefore mathematics helps to develop their aesthetic sensibility, meets the varying interests and helps them in the proper utilization of their leisure time.

vi) Role of Mathematics in Cultural Development

This helps the learner to understand the contribution of mathematics in the development of civilization and culture. It has enabled her/him to understand the role of mathematics in fine arts and in beatifying human life.

At Societal Level

Now we will discuss the role of mathematics at Societal Level;

1. Role of Mathematics in the Development of Education System:

In education system, mathematics plays an important role in shaping the future probability of young people. Education is to develop an individual, to make her/him self-reliant, to make her/him wise, to make her/ him a social contributor and in our education system, for almost every subject, we study in school and university; we need to study mathematics too e.g., Physics, Chemistry, Life-Science, Economics, Business and Accountancy, Geography, History, Psychology, Architect, Designing, Computes, Statistics, Commerce etc.

Also in vocational areas like Tailoring, Carpenting, Cooking, Beauticians, Sportsperson, Farming etc, mathematical knowledge is needed.
Even the professions like, Conductor, Shop Keeper, Drivers, Musicians, Magicians, Cashiers etc use basic mathematical concepts.

2. Role of Mathematics in Development of Economics:

Mathematics is of central importance to modern society. It provides the vital underpinning of the knowledge of economy. It is essential in the physical sciences, technology, business, financial services and many areas of ICT. It is also of growing importance in biology, medicine and many of the social sciences. Mathematics forms the basis of most scientific and industrial research and development. Increasingly, many complex systems and structures in the modern world can only be understood using mathematics and much of the design and control of high-technology systems depends on mathematical inputs and outputs.

Economics of the society is developed by establishment of industries. The applied mathematics like computational science, applied analysis, optimization, differential equation, data analysis

and discrete mathematics etc are essential in industrial field. By application of mathematical methods, the exploration cost of oil and communication cost of images could be reduced. Techniques of wavelets and fractals are used for this purpose. Numerical simulation of mathematical models helps to manufacture super conductor cables to reduce the cost of electricity.

3. Role of Mathematics in Development of Infrastructure:

In particular, mathematics has contributed to progress in science and technology for thousands of years and still continues to do so. It finds useful applications in development of infrastructure i.e., business, industry, music, politics, sports, medicine, agriculture, engineering, and the social and natural sciences. The physical appearance and development of infrastructure is crucial in a society. Thus, for the construction of roads, buildings, stadiums, flyovers, airports, dams, bridges, vehicles, airplanes etc. in mechanical engineering, civil engineering, electrical engineering etc

4. Role of Mathematics in Development of Science and Technology:

The "functional" aspect of mathematics stems from its importance as the language of Science, Technology and Engineering, and its role in their development. This involvement is as old as mathematics itself and it can be argued that, without mathematics, there can be neither science nor engineering. In modern times, adoption of mathematical methods in the social, medical and physical sciences has expanded rapidly, confirming mathematics as an indispensable part of all school curricula and creating great demand for university-level mathematical training. Much of the demand stems directly from the need for mathematical and statistical modeling of phenomena. Such modeling is basic to all engineering, plays a vital role in all physical sciences and contributes significantly to the biological sciences, medicine, psychology, economics and commerce.

Mathematics has been successfully used in the development of science and technology in 20^{th} – 21^{st} century. The areas like advanced semi-conductor devices, bio-technology, digital image

technology, Nano-technology, artificial satellites, and rockets all are based on mathematical concepts.

The recent success of NASA's Mars Rover is also based on mathematics.

5. Role of Mathematics in Development of Medical Science and Agricultural field:

Mathematics is applied to agriculture, ecology, epidemiology, tumor and cardiac modeling, DNA sequencing and gene technology. It is used to manufacture medical devices and diagnostics, opto-electronics and sensor technology.

There are positive senses in which mathematics is special. First, by virtue of its fundamental nature as a universal abstract language and its underpinning of the sciences, technology and engineering, mathematics has a claim to an inherently different status from most other disciplines. Secondly, as we have set out above, mathematics is fundamentally important in an all-pervasive way, both for the workplace and for the individual citizen.

6. Role of Mathematics in Cultural and Moral Development:

Mathematics has its own intrinsic beauty and aesthetic appeal, but its cultural role is determined mainly by its perceived educational qualities. The achievements and structures of mathematics are recognized as being among the greatest intellectual attainments of the human species and, therefore, are seen as being worthy of study in their own right, while the heavy reliance of mathematics on logical reasoning is seen to have educational merit in a world where rational thought and behaviour are highly valued. Furthermore the potential for sharpening the wit and problem-solving abilities fostered by study of mathematics is also seen as contributing significantly to the general objectives of acquiring wisdom and intellectual capabilities.

A cultured citizen is one who follows the norms of society and one who is a civilized person. A well mannered person is always simple, original, patient, honest, accurate and disciplined. Mathematics is a subject which is exact, real, original and precise, and one who studies mathematics needs to follow the laws and rules.

Thus, mathematics helps the people to be cultured citizens having sound morals.

7. Role of Mathematics in the Development of Living Standards.

Since mathematics is used in almost every profession, it helps in improving the living-standards of a person. The developments in economics, science and technology, medicine in brief over-all development of society develops the standard of living. Thus, mathematics plays an important role in making the living standards high. Although the ubiquitous use of information technology in all sectors has changed the nature of the mathematical skills required, it has not reduced the need for mathematics.

Last but not the least any society can never be developed without the empowerment of women since women is the half part of the society. Therefore, we will also see the, role of mathematics education in women empowerment

The Role of Mathematics Education in Women Empowerment

The importance of Mathematics as a tool for science and technology is continually increasing. While science and technology have become so pervasive, mathematics education has continued to dominate the school curriculum and remains a key subject area requirement in higher education and employment sector.

The hue and cry which follows the publication of mathematics results has become an annual ritual. The postmortems about the results eclipse a number of areas where female students have lagged behind. This has also impacted on courses and careers sought by women in the working world. They have attributed their failure to perform to expected standards to lack of sound background knowledge of mathematics. It is this realization that the skills learnt at school have had very little if any, bearing on what society needs in terms of productive citizens. In this regard, the gender imbalances in enrolment, achievement at school level, colleges and universities and the employment sector were also issues of concern. Our societies are becoming more and more technological with a mathematical bias, more attention being focused on attainment of mathematical competencies.

Empowerment provides opportunities to increase knowledge and vocational skills for survival and also improves accessibility to more enterprising career paths for women. Imbalances in enrolment, performance, subjects and subsequent employment in jobs that have a mathematical inclination underscored the need for intervention programs to bridge the gap while it revealed the need for a curriculum reform as a mechanism for improving the quality of education. Corresponding changes in assessment procedures are seen fit to accompany these reforms so as to ensure a holistic approach to learning. This triggered the need for research into aspects pertaining to the role of mathematics education in assisting career choices undertaken by women. The argument is, to what extent does Mathematics education offer new challenges and opportunities for women advancement? The research sought to provide a diagnostic tool from which to view other changes that will seen fit in the teaching, learning and assessment of Mathematics in the context of women empowerment. It may also discuss why it is important to improve the present situation in mathematics education as a way of addressing gender inequalities. It will also provide a forum for creating a women-friendly environment through systematically documenting and publicizing the areas women find problematic apart from trying to establish ways of implementing a series of equal opportunities and affirmative action activities in the classroom and employment sector. In addition the research may also aimed at undertaking sensitization and social mobilization in support of the concerns of women, supporting the development and proper functioning of organizations that support women's concerns. By revealing the existing structural, organizational and institutional practices, the research may target at how policies pertaining to these could accommodate the needs of women.

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