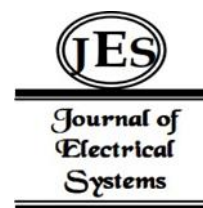


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Need of STEM Education in India for 21st century: A Critical Overview



Abstract: -In this 21st century, the world is facing complex challenges and to solve and face those challenges effective, innovative, and technically strong solutions are required. STEM education helps to do so by promoting critical thinking, developing a problem-solving attitude, and encouraging research which leads to innovation. This paper explores the vital role of Science, Technology, Engineering, and Mathematics in helping India become a leading power in the world. For the implementation of STEM education for said purpose, the priority is preparing students with some basic skills for the jobs of the future as it automatically results in economic growth of any nation and hence for India too. Hence STEM education needs to be given serious thought by the powers to be. Despite the clear benefits of STEM education, various barriers and challenges continue to impede participation, especially among underrepresented groups such as women, minorities, and individuals from low-income backgrounds.

Keywords: *STEM, research, innovation, entrepreneurship;*

I. INTRODUCTION

During ancient times, travelers from different countries and regions having different cultures and climates found interest in exploring India and hence began to visit various parts of India. With their experience, they started to believe that India is a land of wonder. With time, the whole world became aware of Indian culture, architecture, wealth, religions, philosophies, art, and educational practices too. The ancient education system was fully inspired by Vedas, Brahmanas, Upanishads, and Dharmasutras. The main objective of the education system was to have complete learning, lead a disciplined life, and realize one's inner potential.

India is a country renowned for its ancient civilization also which pioneered numerous concepts in the fields of Science, Mathematics, Engineering, Medicine, etc. The Indus Valley Civilization was the first to have town planning, an underground sewage system, air-cooling architecture, and many more features that have astounded the world. Several tools akin to compasses, needles, surgical instruments, etc. were discovered during excavations. We proudly boast of the heritage of Aryabhata, Bhaskara, Varahamihir, Sushruta, and many more. We had world-renowned universities at Nalanda and Takshashila. The ancient sciences and technologies which were almost at par with the modern advancements, were also better suited to the local conditions and made use of local resources. We use the term Vedic Mathematics as a fashion but how many of us have delved into that truly creative period of ancient India? It was this very richness that attracted hordes of invaders which culminated with the colonization. This era drained our country not only economically but also academically [7]. Although we still have brilliant minds who far outdo their peers in the field of Mathematics, we do realize that somewhere, somehow our students lose their way with Math and Science at the high school level. The main reason is that our education system is heavily dependent on textbooks and theory. Also, today's school education is in a crude format that doesn't fit every student's learning ability and inner potential. It is identified as a means to an end - which is building a lucrative career. In the process, our system has turned these subjects into mundane theories with little scope for experiential learning. We have world-renowned institutions even today, like IITs, IISc, NITs, BITS, etc. in the field of engineering, AIIMS in medicine, and IIMs in management. However, with the population boom the number of aspirants for these institutions has risen sharply. The result is all these institutions are now filled with master crackers of competitive exams aptly coached in centers that have mushroomed throughout the country. They have the intelligence but lack the creativity and imagination required for innovation, of course, barring a few exceptions here and there. Hence the lack of entrepreneurship.

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II. THE CONCEPT

STEM is an acronym for **S**cience, **T**echnology, **E**ngineering and **M**athematics. Individually viewed, Science develops an understanding of the world as it is, be it physics, chemistry, or biology. It develops our interest in research and experiment.

Technology helps us in using our knowledge and critical thinking to make everyday challenges easier.

Engineering is the application of knowledge and skills to create products and processes to solve real-world problems.

Mathematics helps us in interpreting, analyzing, and simplifying problems.

STEM aims at integrating the basic building blocks of all four and instead of treating them as distinct entities, combining them and creating a holistic approach to make learning a fun experience. Further, the DIY approach helps in dispelling the fear these subjects invoke among students, especially at the middle and high school levels. STEM education focuses on solving real-life problems through model building, DIY projects, or simulating situations.

III. HOW STEM HELPS

STEM can be included or introduced in any class and with any subject. The earlier it is done the better it is. You can forget what is written in books but you can never forget what you have done with your hands. It is easier to teach and learn typical concepts of math and science by way of projects or model building. STEM enthuses a spirit of lifelong learning and fosters an environment of curiosity, critical thinking, and innovation. It combines the abilities of a child to think, question, explore, discover, and be creative while continuing to amass knowledge. This leads to genuine interest in the subject. It helps the child develop collaborative skills, creativity, knowledge of engineering processes, problem-solving, etc. Hence STEM is increasingly finding applications in various domains like robotics, aerospace, nanotechnology, medicine, and more [1]. If we are to look at the more common places, mathematics is not restricted to equations and theories, it is all around us in banks, supermarkets, inventories, and even family expenses. STEM education is vital to our country and our people to rightfully claim our lost ground.

The concept of experiential learning, if done properly, can change the face of the Indian education system. Recent initiatives by the Government of India like the Atal Innovation Mission and Atal Tinkering Labs are encouraging students by giving wings to their creative ideas. According to recent surveys, it is predicted that 80% of the jobs created in the next decade will require some form of math and science skills. India is poised to have the largest number of young workforce soon. Therefore, it is of utmost essential that the next generation of the workforce be imparted some skill in these areas.

IV. THE FIRST STEP

Many parents and Teachers may have questions about at what age should we start teaching STEM concepts. Or at which level of schooling STEM concept can be included? The answer is STEM education can be started at any age and it is never too early to start with STEM. It can be included at the primary school level, secondary school level, and also at higher secondary school level. STEM at the school level helps students to study their subject with great depth by utilizing STEM skills. Generally, it is found that by the age of eight, children start getting fascinated by gadgets and gizmos and want to explore on their own [2]. That is the right time to introduce the concept of STEM or experiential learning. The more they are allowed to tinker, and make and break, the more will their spirit of learning and innovating be invoked. For this to be possible, a proper cohesive infrastructure must be developed at the school level. The main challenge lies herein.

To see the idea of STEM succeed, the mindset of an entire generation needs to change. First and foremost the student-teacher ratio must be improved which means more and more people should be encouraged to take up teaching. This is possible only if teachers are accorded more social respect. Unfortunately, in our country, social standing is judged largely based on one's income. Hence the pay structure of teachers at the school level should be reviewed and improved. Besides developing the infrastructure, the teachers must be oriented to adopt a more practical based approach to teaching rather than simply harping on textbook theories. Several

organizations/companies are working towards developing teaching-learning material for STEM. All of this requires huge funds. This is where corporations can step in.

V. BUDGETS AND FUNDS

Wishing for path-breaking innovations or research to happen in our country, we must ensure that the people at work have access to cutting-edge technology and facilities. There must be a bridge between STEM learning in the school and STEM opportunities outside the school. This bridge will eventually act as the pathway for higher learning or employment.

Any one body alone cannot be expected to cater to all the requirements of a robust STEM policy. STEM education requires a long-term sustainable ecosystem in the country. This requires not only good policies but also engaging and involving all stakeholders at the grassroots. The need of the hour is governance reforms that acknowledge the need for STEM. The recruitment and training of teachers for STEM education and a reform of the pay structure are in dire need today. These steps will lead to a structured institutionalization of the program. The critical success factors are sensitization of parents and society at large, networking between the policymakers, educators, service providers, and industry, and last but not least students and their families will play a key role in furthering STEM education. Educational institutes can play a key role in inspiring, identifying, nurturing, and fostering STEM talent and opportunities. This is not a simple, one-time task. It entails a dynamic process that can accommodate changes as and when required.

VI. CURRENT SCENARIO IN INDIA

The educators and powers to be have awoken to the need for STEM education in India. More and more companies are coming out with aids and tools to enable STEM education. Government policies are also being framed so that we look beyond classrooms and focus on real-life learning.

With the government's policy of SKILL INDIA, ATAL INNOVATION MISSION, DIGITAL INDIA, MAKE IN INDIA, etc., STEM is now acquiring an impetus in India too. Schools are coming up with tinkering labs with the government's support to let students use their hands either by way of CSR or public-private partnership all of this is largely doable [3]. It does not suffice to say that introducing STEM in a few schools or cities will serve our purpose. The methodology must reach all corners of the country and permeate all strata of society. We can hope to advance in any field only if the exercise is all-inclusive i.e. regardless of caste, creed, gender, or geographical considerations. Education at the school level should reach not only the affluent but also the underprivileged, and in our country, the girl child especially. Nowadays, companies and even individuals are participating in philanthropic activities in a big way. These efforts should be acknowledged and encouraged.

VII. THE WORLD VIS-A-VIS INDIA

All cutting-edge innovation happens at the cross border of two disciplines. To encourage and promote research and development activities, STEM is the way forward. In 2008, Australia signed the Melbourne Declaration on Educational Goals for Young Australians. Therein they recognized that schools must support and facilitate STEM to increase participation among students. Capacity building of teachers in STEM was identified as a critical area for STEM promotion. A collaborative effort between schools, universities, businesses, and industry was acknowledged as the key to fostering an environment conducive to the growth of STEM [4].

In 2015, the Obama administration envisioned the execution of STEM education for the next decade in a policy document. Almost 30 experts from diverse backgrounds and having vast experience got together to discuss the role and future of STEM education in the USA. The gist of their discussion was that a strong STEM education ignites the inquisitiveness in a child's mind which is essential for innovation, and also fosters a spirit of teamwork, perseverance, and application of learning. These are the skills and mindsets which will help society in these rapidly changing times [5].

The United Kingdom has rolled out the STEM program in 2016. Japan has introduced a national STEM framework for 2020. Singapore, Iceland, and many other countries are rolling out STEM policies. The BRICS countries have taken up STEM in a major way. Brazil initiated STEM in 2009 and is concentrating on training teachers as well as students. Russia places great emphasis on the inclusion of female students in STEM programs to create new job roles. China has been using STEM education for quite some time and today boasts of one of the largest pools of R & D workforce. South Africa promotes STEM education, especially among the underprivileged [6].

Looking at the present scenario of education at the global level, we are lagging in accepting the changes in our education system. But if a school, government, higher education, technical education, and all as individuals work together to develop the interest of kids/students in science, technology, engineering, and mathematical subjects through hands-on experiments and practical-based learning in fun to learn environment. Joint efforts as mentioned above have already started in INDIA.

VIII.CONCLUSION

An education that imparts the skill to apply knowledge in real life and learn to improve upon it throughout life will create a bright future for any society and thereby the nation. The rest of the world has recognized and started working on a STEM policy for a long time. However, we are still coming to terms with it. The challenges ahead are enormous; yet, there is no denying the fact that in coming times STEM education will be a path breaker in the areas of higher learning and employment for India. Now is the time to seize the opportunity and build it to our advantage.

IX.FUTURE SCOPE

Proposed approach can helps to policy makers in this area.

X.DECLARATION

Conflict of Interest: The authors declare that they have no competing interests.

Ethical Approval:The contents were prepared through detail literature review in relevant area, critical thinking in teaching learning and group discussion.

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