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Re-imagining K-12 education with a STEM pedagogy in India

Key insights

Understanding STEM maturity within the teaching pedagogy at Indian schools and the challenges to adoption

Background

Our increasing reliance on technology has made the global workforce smaller and more competitive. Countries in turn need to ensure that their future leaders can adapt to change, think critically, and work in an agile manner. "STEM," an acronym for Science, Technology, Engineering, and Mathematics, was coined in the US in the 1990s. In the early 2000s, it was formalised as a method to showcase the interconnectedness of the four disciplines. In simple words, STEM showcases the requirements of the future global workforce. In India, job postings related to STEM have increased by 44 percent from 2016–19. According to the National Science Foundation, 80 percent of the global jobs created in the next decade will require some form of math and science skills. Several countries, including the UK, Canada, and Australia, have national-level STEM policies to fill the gap of STEM-related skills in their workforce.

Countries have persevered to adopt STEM as a teaching pedagogy, and as individual subjects within their schooling systems. PISA (Programme for International Student Assessment) 2018 worldwide ranking shows that China has the highest average score of mathematics, science, and reading followed by Singapore, Macao, and Hong Kong. The UK ranked #14 and the US stood at #25. India has agreed to participate in the PISA 2022 international test.

Countries have a similar goal – prepare their students with the required skill sets to be able to think creatively, critically, and holistically in real-world scenarios (supported by correct technological advancements). However, some countries, including India, find it relatively difficult to understand STEM as an interdisciplinary teaching pedagogy. Due to the high focus on examinations, limited Indian teachers and students lay emphasis on innovation, and agile and critical thinking. Comparisons amongst countries show that schools need teachers with a stronger hold in STEM subjects and activity-based instructional teaching; schools also need to give teacher more progressive faculty development opportunities.

Who did we speak to?

Our extensive research covers a broad mix of key stakeholders, including principals, senior administrators, teachers, and STEM-related business owners in tier 1, 2, and 3 cities across India and curricula (i.e., CBSE, ICSE/ISC, state boards, IB, and IGCSE)*.

What areas did we cover?

Teaching methodology

Understanding the adoption of the STEM hands-on discovery-led teaching methodology across subjects

Infrastructure and instructional aids

Understanding the approach to and affordability of physical and digital teaching aids across schools with different curricula, and fee and aid structure

Budgets

Understanding the purchase power and decision-making authority at schools; this would determine the integration and maturity of STEM within the teaching pedagogy

What we found

The Indian K-12 curriculum currently does not include a holistic STEM-based teaching-learning pedagogy. However, our research highlighted a strong belief amongst the academic fraternity regarding the STEM or STEAM ('A' is for Arts) hands-on discovery-led teaching methodology and approach towards learning being the most beneficial for a child's development. Top international and elite schools following the Indian curricula (forming <0.1 percent of the total schools in the country) have already adopted this approach. However, there is still a huge potential in the private-unaided school space to move towards a more balanced approach of instructional and activity-based teaching. This approach positively affects students' emotional and academic progress, understanding of real-world scenarios, and future career choices.

This is especially important to prevent the widening of learning outcomes and opportunities amongst students from affluent families studied in the top 0.1% schools and others. The National Education Policy (NEP) 2020 lays the foundation to bridge this gap; however, implementation is the key.

Current state of STEM integration

The understanding and implication of STEM varies across schools based on the school management's vision and understanding of STEM application within their curriculum and fee structure implemented. Human resource quality is also an important factor for STEM maturity. The country's teaching certification courses (e.g., B.Ed, where teaching and learning methods taught are extremely instructional), are in need of curriculum upgrades and standardisation.

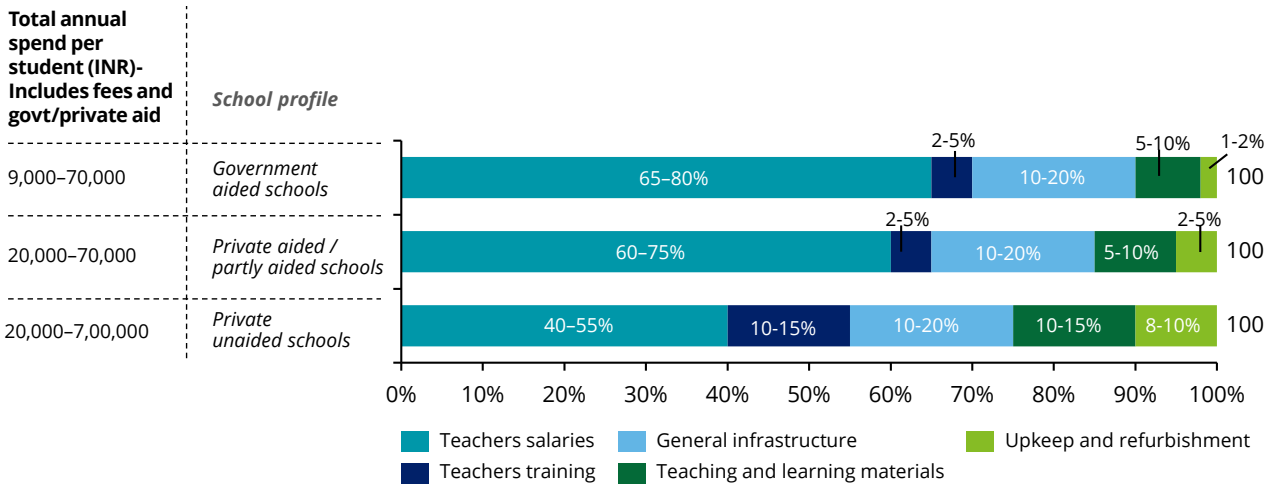
In our research, private schools charging fees of INR 70,000+ annually are more likely to make conscious efforts to recruit top talent (e.g., faculty trained in STEM pedagogy) and purchase the best infrastructure (e.g.; product and technology innovation kits and labs) to aid STEM-related teachings. This affects learning outcomes amongst students from affluent families.

However, even in private schools, more than 90 percent students are enrolled in schools with fee in lower brackets, i.e., from INR 0–2,000 per month. This results in more than 20 crore children across private and public schools with low or poor access to a STEM-related method of learning. This further creates a lag in critical and analytical thinking skills of our aspiring youth population.

Due to large variances within fee and aid structures, budget allocation differs across and within schools.

*Notes: K-12 certifications in India: CBSE (Central Board of Secondary Education), ICSE / ISC (Indian Certificate for Secondary Education / Indian Secondary Certificate), IB (International Baccalaureate), IGCSE (International General Certificate of Secondary Education).

Budget allocation



Schools across curricula and geographies struggle with some common challenges when it comes to effective integration of STEM:

- Low STEM integration within government-mandated teaching degree courses and certifications
- Insufficient and ineffective teacher reskilling programmes
- Lack of funds for recruiting teachers with the required skills
- Poor guidance for STEM integration within the Indian curricula
- Low awareness and unaffordability of commercially available physical and digital teaching material

Hands-on STEM education has taken a backseat as the pandemic led the teaching and learning space move to a remote format. However, this compelled schools, including government-aided and rural schools, to accelerate the adoption of technology and virtual tools for education (e.g., use Zoom or WhatsApp for communication and platforms such as Jodo Gyan for maths). Private schools have seen success with remote learning while the engagement of government school children is at about 30 percent. This is due to lack of access to digital tools, such as laptops or mobile phones.

Schools believe a hybrid learning environment, i.e., physical and virtual, will continue even in the post-pandemic era, paving a way for activity-based learning in the future. Academicians believe this blended approach will continue. However, it is yet to be seen if behavioural change after the pandemic will support this type of environment or slip back into the original 'chalk and talk' method.

Developing a shining future for education

NEP 2020 has laid the foundation for the future by calling out a requirement for the need of a discovery and analysis-based learning environment in schools to positively affect a child's critical thinking skills. Implementation of this is crucial. However, due to the challenges mentioned earlier, impact will take a minimum of 3–5 years. Though efforts towards implementation have started at various schools across geographies, there is still scope for more effective guidance to overcome challenges and a long way to go for impactful adoption across schools.

Critical suggestions for effective STEM implementation

National Council of Educational Research and Training (NCERT)
Revamp and standardise the curriculum for teaching-related degrees to integrate a strong understanding for STEM-related pedagogy with regard to teaching ethos and activities.

Standardise the Indian curricula to decrease differences between state and central boards; specific guidelines should be provided for STEM integration and discovery-based activities across subjects.

Government
Provide attractive incentives to high-quality professionals from the industry to draw them towards part-time or full-time teaching roles.

Corporates
Organise 'train the teachers' programmes to provide real-world insights, experiences, and tools to teachers.

School management/ trustees/directors
Maintain minimum mandatory annual reskilling and training time for teachers to make them aware of new technologies and teaching methods (physical and digital).

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Connect with us

Harsh Kapoor
Partner
harshkapoor@deloitte.com

Siddharth Shah
Director
sidshah@deloitte.com

Contributors

Harjot Singh

Ayush Garg

Rashna Engineer

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