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Study of Secondary and Higher Secondary School Syllabi in India to Develop Engineering Thinking

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Abstract: In this article, the authors explore and understand what constitutes engineering thinking and whether secondary and higher secondary school curricula in India empower students to make an informed decision regarding engineering as a career choice. To analyse the elements of engineering thinking, the principles of K12 level engineering by the National Academy of Engineering and Engineering Habits of Mind (EHoM) by the Royal Academy of Engineering are referred to. The syllabi of the Central Board of Secondary Education (CBSE) and four Indian states (Tamil Nadu, Maharashtra, Andhra Pradesh and Karnataka) are studied, which reveal that CBSE includes only one element of EHoM (creative problem-solving) in higher secondary grade curriculum. The syllabi of four Indian states revealed that the principles identified by the National Academy of Engineering (NAE) are missing in both grades. As an exception, the syllabus of Maharashtra has a creative problem-solving element in class-12 of higher secondary grades. The authors believe that introducing engineering thinking in schools will empower students to choose engineering as a career.

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1. Introduction

Undergraduate Engineering Education in India is wrestling with many challenges. The demand for engineering education in India is decreasing. This can be seen from the number of vacant seats in engineering education institutions. A survey from the All India Council for Technical Education (AICTE) dashboard, as shown in figure 1 (AICTE, n.d), reveals a decline in the number of students opting for engineering study.

In Figure 1, the green bars show the decreasing enrollment from 2012-2013 onwards. The figure also shows the gap between the number of graduating engineers (black bars) and those getting placed (blue bars). Various reasons could be attributed to these trends; however, this gap in enrolment, students completing the course, and subsequent placement essentially translates to fewer engineers in the job pool.

The Employability report (2016) by the Aspiring Minds survey on employability reveals that a large percentage of undergraduate engineers say Engineers in India lack basic coding skills, AI, Machine Learning (ML) and data science skills to keep up with

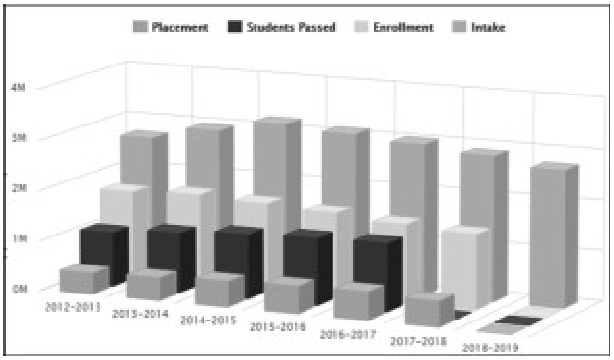

Fig.1 : A comparison between intake, enrollment, students passed and placed (AICTE, n.d)

the sector's changing requirements. Additionally, many fresh graduates from the nation's premier engineering institutes have chosen non-engineering and non-technology-related jobs, despite spending time and money on undergoing intensive academic training in the field of engineering due to a lack of technical skills (India Today, n.d). Thus, the engineering education landscape in India is plagued by challenges like the decline in the number of students opting for an engineering study and lack of competency among the graduating engineers, which are further compounded by many engineering graduates' shifting to non-engineering and non-technology-related professions after graduation. This translates to fewer engineers in the job pool.

As stakeholders, it is apt to ask ourselves, "Why do students choose engineering as a field of study?" There is an alarming scarcity of research done in this regard. However, the Indian Engineering education system has 3,345 engineering institutes, and a staggering 1.5 million students graduate from these institutes annually (Dazeinfo, 2018; Hindustantimes, n.d). A news article published by The Hindu(Samuel, 2013) highlights the thought process that the students follow in choosing their engineering branch of study: (1) The most popular branch in counselling, (2) The branch having good job opportunities as seen by the previous year placements, (3) Parental and peer pressure. Though there are several potential solutions to address these challenges, the authors focus on the role played by the Indian secondary and higher secondary school curriculum in empowering students to choose their subsequent discipline of study. In an ideal situation, the authors would like to believe that after higher secondary schooling, the students have made an informed decision to study engineering; the fact is that this statement is just wishful thinking! It has been reported by Lachapelle et al. (2007) that children and adults know little about the difference between Science, Engineering and Technology.

Through this article, the authors say that if secondary and higher secondary school students are introduced to engineering thinking, they would be empowered to make an informed career choice concerning the engineering and technology fields. The same is echoed in (Katehi et al., 2009), wherein two reasons to introduce engineering thinking at school are mentioned: (1) as a conduit for engineering after higher secondary education, and (2) as a means for advancing technology and scientific literacy in this world where its ubiquity characterises technology. Against the backdrop of this description, the authors pose the following research questions:

(1) What is the current state of secondary and higher secondary education in India concerning introducing engineering thinking?

(2) What could be the possible ways of introducing engineering thinking in secondary and higher secondary education?

Before we proceed any further, it is imperative to understand the key terms mentioned in the research questions: engineering thinking and the Indian school education system. The subsequent two subsections trace the meaning of the key terms and lay the foundation to explore the research questions.

2. Related Literature On Engineering Thinking And The Indian School Education System

This section describes the key themes presented in the research question: engineering thinking and the Indian school education system.

A. Elements of engineering thinking

The primary goal of education is to empower learners with knowledge, skills and attitude to solve problems in the real world. This goal, though aspirational, applies to all fields from which a student graduates and pivots problem-solving as the focal point of all education. The definition of a problem and what intellectual capacities are needed for problem-solving are stated in (Costa & Kallick, 2000, p.1) and are termed "Habits of Mind (HoM)".

A problem is any stimulus, question, task, phenomenon, or discrepancy, the explanation for which is not immediately known. Habits of Mind are performed in response to those questions and problems, the answers to which are NOT immediately known.

A Habit of Mind means having a disposition toward behaving intelligently when confronted with problems, the answers to which are not immediately known. Literature brings to light the habits of mind for Mathematics, Science and Engineering education. They are aptly named Mathematical Habits of Mind (MHoM), Scientific Habits of Mind (SHoM) and Engineering Habits of Mind (EHoM), respectively and are presented in Table 1. Professionals in these fields think and act in specific distinctive ways when solving problems in their respective fields. HoM characterises the thought processes that need to be developed in the learners to function effectively as professionals.

Since engineering thinking is the focal point of this paper, the subsequent deliberations in this paper focus only on EHoM. The EHoM has been drawn from the research report by the Royal Academy of Engineering (RAE) in the UK (Lucas et al., 2014) and the National Academy of Engineering (NAE) in the US (Jacobs et al., 2009). These reports offer glimpses into the cognitive processes that engineers exhibit. Complementing the efforts in identifying the engineering habits of mind, the National Academy of Engineering, in its report on K12 engineering education (Jacobs et al., 2009), identifies three principles for fostering engineering thinking. The Principles by NAE are presented in Table 2. In Principle 3, six engineering HoM describes how engineers think and act, i.e., engineering thinking. The EHoM, as outlined by RAE (Lucas et al., 2014), are presented in Table 3. The philosophy of engineering thinking is not confined to a particular geographical area but is based on the need to educate globally relevant engineers. At the time of this study, the authors did not find any documented evidence from the Indian education system that outlines engineering habits of mind that are applicable to its context.

Nevertheless, these philosophical underpinnings of engineering thinking from authoritative bodies like RAE and NAE influence the education of engineers. A closer look at the Washington Accord will reveal the influence these principles have had on its graduate attributes.

Table 1 : Generic, Mathematical, Scientific and Engineering Habits of Mind

Discipline	Habits of Mind
Generic	Persistence, Thinking and communicating with clarity and precision, Managing impulsivity, Gathering data through all senses, listening with understanding and empathy, Creating, imagining, innovating, Thinking flexibly, Responding with wonderment and awe, Thinking about thinking (metacognition), Takin g responsible risks, Striving for accuracy, Finding humour, Questioning and posing problems, Thinking interdependently, Applying past knowledge to new situations, Remaining open to continuous learning (Costa & Kallick 2000)
Mathematics	Pattern-sniffing, experimenting, tinkering, visualising and conjecturing (Cuocoet al., 1996)
Science	Open-mindedness, Skepticism, Rationality, Objectivity, Mistrust of arguments from authority, Suspension of belief, Curiosity (Muammer & Kevin, 2012; Gauld, 1982)
Engineering*	Systems-thinking, adapting, problem-finding, creative problem-solving, visualising, and improving (Lucas et al., 2014)

*Engineering Habits of Mind by the Royal Academy of Engineering are elaborated in Table 3.

Table 2 : Principles for K12 Level Engineering by National Academy of Engineering

	What?	How?
Principle 1	Introduce Engineering design	1. iterative nature of the design process, 2. use of open-ended problems, 3. establish a context for learning scientific, mathematical and technological concepts
Principle 2	Include developmentally appropriate Mathematics, Science, and Technology knowledge and skills	1. testing and measurement technologies, 2. such as thermometers and oscilloscopes; software for data acquisition and management; 3. computational and visualisation tools, such as graphing calculators and CAD/CAM programs; 4. use of the Internet for gathering information 5. Encourage the consideration of social, environmental, and other impacts of the engineering design process.
Principle 3	Foster Engineering Habits of Mind	1. systems thinking 2. creativity 3. optimism 4. collaboration 5. communication and 6. ethical considerations

Table 3 : Engineering Habits of Mind (EHoM) by The Royal Academy of Engineering

EHoM1	Systems thinking	Seeing whole systems and parts and how they connect, pattern -sniffing, recognising interdependencies, synthesising
EHoM2	Problem-finding	Clarifying needs, checking existing solutions, investigating contexts, verifying
EHoM3	Visualising	Being able to move from abstract to concrete, manipulating materials, mental rehearsal of physical space and practical design solutions
EHoM4	Improving	Restlessly trying to make things better by experimenting, designing, sketching, guessing, conjecturing, thought-experimenting, prototyping.
EHoM5	Creative problem - solving	Applying techniques from different traditions, generating ideas and solutions with others, generous but rigorous critiquing, and seeing engineering as a 'team sport.'
EHoM6	Adaptability	Testing, analysing, reflecting, rethinking, changing both in a physical sense and mentally

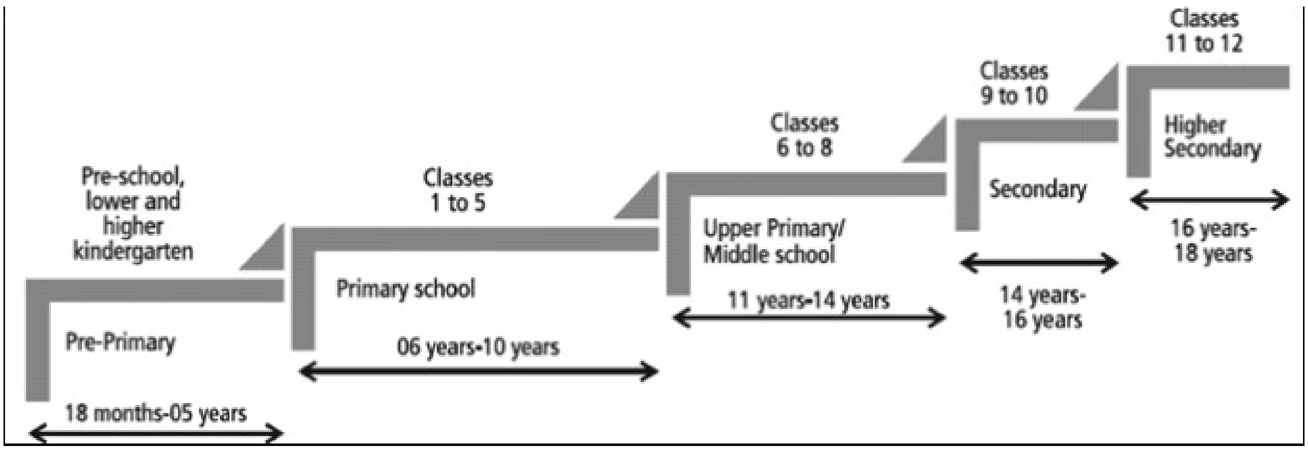

Fig. 2 : Segmentation of Indian school education system by level of education (British Council 2014)

From what we glean from the reports (Lucas et al., 2014; Jacobs et al., 2009), it is conclusive to state that engineering habits of mind and engineering thinking are well-researched, and there exist a specific set of principles that can be applied to develop educational content satisfying the constraints of current levels of grade, required proficiency of knowledge and skills. Subsequently, in this article, the term engineering thinking has been used to avoid confusion, and it refers to the principles from Table 2 and Table 3. Fig. 2. Segmentation of Indian school education system by level of education (British Council 2014)

B. Indian School Education System

The Indian School Education system is one of the most complex and vast in the world. The school education system is segmented at different levels; by education, ownership, and affiliation boards. This section describes the school education system by levels of education only as it is relevant to the scope of the study.

In (British Council, 2014), the authors have presented the structure of the Indian education system, and the same is shown in Figure 2. The Indian school education system is governed by various curriculum bodies like the Central Board of Secondary Education (CBSE), Council of Indian School Certificate Examinations (CISCE), State Government Boards and the National Institute of Open Schooling (NIOS). International Baccalaureate Organization (IBO) and Cambridge International Examinations (CIE) are the international boards. However, most Indian schools are affiliated with either of the two boards, i.e., state government boards or CBSE.

Though engineering thinking can be developed at different grade levels, this article focuses on the secondary and higher secondary school curriculum for State government boards and CBSE. However, a subtle complexity needs to be highlighted here: a syllabus prescribed by the State Board differs for each of the States in India. This not only brings in variation in the syllabi but also resists uniformity. However, schools affiliated to CBSE, irrespective of the state they are located in, follow the syllabus prescribed by the state.

With this backdrop of Engineering thinking and the Indian school education system, the procedure adopted to explore the research questions is presented in the next section.

3. Procedure

This study follows a qualitative approach to examine the syllabi of secondary (9th and 10th grades) and higher-secondary school (11th and 12th grades) levels in India concerning the degree to which the elements of engineering thinking are reflected in the Mathematics and Science syllabi.

To do so, it was first essential to select the states from which the syllabi will be examined. India is divided into twenty-nine states and seven union territories as per the Government of India portal (States Union Territories, n.d.). For this study, the syllabi of the following five states- Tamil Nadu, Maharashtra, Uttar Pradesh, and Andhra Pradesh (unified), and Karnataka has been selected as they have the largest number of engineering institutes in India (AICTE 2018). The statistics of enrollment are presented in Table 4. Table 4 summarises the number of enrolments in engineering institutions of four different states (Tamil Nadu, Maharashtra, Andhra Pradesh, and Karnataka). It is observed that the total percentage enrolment from these four states over the last five years has consistently been greater than 50% than the overall enrolment in India. As a consequence, these states together potentially produce the majority of undergraduate engineers. However, the inter-state movement of students for higher education is beyond the scope of this article.

Engineering is the application of Mathematics and Science to solve societal problems (Dym et al., 2005). Thus, the syllabi of Mathematics and Science courses (freely downloadable from the Internet or hardcopy) from the states mentioned earlier were chosen.

The parameters for analysis are Principle 1 (Engineering design), Principle 2 (Inclusion of developmentally appropriate Mathematics, Science, and Technology knowledge and skills) from Table 2 along with the EHoM by RAE (Systems thinking, Problem-finding, Visualising, Improving existing systems, Creativity, problem-solving and Adaptability) from Table 3. These parameters were used as indicators for elements of engineering thinking and will be referred to as parameters for analysis.

Thus the first two authors analysed the syllabi of Science and Engineering for the presence of the parameters. For representation, the following codes were used to depict the degree to which the parameters are reflected in the syllabi-

1) "High"- Principles 1, 2, and EHoM are mentioned in the syllabus

2) "Mid" – Either Principle 1 or 2 or some of the EHoM are mentioned in the syllabus

3) "Low"-Neither the principles nor the EHoM is mentioned in the syllabi

The subsequent section discusses the findings of this study to understand the degree to which the elements of engineering thinking are reflected in the syllabi under focus.

Table 4 : Statistics of enrollment in engineering colleges across the selected states

	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Tamil Nadu	1,35,302 18.69%	1,36,404 19.65%	1,32,211 19.76%	1,38,882 20.22%	1,28,320 19.53%
Maharashtra	82,855 11.44%	86,048 12.39%	80,436 12.03%	70,407 10.25%	74,315 11.31%
Andhra Pradesh	86,366 11.92%	86,107 12.40%	84,748 12.67%	88,710 12.92%	93,444 14.22%
Karnataka	70,878 9.78%	63,969 9.21%	62,737 9.38%	65,718 9.57%	60,400 9.19%
Total enrollment (%)	51.83	53.65	53.84	52.96	54.25
All States	7,24,101	6,94,249	6,68,754	6,86,797	6,56,964

4. Findings

This section highlights the findings of the two research questions:

(1) What is the current state of secondary and higher secondary education in India concerning introducing engineering thinking?

(2) What could be the possible ways of introducing engineering thinking in secondary and higher secondary education?

The findings for the specific research questions are outlined in subsequent subsections.

A. The current state of secondary and higher secondary curricula in India concerning introducing engineering thinking

For the first research question, an examination of the syllabi for Mathematics and Science courses at secondary and higher secondary school levels for five Indian states was carried out to find elements of engineering thinking. The parameters for analysis are Principles 1 (Engineering design) and Principle 2 (Inclusion of developmentally appropriate Mathematics, Science, and Technology knowledge and skills) and EHoM (Systems thinking, Problem-finding, Visualising, Improving existing systems, Creativity, problem-solving and Adaptability).

The results of this examination are presented in Table 5. Most cells are marked with "Low" for both CBSE and State syllabi across the states. This indicates that the syllabus does not reflect any means through which the elements of engineering thinking can be developed in the students. Specifically, in the CBSE Mathematics and Science syllabi for higher secondary grade levels, the authors found a reference to the term "problem-solving", which is the 5th EHoM. However, in CBSE syllabi, Principle 1 (engineering design) and Principle 2 (developmentally appropriate Mathematics, Science, and Technology knowledge and skills) were not found.

For the schools affiliated with the state government boards, the Principles (1 and 2) and EHoM were glaringly missing, except for the EHoM 5, which was mentioned in the 12th-grade syllabi for the state of Maharashtra. These findings are drawn from viewing only the syllabi, and the laboratory plans (if any) are not consulted. These findings clearly show that the secondary and higher secondary school syllabi hardly reflect the principles that foster engineering thinking in learners. The syllabi are structured according to individual topics/concepts with a glaring lack of context for learning them. It also falls short in making a holistic reference to the engineering design process, including open-ended experiments, testing and measurement technologies and other parameters.

B. Ways to introduce engineering thinking in secondary and higher secondary education

The elements of Engineering thinking belong to the higher-order thinking skills of Bloom's taxonomy (Krathwohl & David 2002). The development of these intellectual capacities requires an educational ecosystem that is designed to foster them. In the report by RAE (Lucas et al., 2014) and NAE (Jacobs et al., 2009), researchers, academicians, and policymakers have stated that engineering thinking can be introduced at K12 levels (from kindergarten to higher secondary levels) by incorporating STEM(Science, Technology, Engineering and Mathematics) education. STEM is an educational ecosystem which keeps engineering at its core and uses Science, mathematics and technology as tools to solve real-world problems. Thus, the STEM instruction method can be adapted to expose students to engineering thinking to empower them to "thoughtfully" choose engineering as their field of study, widening the pipeline for students entering STEM professions (Wang et al., 2011).

The report (Jacobs et al., 2009) by NAE on K12 engineering education emphasises the need for introducing STEM education. It states that Engineering provides a real-world context for learning Science and mathematics as "in the real world, engineering is not performed in isolation—it inevitably involves Science, Technology, and Mathematics. The question is why these subjects should be isolated in schools". Many initiatives have been in line with the NAE's call for including STEM in schools.

In the US, STEM education has come under the lens during the past decade. In 2010 and 2011, two landmark reports (Holdren et al., 2010; National Research Council, 2011) strategically promoted STEM education. Its implementation began with a top-down focus, beginning with policy formulation at

Table 5 : Analysis of elements of engineering thinking at higher and higher secondary school curriculum

Boards	Parameters of analysis	Secondary grade				Higher Secondary grade			
		Class 9		Class 10		Class 11		Class 12	
		Science	Math	Science	Math	Science	Math	Science	Math
CBSE	Principle 1	Low	Low	Low	Low	Low	Low	Low	Low
	Principle 2	Low	Low	Low	Low	Low	Low	Low	Low
	EHoM	Low	Low	Low	Low	Mid	Mid	Mid	Mid
Tamil Nadu State	Principle 1	*	*	Low	Low	Low	Low	Low	Low
	Principle 2	*	*	Low	Low	Low	Low	Low	Low
	EHoM	Low	Low	Low	Low	Low	Low	Low	Low
Maharashtra State	Principle 1	Low	Low	Low	Low	Low	Low	Low	Low
	Principle 2	Low	Low	Low	Low	Low	Low	Low	Low
	EHoM	Low	Low	Low	Low	Low	Low	Mid	Mid
Andhra Pradesh State	Principle 1	Low	*	Low	Low	Low	Low	Low	Low
	Principle 2	Low	*	Low	Low	Low	Low	Low	Low
	EHoM	Low	Low	Low	Low	Low	Low	Low	Low
Karnataka+ State	Principle 1	Low	Low	Low	Low	Low	Low	Low	Low
	Principle 2	Low	Low	Low	Low	Low	Low	Low	Low
	EHoM	Low	Low	Low	Low	Low	Low	Low	Low

the federal and state level, attractive initiatives for STEM education, funding to create vibrant school ecosystems to create an ethos for STEM education and teacher training (Kennedy & Odell, 2014).

In 2011, the National Research Council (National Research Council, 2011) identified the process indicators necessary to assess STEM curriculum implementation, monitoring, evaluation and research. Today, the US boasts of a STEM curriculum, as the promotion of STEM education was accelerated due to national urgency (National Academy, 2005; National Research Council, 2011). Apart from federal initiatives, a coalition of private industries also supports STEM education (US Chamber of Commerce Foundation, 2018).

With the acceptance of STEM education as an effective instructional method to introduce engineering thinking, different programs (formal and informal) expose students to engineering thinking. By formal programs, a reference is made to all allied learning activities which are a part of the school curriculum, and by informal programs, a reference is made to after-school initiatives, summer workshops, etc. The remaining part of this section highlights both informal and formal initiatives in this regard.

An example of an informal STEM initiative is the Engineering is Elementary project of the National Center for Technological Literacy at the Museum of Science, Boston. This centre introduced a research-based, standards-driven, classroom-tested curriculum for grades 1-8 that integrates engineering and technology concepts, skills and elementary science topics, mathematics learning, and literacy and social studies. This curriculum addressed most challenges presented in Table 2 (Lachapelle & Cunningham, 2007).

In (Schön et al., 2014), another informal initiative in the US and Europe, the Makers movement as an education paradigm, has made inroads into STEM education. "The Maker Movement is a community of hobbyists, tinkerers, engineers, hackers, and artists who creatively design and build projects" (Martin, 2015). When brought into K12 education or higher, this movement introduces engineering practices for both playful and valuable ends. This ideology has various physical manifestations, such as; FabLab in MiT, Hackerspaces and Makerspaces. The differences between these conceptualisations are highlighted in (Schön et al., 2014). Most of these initiatives involve after-school implementations to introduce engineering thinking and serve as means to STEM education (Bronwyn et al., 2015; Halverson & Sheridan, 2014).

In the United Kingdom, the Royal Academy of Engineering has striven to promote initiatives that introduce engineering thinking. The intention is to close the gap between the demand and supply of engineers crucial to the UK's economic development. The UK's "Engineering Engagement Programme" has supported the teaching and learning of STEM for ages between 11-13 years by creating a focused engineering curriculum. The programme has partnered with a national network of schools and national players in the STEM field and has created learning resources, after-school clubs and continual professional development of teachers and club leaders. The entire programme and its evaluation are available (Harrison et al., 2014).

Coming to the formal initiatives in STEM education, a study (Young et al., 2011; Bicer et al., 2015) highlights the initiatives in Texas for STEM schools. These schools follow the pedagogy of Project and Problem-based learning and are equipped with infrastructure for the novel instructional approach for middle and high school levels.

Worldwide, countries are at various stages in STEM education adoption and implementation; a nationwide network supports United Kingdom's STEM education for STEM (i.e., STEMNET) (Young et al., 2011), inventive thinking and allied cognitive activities are emphasised in Singapore as part of science coursework (STEM ambassadors, n.d.)(Science Syllabus in Singapore, n.d.); STEAM (Science, Technology, Engineering, Arts and Mathematics) education has been formalised by the Korean government by integrating it with school curriculum (Ministry of Education in Singapore, 2014; Jho et al., 2016). In China, STEM education has been formalised by the government's announcement to include the same in the primary school curriculum (STEM Education in China, n.d.). To study, compare, and analyse the growth of STEM education, the Australian Council of Learned Academies report has compared the status across 23 countries. It has been stated that those countries with federal policies for advancing STEM education fare better than others, including Australia (Marginson et al., 2013).

C. Formal and Informal Initiatives in India

This section first outlines the formal initiatives followed by informal initiatives for STEM education in India. As discussed in the section on the Indian school curriculum, most schools in India are affiliated with State Government or Central boards. Moreover, STEM education has not been formalised in its curriculum to develop engineering thinking. There are several informal private players in this field who introduce STEM fields as after-school workshops and clubs. A quick search on the Internet yielded the names of many private organisations with whom private schools partner with. However, the syllabi of state and central boards are pivotal in deciding what content the students study and how they study. Unfortunately, the inclusion of outcomes related to STEM education is not evident in them. The subsequent paragraphs highlight the informal initiatives.

Atal Tinkering Laboratories (ATLs) is one of the successful initiatives in India, which is established with a vision of creating one million neoteric innovators by 2020 and establishing ATLs in schools across India (Atal Tinkering Lab, 2018). This scheme aims to foster curiosity, creativity and imagination in young minds; and inculcate skills such as design mindset, computational thinking, adaptive learning, and physical computing. Its key feature is in allowing young children a chance to work with tools and equipment to understand the concepts of STEM

The Department of Science and Technology (DST) has another informal initiative in India that promotes science projects relevant to national needs. DST plays an essential role in the promotion of Science and technology in India. In DST, National Council for Science and Technology Communication is a scientific programme that promotes new proposals and communication initiatives in Innovation and STEM Demonstration through hands-on Science, exhibitions, fairs, tours for students (National Council for Science and Technology Communication, n.d.)

This section discussed the various programs aligned with the development of engineering thinking through STEM education. Though there are both formal and informal initiatives, the countries that have policies to eliminate the isolation of Science and Math in schools by adopting engineering thinking fare much better in the trajectory for STEM implementation.

5. Discussion

In the earlier section, the authors have discussed how problem-solving is the goal of education. In engineering, problem-solving requires proficiency in Mathematics, Science and disciplinary knowledge and ease of using tools and technology for solving societal problems. The instruction method suited for this is STEM education, which develops engineering thinking and "making skills" in students across school levels.

However, when the syllabi of secondary and higher secondary levels across five states in India for Mathematics and Science courses are scrutinised for the presence of elements of engineering thinking, the results reveal a bleak situation. The syllabi impart knowledge of scientific and mathematical concepts without regard to their application for problem-solving. Thus, without awareness of what entitles engineering work, the students select engineering as their career after post-secondary schooling. The authors propose that if the students are empowered with engineering thinking at the school level, they will be better positioned to choose their further branch of study. Another reason why such education is relevant is that today's world requires individuals who can participate in their country's scientific and technological development.

The study presented here gives a preliminary understanding of the status of syllabi in developing engineering thinking. Only a representative sample of states and courses are chosen. Though STEM education is proposed to develop engineering thinking, a study in the Indian context is needed to ascertain if there are any other qualifiers. To revamp and propose any new education model, a comprehensive study needs to be undertaken.

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