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In-Service Teachers' Perceptions on STEM Education: A Study Conducted in the Region of Mumbai

Steffie Dmello

ABSTRACT: *Teachers' awareness of STEM has a huge impact on students' future, as they make career choices. This study explores teachers views regarding integrating STEM, its interdisciplinary nature and NEP. It also seeks to identify teachers views on factors that will facilitate or hinder implementation of STEM in their classrooms. Qualitative methodology was used and semi-structured interviews were conducted. 10 teachers participated in the interview and discussed their views on integration of STEM and its application in the classrooms. Findings expressed teachers concerns regarding under preparedness to enact STEM practices, lack of infrastructure, resources and guidelines to implement STEM in regular classrooms. The study ends with recommendations to develop professional development workshops for teachers as they act as a catalyst in applying STEM methodologies.*

Keywords: Integrated STEM, NEP, Interdisciplinary learning

I. INTRODUCTION

STEM (science, technology, engineering, and mathematics) competencies are receiving rapid global attention, and these skills are in high demand not only within specific STEM occupations but also outside of them (English, 2017; Reeve, 2015). Today, STEM education plays a pivotal role in preparing the workforce globally and students need a solid STEM knowledge to become ready for college and employment (Brown et al., 2011; Cinar et al., 2016). STEM education is also seen as a way to improve students' scientific literacy, or their ability to use scientific information to understand social issues (Margot & Kettler, 2019). Students who are scientifically literate have a better chance of becoming educated citizens who are able to make sound and informed decisions regarding the issues that affect society (Koh & Tan, 2021). While there have been numerous discussions regarding the popularization of science and the development of a scientific minds in India, STEM education still hasn't received the attention it deserves in our educational system. STEM education in schools continues to struggle due to a lack of fundamental elements like curriculum, teaching and learning resources. This gap has generally been recognized and some steps have been taken over the past few years (Gangan, 2021). The eagerly anticipated National Education Policy 2020 (NEP) may finally serve as the catalyst for increasing STEM education in India wherein experiential learning and hands-on learning will play a big part in STEM education (Smile Foundation, 2021). But in India, there is a complete diversity in terms of education

and industry, until and unless we bring these two sectors together how can we actually implement the NEP 2020? (Webinar on "NEP-2020 and STEM Education," n.d.). In India, educators find it difficult to understand STEM as an interdisciplinary teaching pedagogy. Due to the high focus on examinations, there is limited emphasis on innovation and critical thinking. (Deloitte, 2021). It is obvious that educators decide the progress of educational advancement since they are the beneficiaries and implementers of all projects, plans and activities to accomplish the development objectives. It is evident that breaking out of one's comfort zone is not an easy task. With the ongoing schooling educational plan and working time, numerous educators are reluctant to put resources into new showing strategies or new instructive exercises. Additionally, there are objective factors, like the large number of students in the class and a lack of facilities that make trying new ways of teaching less effective (Thang, 2019). The teachers remain the primary focus of STEM education since the battle cannot be won until teachers' mindsets are changed. Teachers will ultimately be responsible for the actual implementation (Webinar on "NEP-2020 and STEM Education", 2020).

The objective of this research is to investigate the awareness of teachers regarding STEM and its interdisciplinary nature, how ready they are to implement STEM in the classroom and factors that can hinder or facilitate such form of instruction in their school. The goal of this study is to provide some suggestions for improving the effectiveness of STEM education in secondary schools. By focusing on interdisciplinary and integrated initiatives, future citizens could be able to develop STEM practices that help to build the skills and knowledgebase to meet the challenges facing society (Kurup et al., 2021).

II. LITERATURE REVIEW

Background of STEM

Bybee (2010) provides an excellent information on the use of the term STEM in his paper on Advancing STEM Education: A 2020 Vision. He states that the term "had its origins in the 1990s at the National Science Foundation (NSF) and has been used as a generic label for any event, policy, program (e.g., STEM Academy), or practice that involves one or several of the STEM disciplines." He also observes that it is a "slogan that the education community has embraced without really taking the time to clarify what the term might mean when applied beyond a general label, and in the U.S. the term is often interpreted to mean science or math, and seldom does it refer to technology or engineering." However, the concept of STEM education still remains muddled. The degree of integration is one major and frequent source of confusion (Koh & Tan, 2021). There are many definitions and interpretations of STEM education and no clear consensus on its meaning. As stated in numerous articles, STEM education has been defined variously ranging from disciplinary through to transdisciplinary approaches (e.g., Brown et al., 2011; Burke et al., 2014; Honey et al., 2014; Moore and Smith, 2014). For example, STEM education could refer to a stand-alone STEM course (e.g., physics or calculus) or a program of study that includes a variety of courses from the STEM areas. Although there is no clear consensus on the meaning of STEM education, the term is often used in a context that emphasizes an immediate need to improve education in STEM (Reeve, 2015). There are various ways in which STEM is conducted, for instance in silos or as a multidisciplinary approach. In most nations, all four subjects are taught separately or in 'silos' (EL-Deghaidy et al., 2017). One main essential component that is gaining popularity is the integration of STEM in regular curriculum. It is possible that one discipline is the dominant one whose concepts and ideas are the main focus whilst the other disciplines provide skills or knowledge to support the learning of the concepts of the dominant discipline (Koh & Tan, 2021). As such, for this study, the focus will be on integrating science and mathematics in the curriculum in terms of basic knowledge or skill application.

NEP and STEM in India

In January 2015, a committee led by former Cabinet Secretary T. S. R. Subramanian began consultations on the New Education Policy. Based on the committee report from June 2017, a panel chaired by former Indian Space Research Organization (ISRO) chief Krishnaswamy Kasturirangan presented a draft NEP in 2019. NEP was approved by the Union Cabinet on July 29th, 2020 (Iyer & Kalyandurgmath, 2022). NEP is expected to fill many gaps that our education system currently has. It lays down a broad framework for many reforms to address the gaps. According to the policy's vision "National Education Policy 2020 envisions an India-centric education system that contributes directly to developing our nation sustainably into an equitable and thriving knowledge society by offering high-quality education to everyone" (The Hindu, 2022).

One of the major focuses for NEP is to change the current education system of rote learning to evidence based and hands-on learning. NEP recognizes and sets a path for a multi-disciplinary approach to education which is philosophically aligned to STEM learning. NEP emphasizes on schools to have more experiment-based classes and hands-on learning. It also recognizes that evidence-based learning, scientific temper and coding skills should be imparted in the students (Government of India, Ministry of Education). The National Education Policy (NEP) 2020 recommends that modern disciplines such as Artificial Intelligence be introduced into the curriculum at appropriate levels which will lay the foundation for key skills required for 21st century. In accordance with the NEP 2020, the National Council of Educational Research and Training (NCERT) has begun the process of developing a new National Curriculum Framework for School Education, during which the possibility of introducing an introductory course on Artificial Intelligence (AI) at the secondary level will also be investigated. Meanwhile, in its affiliated institutions, the Central Board of Secondary Education (CBSE) has introduced Artificial Intelligence as a topic in class IX from the 2019- 2020 school year and class XI from the 2020-2021 school year. The policy states that Artificial Intelligence and other technologies will completely change the way students learn in the classrooms. However, this requires a lot of research both on technological as well as educational grounds.

Many other initiatives from government as well as EdTech companies to set-up STEM Labs with upcoming technologies like tinkering labs, 3D printing, electronics, IoT and sensors are bringing STEM to life in school classrooms (Gangan, 2021). At a critical time when the Indian government is promoting initiatives such as Make in India, Skill India, and Digital India, an effective STEM education will be a game-changer. Hence STEM education is need of the hour. Students need to develop their STEM skills to levels that are significantly higher than what was previously considered acceptable, in order to be successful in this brand-new information-based and highly technological society. NEP has been made possible by previous government initiatives, such as the NITI Ayog's Atal Tinkering Labs project to integrate STEM education into the education system (Iyer & Kalyandurgmath, 2022). Through NEP, educators and teachers can acquire new teaching techniques and broaden their skill sets. Experiments, hands-on activities, experiences that are visually and graphically presented, role plays, discussions, and debates are just a few of the new technology-enabled methods teachers can use to demonstrate their skills to students. According to Iyer & Kalyandurgmath (2022), this policy change will result in a paradigm shift in how education is viewed, taught, and accepted throughout the country. The effectiveness of any policy is dependent on its implementation, which requires multiple initiatives and actions from multiple bodies coordinated with various Central and State government bodies in synchronized and systematic fashion.

Teachers' perceptions of STEM education

In light of the rising demand for professionals with the knowledge and skills essential to economic growth and development, educators are responsible for preparing students with essential STEM skill sets. Schools particularly need to improve their STEM education offerings and redesign their instructional pedagogies in order to increase students' STEM-related capabilities (Margot & Kettler, 2019). Not surprisingly, the urgency of STEM for national progress, security, and well-being triggered the launch of a plethora of educational reforms that many countries worldwide embraced to revamp STEM education for the economy (Sellami et al., 2022).

Preservice or in-service teachers have been the subjects of research into teachers' perceptions of STEM education. For example, Pimthong & William (2016) and Cinar et al. (2016) concentrated on pre-service teachers while others (Brown et al., 2011; Srikoom et al., 2017; Wang et al., 2011) focused on in-service teachers. In addition to research on teachers, research has been also conducted on STEM perceptions of university faculty members (Breiner et al., 2012; Lamssali et al., 2021). There are multiple ways to collect and record these methods, but many of them are merely theoretical and may not have an actual impact on the teacher's practice. The study by Unver (2014) and Dare et al. (2018) revealed that teachers have difficulty connecting theoretical concepts to practice.

Even though STEM is very popular, not all educators are aware of it. A study by El-Deghaidy and Mansoor (2015) and Brown et al. (2011) indicated that only some teachers were able to exactly define STEM. Breiner et al. (2012) reported 72.5% of university faculty participants were able to describe STEM. On the other hand, Çevik et al. (2021) indicated that almost all university faculty members were aware of STEM. Many researchers also claim that teachers' perceptions are related to their years of experience of teaching. A study by Smith et al. (2015) results did not show statistically significant differences in teachers' perceptions of STEM that attributed to their years of experience. However, the study of Park et al. (2016) showed statistically significant differences in teachers with more than 15 years of experience. Furthermore, in extensive research by Margot and Kettler (2019), a lack of consistency between teaching experience and perceptions on STEM education was reported. This suggests that a teacher's perceptions of STEM education are independent of their background in any way.

A study by Knowles et al. (2018) and Egarievwe (2015) found that the number of students choosing STEM postsecondary opportunities is directly impacted by increasing teacher STEM awareness. In a study completed by Bakirci & Karisan (2018) and Ramli et al. (2017) it was stated that success of STEM education relies heavily on teachers. It suggested that teachers need to become more aware of STEM subjects in order to develop effective strategies for STEM education. In summary, the researchers stated that for teachers to develop their skills in STEM teaching, they must first be aware of STEM. Teachers with a strong understanding of STEM can positively influence students' interest in STEM career fields.

By measuring teachers' perceptions of STEM awareness and support, it is possible to identify which aspects require improvement and support. Teachers who are aware of the significance of STEM education and have access to outside resources for their students can contribute to the overall development of their students as well as the number of students pursuing STEM degrees and careers. There are many perceptions and each has a unique view. The findings of this research would assist in understanding the perspectives of teachers in the region of Mumbai.

III. RESEARCH GAP

Numerous studies on the STEM program have been conducted. However, there is still a research gap because there haven't been any studies to understand teachers' awareness and support for STEM in Mumbai. While numerous articles have attempted to comprehend the integration of NEP 2020, the perspectives of teachers, who will play a significant role in its implementation, have not been considered. As a result, the researcher has made a sincere effort to fill the gap in these areas related to STEM.

This study aims to determine teachers' perceptions of STEM education and the factors that will aid or hamper such instruction in their schools, in order to promote STEM education. Since there is not much research on STEM in India, the research questions focus on the following:

1. What are teachers' perceptions of STEM education?

2. Are these teachers ready to implement STEM according to NEP in their classrooms?

3. What are the factors that facilitate or hinder STEM education practices?

IV. RESEARCH METHODOLOGY:

A study was conducted in the region of Mumbai. This study opted for a qualitative instrument. Focusing on the qualitative research allowed the study to incorporate teachers' perceptions, both social and intellectual, about the integration of STEM. For Analysis, text was subjectively interpreted through classification, coding, and identification of themes (Gibbs, 2007). The data was analyzed using an inductive approach without the imposition of a hypothesis; rather, the author attended the themes that emerged out of the data (Goodpaster et al., 2018).

For the purpose of this study, open-ended semi-structured interviews were considered appropriate. Depending on the participants' convenience, the interviews were conducted in person or online, and a recorder was used for recording. Notes app on iPad was used while interviewing a person to transcribe the data simultaneously. iPad provided ease of transcription. A recorder was used to record the audio as well, since the transcription on iPad was not always accurate, had a time limit and there was a chance of missing important points. The transcribed data was subjected to qualitative analysis through the process of coding, which allowed categories and themes to be derived from the actual data.

The author used the method of coding to identify statements/comments related to teachers' perceptions. This process yielded statements or phrases reflecting a variety of views held by the 10 participants. The statements were grouped into themes by using the method of constant comparison to group similar statements and phrases together. A hierarchical structure was created as a result of the examination of categories in relation to one another. The author reached a consensus about the codes and themes, and collaborated to reduce the data into the final categories.

Participants:

This study involved 10 teachers from region of Mumbai employed in ICSE, CBSE and SSC boards. Teachers were contacted via WhatsApp or Email. Due to lack of funding, social contacts were used to choose participants for study. A purposive sampling was done and 17 teachers were approached. However, only 10 were ready for interview. Teachers chosen for this study had more than 5 years of experience teaching either Science, Mathematics or Computer. The demographic information of the participants is summarized in Table 1.

Research participant number	Teacher code used for this research	Gender	Experience (in years)	Highest qualification	Board
1	RP 1	Female	6	MSc., B.Ed.	ICSE
2	RP 2	Female	7	B.Sc. B.Ed.	CBSE
3	RP 3	Female	8	M.Sc. B.Ed.	ICSE
4	RP 4	Female	8	B.Sc. B.Ed.	SSC
5	RP 5	Female	12	B.Sc. B.Ed.	ICSE
6	RP 6	Female	13	B.Sc. B.Ed.	SSC
7	RP 7	Female	18	M.Sc. B.Ed.	ICSE
8	RP 8	Female	20	B.Sc. B.Ed.	SSC
9	RP 9	Female	25	B.Sc., M.A. B.Ed.	ICSE
10	RP 10	Male	18	M.Sc. B.Ed.	ICSE

Findings: The primary data collection tool was the interview. 10 teachers were interviewed from region of Mumbai. The interviews have been analysed using the identified themes with relevant responses of the participants used to highlight the main findings.

Awareness of STEM.

When participants were asked to share their views about STEM, nearly 60 % were aware about STEM. Some of the responses are stated below:

RP 2: I learned about STEM in detail when my sister enrolled in B.Ed... She had an activity to do. Despite the fact that I was aware of STEM, I never made an effort to comprehend it because our focus has always been more teacher centric for the past 18 years.

RP 1: I came across STEM during comprehensive professional development program held in our school. We had some guidance sessions conducted by STEM instructors in our school.

RP 10: I think of STEM as project-based learning since most of the things are activity based.

However, around 40 % of teachers weren't completely aware about STEM but some looked it up online or asked their colleagues.

RP 4: *We don't use STEM education... I read about it, when you asked me for an interview... I had just come across it in advertisements.*

Despite the fact that NEP was launched two years ago, many teachers are still not familiar with the concept of STEM.

Integrating STEM in the curriculum.

When participants were asked about their views regarding integrating STEM in regular curriculum, nearly 90% of the participants agreed that STEM education should be incorporated into the curriculum, but many were unsure of how this would actually work out.

RP 3: I feel it should be integrated because it will help to develop skills and make students ready for the real world. But will it really be that simple? Many don't even have an idea of what exactly it is... So, it's going to be a task.

RP 9: Integrating all 4 subjects? That's going to be pretty difficult… Maybe we can try integrating 2 first? Not all teachers have knowledge about all subjects so how do we teach something we ourselves are not confident about? Say for example, I am not very good with computers, but I love science so if we integrate all 4 wouldn't it be difficult? Also, we didn't study engineering, how do we go about with it?

Almost all teachers are in favour of integrating STEM into the curriculum but are concerned about how this will happen and whether it will be practical. Teachers are also concerned about integrating all four subjects and have suggested that it should be done in a phased manner (for instance, integrating science and mathematics first). Furthermore, all teachers specialize in certain subjects and thus have a comfort zone in those subjects only. As a result, teaching all four subjects might be challenging without upgrading their knowledge and skills.

Implementing STEM in classroom.

When teachers were questioned on how they plan to implement STEM in classroom setting, they had following responses:

RP 8: I don't think that will be easy to do… we do not have any guidelines on doing so. Neither any methods for applying it nor any PD workshops. Our classes have a strength of 70 students and I don't think it will be feasible to do…

RP 1: Government has made some policies and is planning to bring about some changes but I don't think it's going to be a cake walk. Although our school has told us to give a thought about it. I feel we might have to take baby steps towards it.

The majority of teachers are skeptical to implement STEM in their classrooms because they believe that teachers should know everything before interacting with students. Additionally, before implementing STEM, they recommend that all teachers receive training.

Factors to be considered for successful implementation of STEM.

When participants were asked about what are the important aspects that we need to consider for successfully implementing STEM in future, around 70% of the responses were same to ones explained below:

RP 2: Above all we need teacher training and it should be vigorous. I am unsure how many would actually do it. Perhaps the government need to enforce it in the same manner as they began Nishtha courses for teachers... Alternatively, a pilot program can be planned and selected teachers from each school can attend full time workshop and guide their colleagues further...

RP 5: There should be proper infrastructure, availability of materials and rearranging the curriculum since our current structure of curriculum is not equipped to integrate STEM… This is going to be a big change and hence proper guidelines along with courses for teachers is essential. All boards function differently and that should be taken into consideration too. I believe some schools have huge number of students in each class and the same should be addressed as well.

RP 3: During Covid our school had organised some sessions for us and we tried to implement the same but we came across many hurdles like, we had to use our own materials, which is of course expensive, also catering to needs of 40 students wasn't easy. For this maybe one more assistant teacher could be required and educators as well as the students should be provided with the required resources.

Participants feel the most important factor is teacher training since educators play a pivotal role in implementation of STEM, followed by required materials, infrastructure and guidelines for implementing STEM.

Impact of integrating STEM on student learning.

Teachers were further questioned on what impact will STEM integration have on student learning, around 90% of the participants responses were similar to the ones presented below:

RP 2: This obviously is going to benefit students since we will be shifting from teacher centric to student centric.

RP 5: It is going to be helpful because this will help students for real world situations and problems. Nowadays they just do mere rote learning... STEM will also help students to come up with creative ideas and solutions which will also enhance their problem-solving skills. As a teacher, I understand that... but our syllabus is so packed that we have to always run to complete our portion and so like I mentioned earlier, we need to rearrange our curriculum so that students can get maximum benefit out of it.

Teachers stated that integrating STEM is definitely going to be helpful to develop cognitive skills of students and prepare them real world situations.

Usefulness of NEP in Integrating STEM

Since NEP 2020 was launched, teachers were questioned on what impact would NEP have on integration of STEM, almost 95% of the participants' responses were similar to the ones demonstrated below:

RP 9: When I went through NEP, I understood that the government is planning a lot of things to do which is great..., and it should be helpful too. Say holistic development of children, using AI and so on. They have a plan but how do we apply it? I had attended a webinar where the experts were discussing many challenges... and yes, these challenges are real but what about the solution? I haven't even seen any progress yet.

RP 3: Though the policy looks very nice… we will have to wait and watch on its implementation to comment on how useful it will be in integrating STEM.

According to the participants, NEP is definitely helpful but it should be providing some guidelines to apply the same in the classroom.

V. DISCUSSION AND IMPLICATIONS:

The current study uses qualitative data from a semi-structured interview conducted to solicit information regarding perceptions of 10 teachers about STEM education. I believe that the findings can serve as groundwork for a holistic view of the teachers regarding STEM, its application in the classroom and factors that hinder or facilitate STEM.

Overall, the participants discussed multiple views on STEM and its integration. Perhaps most notably the study revealed that even though government has planned for holistic development of a child and is focusing on STEM, most teachers are concerned about how they are actually going to implement it in the classroom.

It was indicated from the first question itself that in service teachers had limited awareness of STEM education. This reflects the need to improve awareness of STEM and this can be done either by social media or by the school itself by providing professional development workshops. Government of India has been conducting various courses but they lack introduction or understanding of STEM. Despite all the positive reviews of implementing STEM in classroom, there are some challenges that have been raised. One challenge highlighted by the teachers is the amount of time that will be required to complete their syllabus while simultaneously practicing STEM. According to some findings and teachers' perspectives, STEM lessons might be offered after school hours to give teachers enough time to finish their syllabus.

This study also found that teachers faced difficulties with limited resources and high costs for STEM-related projects. For instance, it would take a lot of materials just to complete an electrolysis project. When a large number of materials are required to accommodate 40 to 50 students in a class, this becomes challenging.

The majority of ICSE and CBSE schools have a strength of almost 40 students, however it would be more difficult for SSC classrooms where the strength exceeds 60 students. This challenge has also been described in the works of Wang et al. (2011). In addressing this challenge, teachers recommended that government as well as the organization should provide some materials for the students which would then help in implementation of STEM.

The study also highlighted that the lack of STEM training could be a challenge for a teacher adopting STEM in his or her lessons. Wang et al. (2011) explained that a real-world problem serves as the foundation for interdisciplinary integration. However, the majority of teachers who participated reported that they lacked sufficient knowledge of the other fields, such as engineering or mathematics, to be able to employ these instructional strategies or create STEM lessons. Some teachers still feel uneasy using STEM activities in their classrooms despite professional development (Asghar et al. 2012). Numerous facilitators of professional development have observed teachers' resistance to use STEM (Dare et al. 2014). According to Williams (2011) and Honey et al. (2014), science teachers must employ integrative methods in order to teach STEM integration in the classroom, but integration is often difficult for teachers to teach. In order to adopt STEM in science teaching, a teacher needs to be well equipped with not only the content knowledge in science or mathematics, but also the instructional skills in delivering science content through a STEM (Srikoom et al., 2017). The Indian government has started some workshops for teachers' professional development, but improving teachers' content knowledge is a challenge. Maybe the school should start vigorous workshops for teachers so that all the in-service teachers feel at ease and confident in their ability to manage the class. Different stages of preparation can be led by researchers too. For instance, training in STEM such as the one conducted in the study by Han et al. (2015) allowed teachers to implement STEM in classrooms and also helped researchers identify the challenges faced by educators which would help for further study.

Students' peers, families, and the use of technology in everyday life can pique their interest in science and STEM subjects and encourage them to pursue STEM careers. As a result, it's critical to take advantage of the culture and use science lessons to promote STEM applications. In this sense, the survey by Roberts (2002) states that the perspectives on guardians, educators, vocations counsellors and society overall can play a huge role in molding students' decisions with regards to whether to study these subjects at higher levels. Science teachers must be aware of their pedagogical responsibilities regarding subject selection and career aspirations and be able to refer students to professional, sources of career information, advice, and guide them further. As

a result, it is critical to develop STEM-related projects and activities that can help students' teachers, parents and universities better understand STEM initiatives and also help students become more aware of STEM careers and subjects. Numerous studies and reports back up these recommendations (for instance, Stohlmann et al., 2011; Wang et al., 2011).

The teachers view highlighted are the ones that are similar to Hanif et al. (2018) and Iskandar et al. (2020), where it indicated that STEM projects stimulate students' critical and creative thinking in STEM subjects. Being able to see connections between subjects and thinking critically and creatively in STEM domains, for example, could assist students in making wise career decisions.

VI. CONCLUSION:

This study fills a gap in the research field of STEM education in the Mumbai region in general as it seeks to understand the current views that teachers hold toward STEM education and its core interdisciplinary nature. This study findings suggest that teachers are not fully aware of STEM and its practices especially due to lack of training and support needed to enact such practices. There is a need to conduct more professional development programs for teachers.

These findings can help to provide recommendations to government to introduce professional development workshops for teachers. This could lead to developing a STEM professional development model of what teachers need in terms of pedagogical content knowledge to enact STEM education in class. Future studies can focus on what are students' views when STEM is implemented in classroom. This as a whole would help in planning STEM based comprehensive development programs. Teachers made comment about lack of time and hence re-arranging the curriculum will be important to promote STEM. Understanding of NEP 2020 and applying STEM according to its guidelines is also important. The main limitation in this study was that this research was conducted only in region of Mumbai. Other regions and states may have different needs and varying issues. Furthermore, this research was conducted in urban region where institutions have better facilities as compared to rural region who lack infrastructure as well as advanced technology. More research is still needed in India on STEM education to comprehend how STEM could be implemented.

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