

# Social Emotional Learning through STEM Education: Educators' Perspectives

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**Abstract:** *In an increasingly competitive world which is ruled by technology and innovation, the indispensable need for humanistic skills has never lost its charm. A society high on social and emotional intelligence along with an acumen for science technology is sought after. To promote STEM Education in India, ATAL TINKERING LABS (ATLs) have been established in more than 5000 Government as well as Private schools in India. These Labs have been established with a objective to encourage innovation, critical thinking, creativity, problem solving etc. skills among the students. In addition to all these skills, one of the objectives of ATLs is to improve Social Emotional skills of students. For success in life, Social Emotional learning is an integral skill a person must have. ATLs provide the space for "Do it yourself" culture for mass manufacturing in the hands of young entrepreneurs and independent thinkers. Here the goal is to understand the effectiveness of ATLs. Teachers play an important role in the development of skills and bring out talent in the students and effective implementation of a program. In this paper an attempt has been made to understand Educators' perception about STEM Education and Social Emotional learning. For this purpose, research was carried out on educators who are in-charge teachers of ATLs, in Government schools of Haryana. After establishing content validity a questionnaire was administered to explore educators' perception. Based on the responses, face to face interviews with participating educators were conducted, it was revealed that most educators are of the view that students working in ATAL Tinkering labs have improved learning outcomes and better social personal qualities. However, educators find some challenges while working with students in ATLs, such as difficulty in developing interdisciplinary problems related to day-to-day life and to find their solutions. Lack of proper timetable for ATL classes during school hours, transfer of educators in other schools, where there are no ATLs. Trainings of educators are required on coding, artificial intelligence, machine learning etc for proper utilization of Atal Tinkering Labs.*

**Keywords:** ATAL Tinkering Labs (ATLs), Educator's perception, STEM Education, Social Emotional Learning

## 1. Introduction

As per National Education Policy, 2020 of India, the world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances such as machine learning and artificial intelligence, the need for a skilled workforce, particularly involving mathematics, computer science and data science will be in greater demand. Education should provide opportunities to be creative and innovative. Pedagogy must evolve to make education more experiential, holistic, integrated enquiry driven, discovery-oriented. Atal Tinkering labs provide such opportunities to the students. The students learn by doing and are encouraged to develop new understandings while refining their ideas (Mooney and Laubach 2002). To develop 21<sup>st</sup> century skills among students like critical thinking, problem solving, computation, creativity, Atal Tinkering Labs are being established in various Government and private schools in India. At present more than 5000 ATLs are functional in India. ATLs are 1200 to 1500 square feet area dedicated to endorse STEM education by providing innovative workshops where do it yourself kits on latest technologies like 3DPrinter, Robotics, internet of things is available, but content of other disciplines. They must be capable of creating an educational environment that allows students to solve problems while deepening their content knowledge.

India is a developing country and needs more citizens to adopt STEM related careers as their occupation as it is fast growing and best paid. To create interest of the young generation in STEM related subjects and to develop a culture of innovations, ATLs provide the best platform. In order to promote STEM (Science, Technology, Engineering and Mathematics) Education, Atal Innovation Mission (AIM) is a flagship initiative of the Niti Aayog, Government

of India by establishing ATAL Tinkering Labs (ATLs) in schools. ATLs are the workspaces where young minds can give shape to their ideas through hands-on activities. Atal Tinkering Lab is a physical space in the vicinity of school equipped with the education technology in the world. Its vision 'Tinkering in schools' became a celebration of creativity and expression of knowledge generation in all stakeholders.

Social Emotional learning is an important skill for students for school, work and life. Collaborative of Academic, Social Emotional learning (CASEL) has defined social emotional skills as activities which help children and adult acquiring and effective application of knowledge, attitude and skills needed to handle emotions, to make responsible decision, to establish and maintain decision, to establish and attain positive goals and to realize and express empathy.

Social Emotional skills can be understood as belief and attitude that allow students to manage themselves as well as their relation with others. School curriculum developed with aim that there is development of cognitive skills as well as social-emotional, physical silks of students. If educators are not aware about social emotional skills, they do not take care about development of these skills. In absence of social emotional skills among students, schools have to face many challenges like indiscipline, unrest, growing incidence of bullying, violent and abusive behavior among students. Social emotional skills not only help in adjustment in society but also helpful in academic success of students.

In this study focus is on, Is there any relation between STEM education and Social Emotional skills of students? Educators' role cannot be neglected in the development of students, that is why to know educators' perception is mandatory. If teachers are not well aware about it, their

professional development programs can be organized to get maximum benefits of Atal Tinkering Labs in schools of Haryana.

## 2. Background

To explore Teachers' perception about STEM education and Social Emotional Learning a systematic review of earlier researches on this topic was done. The basis of STEM pedagogy is integrating real world problems with their content knowledge of Math and Science. The students learn by doing and are encouraged to develop their understanding while reflecting their ideas (Hooney and Laubach 2002). For this purpose, teachers should have a deep understanding of the subject and should be able to connect with real life situations. Teachers have to know not just their own subject but also be able to create an educational environment that allows students to solve well defined problems on the basis of their knowledge. Teachers play a role of catalyst in the talent development process. (Gagne 2007) In this role they may either help or hinder a student's development of STEM talent.

More et al. (2014) conducted an exhaustive survey on STEM Education and found that it includes six major tenets

- a) Inclusion of math and science content
- b) Student centred pedagogy
- c) Lessons are engaging and motivating context
- d) Inclusion of engineering design challenge
- e) Students learn from making mistake
- f) Teamwork is emphasized.

STEM pedagogy explains the teacher's role to guide students to examine problems from all angles by questioning. Teachers are as facilitator, students use hand-on, practice application of content in order to solve the challenges. According to (Honey et al 2014) STEM education is to teach 21st century skill to students, which include work for readiness, ability to make connections among STEM disciplines, interest and engagement.

STEM education includes use of Math and Science concept, students have learned, to apply in engineering design and technology to solve real life problem (Chamberlin and Peries) STEM pedagogy also leads students to a deeper understanding of content while solving ill-defined problem (Mann & Mann 2017)

Government of India (Niti Aayog) is making efforts to implement STEM education by establishing ATAL Tinkering Labs both in Government & Private schools of India. The role of educator is very important for the success of the program. Educators have to provide such environment to encourage students to work on real life problems and to provide project-based lesson that encourage critical thinking and innovation while building student understanding of content (Nadelson and Seifert 2013)

Teachers felt the development of new STEM problems while integrating different domains is a challenge. Teachers also reported trouble in combining the STEM Pedagogical approach with their typical concept (Asghar et al.2012). Even after professional development, some teachers are still

uncomfortable using STEM activities in their classroom (Asghar et al.2012).

While some teachers saw STEM as they really needed to cover in their classrooms, some teachers felt that it is a valuable way for students to learn. The teachers strongly feel that STEM should be integrated into students' K-12 education. In other words, they felt that STEM is very important. Teachers believe that STEM leads to higher expectations from the students after high school and feels that it increases the scientific literacy of the students which is very valuable as it develops the students to think critically about current issues and to see the future implications in their own lives.

Teachers believed that STEM education has a positive impact on student learning and outcomes (Park et al 2016). Teachers also experienced a rewarding feeling of making a difference with students and their communities while utilizing STEM education.

Educators' perception of STEM education influences how they design the units and their method of delivery of instructions. A dynamic teacher with a positive attitude towards STEM seems to be a single most important factor to implement the fidelity and STEM program success (McMullin and Reeve 2014). These teachers believe that STEM integration can improve their students' learning outcomes.

### Social Emotional Learning; educators' perception

Why social-emotional learning? According to Kirdon, (2018) Social Emotional Learning is important for students because it goes beyond the brain (Head) and it helps them to connect their emotions and their heart. It helps in building up students' character. Character education promotes core virtues, moral sensitivity and commitment, ethics and personal growth. Social Emotional learning can assist students with managing stress, handling mistakes and establishing healthy relationships (Gulbrandson2019). Additionally, social emotional learning can help to reduce discipline issues and emotional stress, increase a positive attitude towards oneself and improve test scores along with grades and attendance, which means all the areas that students struggle to maintain their first year of high school (Weissberg 2016). SEL has a positive impact on mental health, which can increase motivation to learn and decrease risky behavior. SEL can provide students with skills they need to effectively manage their behavior, emotions and relationship with others. (Go Guardian 2019)

According to Durlok and Mahoney (2019) there are several positive benefits of SEL, which include improved academic performance, lower level of stress, improved students' attitude, decrease in conduct issues and improved social behavior. SEL program showed an 11% gain in academic achievement. However, for successful implementation of SEL in classroom educators must be well aware of it. Before educators can effectively embrace, implement, incorporate and teach students about SEL in their classrooms, it is important that adults understand SEL and practice SEL skills and competencies. Much often adult SEL is ignored (Harrison\_Berg2018).

According to Rolistalle 2019, when educators have strong SEL skills, they are more prepared to teach SEL skills to students, able to model SEL skills and competencies and are better equipped to manage stress and demands of the educational profession.

### Research Questions

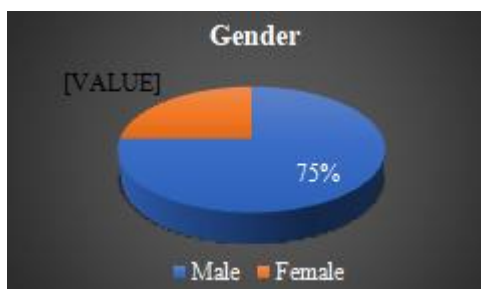
**Question 1:** What is the educators' perception on the role of STEM education in developing SEL?

**Question 2:** What are the challenges the educators face in implementation of STEM through ATLS?

### 3. Methodology

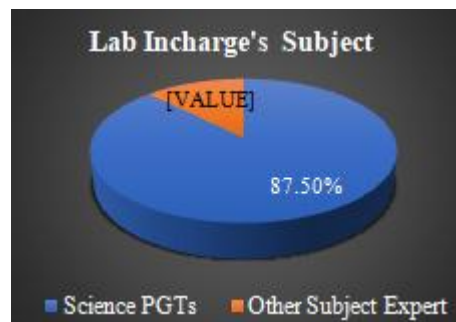
To know teachers' perception about ATAL Tinkering Labs, the method should allow a comprehensive overview of educators. Mixed research was designed in which a survey was conducted on educators (incharge teachers of ATLS) using questionnaires as well as interviews. Self-developed Questionnaires were shared with 30 educators (20 from Rural and 10 from Urban schools) of Government schools of Haryana, where ATLS are functional. Face to face interviews were also conducted with randomly selected 10 participants. The purpose of this study was to know the Educators' perception about Atal Tinkering Labs in schools of Haryana. This study was carried out to understand educators' beliefs related to the benefits of ATLS. Whether they are confident in taking the classes in ATLS. Their knowledge about Social Emotional Learning and its advantage to students in their day-to-day life. Whether ATLS can help in improving SEL of students? Realizing the importance of perception of educators to get maximum utilization of ATAL Tinkering Labs for improving students' skills, this study was conducted. To fulfil the objectives of the study a questionnaire was developed containing 20 items. Each item has four options, participants were supposed to tick mark the right option. In addition to questionnaires, face to face interviews were conducted to know educators' perception about ATLS and challenges faced by them for implementing STEM education through ATLS. What are their views about Social Emotional learning? How SEL can be helpful for the academic improvement of students. Do teachers make efforts to develop SEL among students? Whether students working in ATLS have better SEL etc. On the basis of questionnaire and interviews we have deduced the following findings.

#### Demographic Information

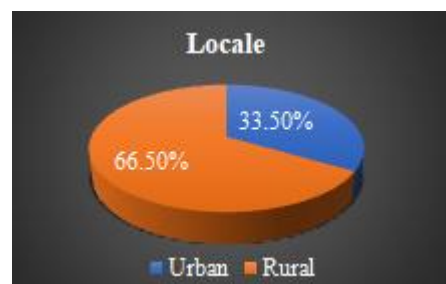


- **Gender of Lab Incharge Teacher:** A total of 30 teachers who were the incharge of ATLS in different Govt Schools of Haryana were taken as a sample. Out of

which, a total of 75% incharge teachers were male and 25% were female.



- **Lab Incharge's Subjects:** Out of the total sample 87.5% were post graduate science teachers and 12.5% were from other streams like English, Sanskrit and Fine art. In all the schools, science teachers were preferred to give the charge of ATLS because it is easy to work with STEM pedagogy. But wherever science teachers were not available or transferred, the charge were given to other experts as short-term arrangement.



- **Location of Schools having ATLS:** In the total sample, a total of 66.5% schools were situated in rural area and 33.5% schools were situated in urban areas of Haryana State.
- **Type of School:** Schools are of two categories, one Govt Senior secondary school and other Govt Model Senior secondary schools. In Model senior secondary schools, the medium of instruction is English while in other senior secondary schools, medium of instruction is Hindi.

### 4. Findings

By administering percentage method and content analysis, the findings with relevant justifications against each research questions of the present study are given below.

#### Research Question 1: What is the educators' perception on the role of STEM education in developing SEL?

The primary objective of present study was to explore the educators' perception on the role of STEM education in developing social Emotional Learning. In the light of first question, a total 10 questions were asked to the teachers taken as a sample.

**Finding 1:** Teachers had a positive attitude towards using ATLS.

In the response of question i. e., "how useful ATLS are for students", 84% teachers responded that ATLS are very much

useful, which shows they were having a positive attitude towards ATLS.

**Finding 2:** Teachers perceived ATLS very helpful for students in their personality development and social emotional learning.

In response to the question i. e., “working in ATLS is helpful for students in their personality development and social emotional learning”, 80% of educators' perception is that STEM education/ ATLS helps in improving social emotional learning of students. Students who are enrolled in ATLS are more focussed, well behaved and have good relations with teachers and their peer learner. They work together on common problem which develop their cooperative, collaborative skills. These students are able to manage their emotions well when stressed. Their aggressive behaviour is under control.

**Finding 3:** Teachers perceived social emotional learning very much required for students.

In response to the question, whether Social Emotional Learning is required to student, to be successful in life. 85% educators are of view that SEL is very much helpful for students. These skills inculcated in students help them to be better person in life.

**Finding 4:** Students were reported with ‘always ready and interested’ attitude for classes in ATLS.

75% of Educators perception is that Students who are enrolled in ATLS are more focussed, are well behaved and have good relations with teachers and their peer learner. They work together on common problem which develop their cooperative, collaborative skills. These students are able to manage their emotions, when stressed. Students are always enthusiastic for working in ATLS.

**Finding 5:** Teachers agreed that students are helpful to each other.

Educators agreed that students enrolled in ATLS are helpful to each other. According to them, for students to work in ATLS is enjoyable as well as challenging. It makes them engaged and motivated. Teachers believe STEM education, which is being furnished in ATLS, is inherently motivating to students.

**Finding 6:** Teachers shared that students always try to connect the ATL projects with their real-life situation.

Teachers feel that students are interested to work on STEM challenges and the students eventually begin to feel motivated and empowered by their ability to solve complex problems. The complex, open ended design of STEM challenges also leads to student increase in academic achievement. Teachers note overwhelmingly positive responses from students during STEM education, they try to connect the ATL projects with their life situations. Teachers felt that increase in student enjoyment and engagement was the main reason for integrating STEM into their curriculum.

**Finding 7:** Teachers believe that students accept STEM problems as a challenge, which help them to improve designing skills

Educators believe that struggle and even failure are inherent yet valuable components of the engineering design process

within STEM education. Students are asked to improve upon their design and find solutions. They are encouraged to take risks. Teachers feel this is beneficial to students, especially for high achieving students. Our findings showed that ATLS are helpful in improving students’ interest in science subjects and also improve the learning outcome of students.

**Finding 8:** Students working in ATLS has respectful relations with their teachers.

65% of Teacher In charge strongly agree that students working in ATLS are emotionally strong. They have better adjustment with peer students (as they learn in collaboration) they are able to manage their emotions facing failure in any project. Have good relations with their teachers as well as take decisions and have problem solving nature (social skills) are improved. While the remaining 35% of educators under survey said that ATLS help in social emotional learning to some extent. However, boys are more interested in problem solving activities as compared to girl students.

**Question 2: What are the challenges the educators face in implementation of STEM through ATLS?**

In response to the second question, it was found that most teachers value ATAL Tinkering Labs and their importance for improving learning of students but they reported barriers such as time-table challenge, workload challenges, structural challenges, concern about assessment etc. Administrative support from school heads and district officers are also lacking in some places. Another important barrier in effectiveness of ATLS is lack of technical support in form of trainings related to STEM pedagogy, problem solving and project-based learning. Educators mentioned that although few workshops are organized at SCERT level, they are not sufficient.

**Finding 1:** Teachers expressed their concern about non-allotment of period for ATLS in time-table.

There is no provision of ATLS classes in the time-table of school. Teachers are supposed to take extra classes before or after school for working in ATLS. It is sometime difficult for teachers as they have their home assignment after school hours.

**Finding 2:** All teachers taking classes in ATLS are not confident

50% teachers In charges are confident, 30% are confident to some extent, 20% of teachers are not confident for taking classes on Artificial Intelligence and experiential learning every year.

**Finding 3:** There is a lack of administrative support for ATLS classes in schools

Lack of Administrative support/District support. All school heads are not very supportive for ATLS classes. As school heads are more concerned about the regular board result of schools, many educators find it difficult to cope up with school heads in adjusting time table for ATLS.

**Finding 4:** In some schools language teachers are given responsibility of ATLS in the absence of science teacher.

Language teachers like English and Sanskrit teacher has been given responsibility for ATLS in some schools. As they

don't have a science background, they may not be able to justify the classes they are taking in ATLS.

**Finding 5:** There is a requirement of training/workshop for teachers to take ATL classes

While interviewing teachers on implementation of STEM education through ATLS, Most of Educators expressed their concern. They demanded regular trainings/workshops for their capacity building to take classes in ATLS.

**Finding 6:** Some trained teachers of ATLS are transferred to other schools

During interviews, it has come to the notice of researchers that in some schools, teacher incharge of ATL, who has obtained some training, has been transferred to other school, where there is no ATL.

## 5. Discussion and Conclusion

This Study shows that students are natural explorers, they are always enthusiastic to work on problems they are assigned in ATLS. However, an educator plays a key role in policy implementation. Educators' role as catalyst in the talent development process. In this role they can either help or hinder a student's development. Educators facilitate teamwork as students actively discuss their findings, record data etc.

In this study it is found that all educators are not well trained for taking classes in ATLS. Capacity building of educators through a series of workshops, trainings on developing problem-solving pedagogy is must. Only then better results in the form of students' learning outcomes can be expected. Students working in ATLS have better social emotional skills. STEM education provides students problem solving ability and practice their knowledge creatively. They are able to handle failure. They work in collaboration, as a team to solve a problem. They are focussed and their energy is used in constructive way. They are a source of inspiration to fellow students.

Most of the teachers under survey were of the view that establishing ATLS in school is a very good initiative of Niti Aayog [Government of India] to promote innovation, critical thinking, creativity etc. However, they face certain challenges. They reported barriers for proper implementation of ATLS in schools which are

- 1) Additional workload on Educator (teacher incharge), as subject teachers already have a regular timetable for teaching their core subjects.
- 2) Nonavailability of periods for ATL classes in the timetable of school. Educators are supposed to adjust their classes for ATLS after or before school hours.
- 3) Lack of support from administrators, school heads, as there is no assessment of ATLS work.
- 4) Educators find it difficult to design problem solving assignments for students, they felt that technical support would improve their effort to implement ATLS in schools.
- 5) Transfer of educator, who is incharge of ATL is also a great challenge. An educator's capacity is developed, but as per transfer policy, after 3-5 years he is

transferred to another school, where there may not be ATL.

## 6. Educational Implications

For upgrading the functioning of ATLS in Govt Schools of Haryana, Researcher has recommended the following proposals.

- 1) Provision of period for Atal Tinkering Lab in school Time-Table, so that students regularly do hand on experiments in ATLS.
- 2) Capacity building of Educators who are working as incharge of ATLS. They may be trained on coding, artificial intelligence and designing interdisciplinary problems.
- 3) Integration of STEM pedagogy in school curriculum so that it may be assessed in school examination.

We suggest checking the workload of Incharge teachers. Hand holding of educators through training and workshops. Administrative support from school heads, in the form of adjustment in timetable is must. In the long run STEM syllabus may be integrated with curriculum which can be assessed in school/ board.

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