



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## Atal Tinkering Lab: The Practical Relevance of STEM Concepts

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### Abstract

This article focuses on the practical relevance of STEM Concepts under the Atal Tinkering Labs as part of the Atal Innovation Mission's. Atal Tinkering Laboratories (ATLs) are being established in schools all around India to "Cultivate One Million Children in India as Neoteric Innovators." However, the Government of India's main program to encourage entrepreneurship and innovation in the nation is the 'Atal Innovation Mission (AIM)', run by NITI Aayog. In order to do this, AIM has launched a comprehensive suite of program that support innovation at different stages of the innovation lifecycle and are targeted at different stakeholders. Thus, introducing young minds to the ATL program is crucial to fostering qualities like design thinking, computational thinking, adaptive learning, physical computing, and imagination. It also aims to promote their curiosity and creativity to fulfill the objectives of the Aatmanirbhar Bharat program. The paper covers the primary goal of setting up ATLs is to inspire young pupils to comprehend STEM (Science, Technology, Engineering, and Math) subjects in a practical and imaginative manner using the specialized tools and resources. The strategy aims to get rid of restrictions brought on by dry classroom instruction and relying solely on textbooks as a source of information without any exposure to practical methods. The students would use the specialized tools and resources to investigate how STEM theories and concepts applied in real-world situations. The timely competitions will also be organized to further motivate kids to show off their newly acquired talent, allowing pupils to showcase their abilities through a variety of pertinent tasks.

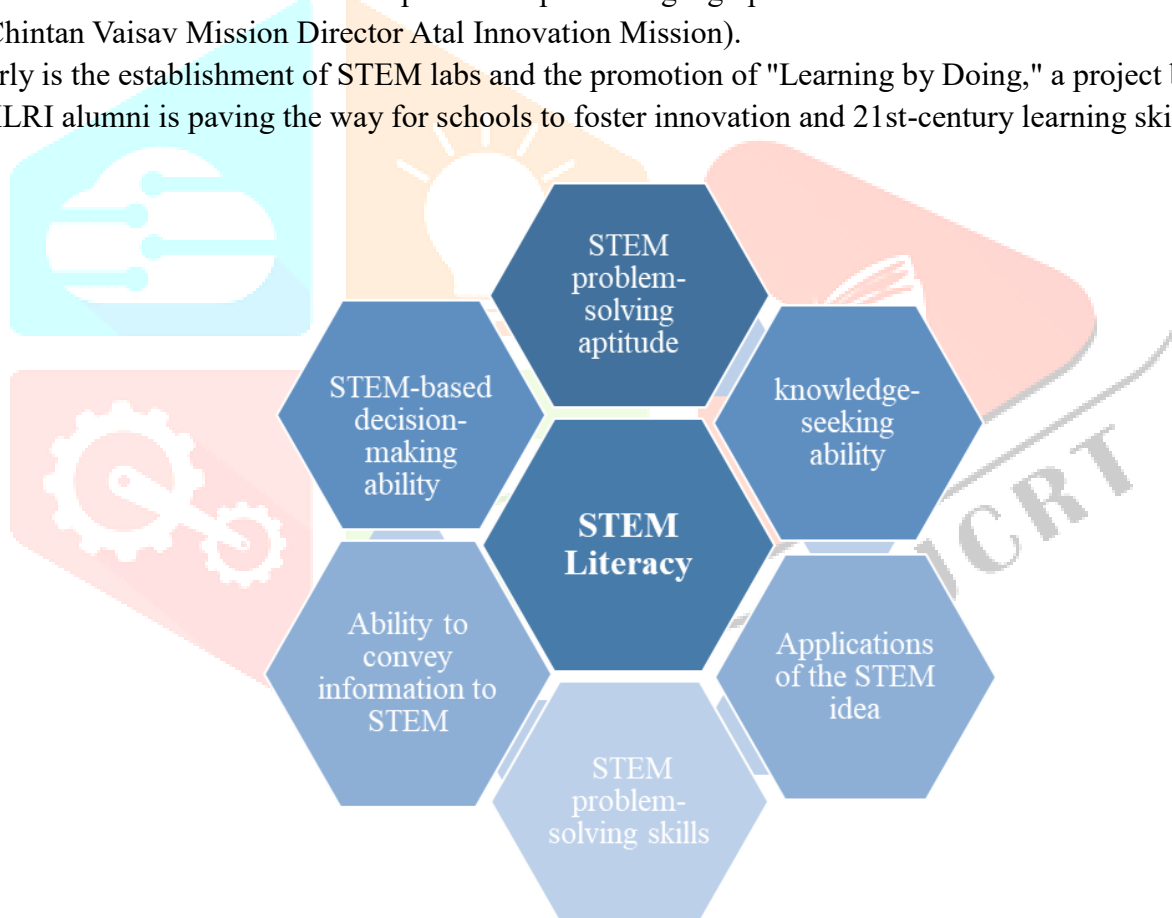
**Keywords:** Atal Tinkering Laboratories, STEM

## Introduction

The NITI Aayog, an Indian think tank, has created a network of "Atal Tinkering Labs" (ATL) under the Atal Innovation Mission (AIM). The main objective of this initiative is to enhance the STEM education system in India by nurturing the curiosity, creativity, and imagination of young individuals. These Atal Tinkering Innovation Laboratories (ATLs) are being established in schools across the country as part of the larger mission called "Cultivate One Million Children in India as Neoteric Innovators." The program aims to develop traits such as curiosity, inventiveness, and creativity in young minds, while also fostering skills like design thinking, computational thinking, adaptive learning, and physical computing. (Atal Tinkering Labs 2023)

The innovators and discoverers of the next generation will propel India to the top of the global power rankings. The Atal Innovation Mission (AIM), the premier project of NITI Aayog, is the Atal Tinkering Lab, which encourages creativity and innovation. ATLs are open innovation maker spaces where budding inventors give their concepts physical form through DIY mode. The initiative has grown into a widespread movement that is transforming India's educational system. I have a lot of hope for the future of our nation when I meet students from all across the nation who develop ideas despite their geographic isolation and limited access to resources. (Dr. Chintan Vaisav Mission Director Atal Innovation Mission).

Tinkerly is the establishment of STEM labs and the promotion of "Learning by Doing," a project by IIT Delhi and XLRI alumni is paving the way for schools to foster innovation and 21st-century learning skills.



*Fig. 1 STEM Literacy*

Atal Innovation Mission (AIM) is an initiative by the Government of India that aims to foster a culture of development and entrepreneurship. As part of this mission, the Self-Employment and Talent Utilization (SETU) program has been established. SETU serves as a platform to promote various activities such as Grand Challenges, start-up ventures, and independent projects, particularly in areas that are driven by innovation. The Atal Innovation Mission consists of two centers that will facilitate the implementation of these initiatives:

- Business enterprise advancement through talent utilization and self-employment, wherein trailblazers would receive help and direction to develop successful business concepts.
- Innovation promotion: to provide a setting for the generation of original ideas. (The handbook titled "Nayee Dishayein Naye Nirmaan Naya Bharat" serves as a guide for the Atal Tinkering Labs.)

## About Tinkering

The term has a lengthy past. Around 700 years ago, it was common for traveling tinsmiths to fix various home goods that occasionally needed minor repairs. It was given the label "tinkering," which normally refers to unfocused preening or a small bit of mending. Now, how does it relate to the modern-day global education sector? To do it, we must access a child's brain.

## Types of Tinkering Labs (Tinkerly)

There are two types of Tinkering labs:

**ATAL TINKERING LAB  
(GOVERNMENT-FUNDED TINKERING LABS)**

- The Atal Tinkering Labs not only provide the right tools for testing but also the ideal calm environment and the company of peers who share your interests, which accelerates learning and draws attention.
- . In addition to providing a carefully planned initial phase of experimentation or tinkering that would eventually lead the kids to learn, conceptualize, and invent on their own, guides and lab assistants are present to protect the students' safety. With positive results, tinkering has already transformed the educational system in many industrialized countries, and India is now prepared to benefit from Atal Tinkering Labs.

Out of the 100 labs, the Indian Space Research Organization (ISRO) has adopted 45 Atal Tinkering Labs (ATL) in the initial phase. The decision was made public on Monday at an online event hosted by the Department of Space (DOS), Atal Innovation Mission, and NITI Aayog, according to ISRO. (Jan 2021 India TV)

## TINKERLY'S TINKERING LAB

(CUSTOMIZED LAB  
WITH ENCRYPTING  
PROSPECTUS RANGED  
WITH NEP 2020)

- In this environment, young minds are exposed to cutting-edge technologies like AI, IoT, and robotics, which will pique their interest in the study of STEM subjects.
- The goal of this space Atal Tinkering lab initiative, which was to establish 10,000 Atal Tinkering labs in qualified schools, has been achieved. Private schools have a very small likelihood of being chosen by the NITI Aayog. Students that use technology to create new things have access to advanced capabilities in Tinkerly's Tinkering lab. Therefore, these private schools have the option of using a Tinkering lab with a curriculum that teaches students from fundamental to intermediate level skills and is in line with NEP 2020.



*Fig. 2 The Approach of Tinkering Lab*

- A challenge card will be given to each class group.
- It includes a statement of a genuine problem.
- The ideas of Computational & Design Thinking must be used by the students to solve this problem statement.
- A 5- to 10-minute observation and discussion session will wrap up the lesson.
- The students can relate how math and scientific principles were used in the development of their own projects.

## Atal Tinkering Lab for schools

- The National Instruction Policy (NEP 2020) Mapping Curriculum, which places a heavy emphasis on the value of robotics, coding, IoT, AI, and coding instruction in the modern world, is followed by the Tinkering Lab.
- All teachers had a five-day introductory training course.
- Two times a year, 2 + 2 days of on-demand training and 12 hours of online assistance for teachers will be organized.
- We assign a dedicated CRM & Trainer staff to work with students on each STEM activity.

## Need of Atal Tinkering Labs

In an effort to foster a culture of scientific inquiry and invention among students, the Council for Scientific and Industrial Research (CSIR) chose to adopt 295 Atal Tinkering Labs (ATLs) across the nation on April 9, 2021. Leading CSIR researchers and scientists will serve as mentors and resources for students at these ATLs.

Atal Tinkering Lab, as used in the current educational system, refers to a place where kids can experiment with, learn, grow, and conceptualize various scientific ideas. The Atal Tinkering Lab supports DIY-style projects that encourage students to put what they have learned in class into practice. The children will gain a natural affinity for STEM in addition to learning how the theories they have acquired in their textbooks are applied and important in real life. Students would be inspired to delve deeper and come up with something new if the right environment and resources were provided for them to apply the theories they learned in class. When a few diverse theories are put forth and combined in a meaningful, focused fashion, innovation occurs, as evidenced by the majority of scientific and engineering breakthroughs (Tinkerly 2023).

- ATLs are places where kids may work on their ideas in a hands-on, DIY way while simultaneously learning innovation skills.
- They are presented with the opportunity to grasp concepts related to STEM (Science, Technology, Engineering, and Mathematics).
- The laboratories are equipped with teaching materials and resources for sensors, robotics, computers, open-source microcontroller boards, as well as electronics and science subjects.
- The labs may also offer additional modern amenities like meeting spaces and video conferencing.
- There would also be additional activities including competitions at the national and regional levels, workshops for solving problems, exhibitions, product design and production, talks, and so forth.
- The AIM would provide financial assistance to ATLs. Each school with an ATL will receive Rs. 20 lakhs (which includes an initial Rs. 10 lakhs for establishment costs and Rs. 10 lakhs for operations costs for a maximum of five years).
- It makes sense why many high school students struggle to recall even the most fundamental STEM materials and references they read as younger kids.
- As a result of the aforementioned 3 factors, students' understanding of STEM is rather shaky, and over time, they grow disinterested in the topic (or subjects) because of their lack of commitment.

## Access to ATL

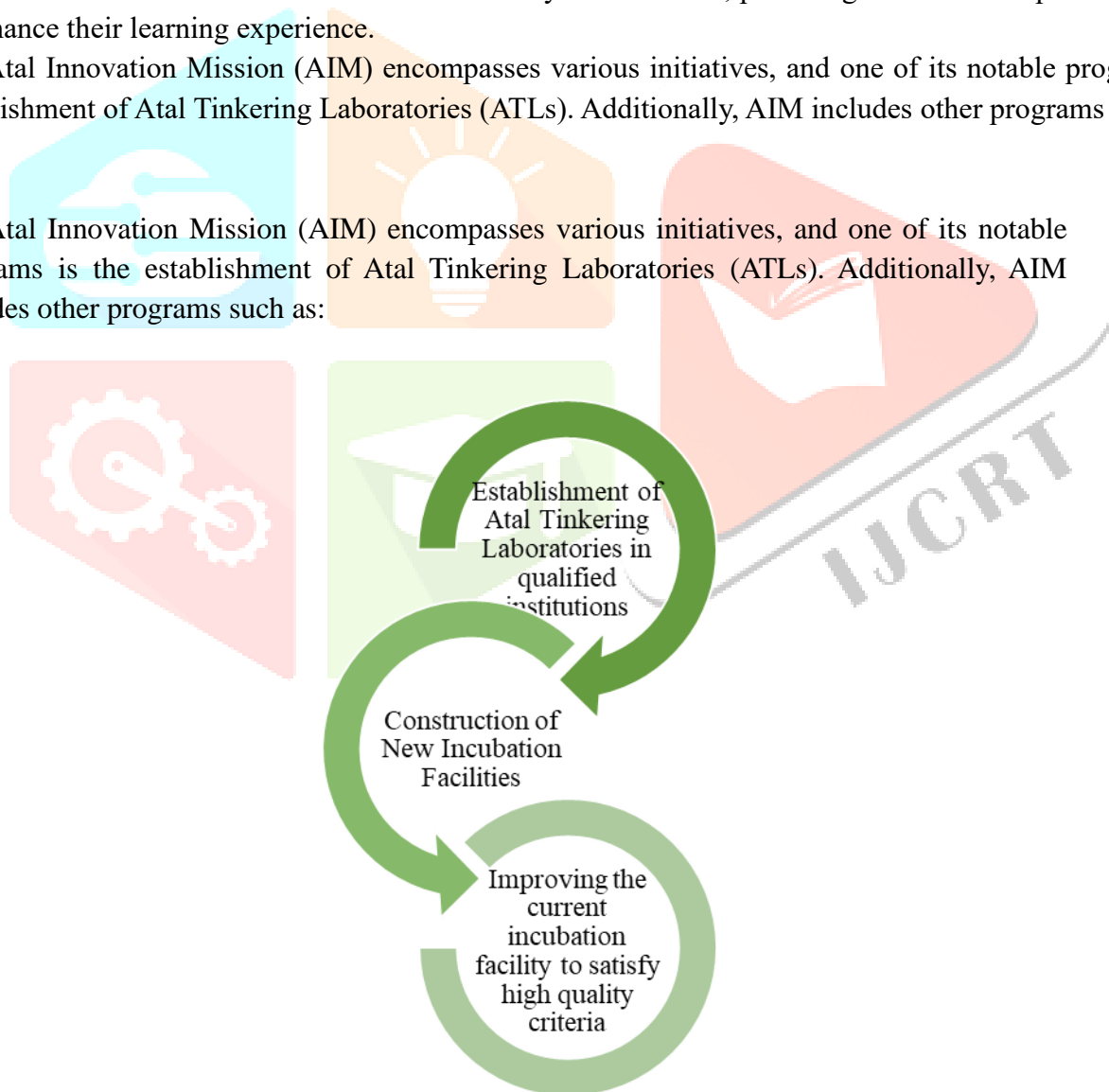
ATLs will be established in government-run schools, as well as schools operated by regional organizations, private trusts, and societies, catering to grades VI to X. The Atal Innovation Mission (AIM), along with Self-Employment and Talent Utilization (SETU), serves as the flagship program of NITI Aayog, reflecting the Indian government's commitment to fostering a culture of innovation and entrepreneurship. The primary objective of this initiative is to provide a platform for promoting Grand Challenges, supporting startup enterprises, and encouraging various forms of self-employment, with a particular emphasis on technology-driven sectors (Atal Innovation Mission 2021).

### The Establishment of Atal Tinkering Laboratories

The main objective of establishing ATLs is to ignite the curiosity of young students and foster their understanding of STEM (Science, Technology, Engineering, and Math) subjects through hands-on and creative approaches, utilizing specialized tools and resources. This approach aims to overcome the limitations of traditional classroom instruction and reliance solely on textbooks, providing students with practical exposure to enhance their learning experience.

The Atal Innovation Mission (AIM) encompasses various initiatives, and one of its notable programs is the establishment of Atal Tinkering Laboratories (ATLs). Additionally, AIM includes other programs such as:

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*Fig 3. Atal Mission Innovation Program 2021*

The students would use the specialized tools and resources to investigate how STEM theories and concepts are applied in real-world situations. There will also be competitions held at the appropriate times to further

motivate kids to show off their newly learned talents, where pupils can display their abilities through a variety of pertinent tasks.

The ATLs will educate young brains to blend creativity and logic by providing them with DIY kits that include tools for robotics, electronics, science, 3D printers, sensors, and other relevant fields. The list of organizations that are eligible to apply for ATLs is fairly broad and includes government agencies, privately run trusts, and schools run by local governments. However, 25% of ATLs would be set aside for institutions under government management.

### **Centres for Atal Incubation**

As part of the larger mission of the Atal Innovation Mission to "Cultivate One Million Children in India as Neoteric Innovators," Atal Tinkering Laboratories (ATLs) are being set up in schools across India. The primary goal of this program is to nurture traits such as curiosity, inventiveness, and creativity in young minds, while also developing essential skills like design thinking, computational thinking, adaptive learning, and physical computing.

Under the Atal Innovation Mission (AIM), there is a plan to facilitate the establishment of new incubators called Atal Incubation Centres (AICs) to provide support to innovative startups in their journey towards becoming flexible and sustainable ventures. These AICs will serve as international incubation centers across various locations in India, equipped with essential physical infrastructure including working offices and necessary equipment. Moreover, the AICs will offer access to sectoral experts who will provide mentoring to new businesses, assistance with business planning, opportunities for seed capital, industry partnerships, training, and other critical resources required to empower and nurture innovative startups.

On January 11, 2021, the Indian Space Research Organization (ISRO) made the decision to adopt 100 Atal Tinkering Labs. This initiative aims to promote STEM education among schoolchildren and foster their interest in space education and space technology-related concepts.

CSIR has recently partnered with the Atal Innovation Mission to adopt 295 Atal Tinkering Labs nationwide. These labs were established with the aim of fostering students' interest in STEM-based research and innovation. During the virtual launch of this collaboration, R Ramanan, the Mission Director of AIM and Additional Secretary of NITI Aayog, emphasized the crucial importance of "Scientific and Industrial Research driven applied Innovations" highlighted by the pandemic. This collaboration with CSIR marks a significant milestone for the Atal Innovation Mission, as it paves the way for encouraging STEM research and innovation through partnerships with both public and private organizations.

## The right equipment and a supportive environment can make the students:

1

Discover the intricate facets of STEM disciplines in a more straightforward and human way.

2

Using diverse senses to experience STEM concepts practically aids pupils in remembering the various facets of the topics.

3

A DIY environment encourages pupils to think creatively rather than adhering to the constraints of previously acquired terms.

4

The Atal Tinkering labs' design enables students to seamlessly combine their left (logical) and right (creative) brains. It aids in the students' "liking" of their topics on a natural level.

### Tinkering as an inclusive approach for building STEM based learning

Tinkering is the act of disassembling and then reassembling, fixing, or enhancing something. A tinkerer is someone who plays around with objects and concepts to fully comprehend how they function. Tinkerers are adding critical thinking and problem-solving abilities as they spend hours disassembling devices and trying to figure out how things operate. Tinkering and iterating for hours frequently leads to the invention of a new device or the discovery of a solution to a problem. Tinkering contributes significantly to STEM education since it instills 21st-century skills as well as engineering and learning habits of mind. In the past, tinkering was thought to be a valuable ability. (Grabowski Wehrell Diana 2021)

The students who are disadvantaged in terms of their education, social status, cultural background, or economic standing, tinkering pedagogy may be used to provide more engaging, inclusive, and equitable STEM learning experiences. Schools look at Tinkering as a learning approach which has an impact on teachers' awareness towards STEM education. To boost young children's exposure to and interest in STEM. With the rise of the maker movement, maker and tinkering spaces and programs have dramatically increased in both the informal and official education sectors. To reap these advantages, it is essential to keep developing and refining design and facilitation methods that can improve young learners' engagement in engineering disciplinary practices and STEM-relevant abilities.



- Teaching and learning with a tinkering mindset A student can explore independently, pursue their own interests, or work together in small groups while tinkering in STEM.
- Learning activities including tinkering are inquiry-based.
- Students are introduced to STEM concepts through tinkering through practical exercises and difficulties.
- Students get the chance to hone their 21st-century abilities (creativity, critical thinking, communication, and cooperation) through tinkering.
- Through tinkering, students are provided with the opportunity to engage in the engineering design process and apply it in practice.
- Students have the chance to cultivate engineering mindsets (improving, systems thinking, adapting, problem-finding, creative problem solving, and visualizing) through the use of tinkering as a pedagogy.
- Through tinkering, students are afforded the opportunity to develop learning habits of mind, which encompass qualities such as curiosity, openness, resilience, resourcefulness, teamwork, introspection, and ethical thinking.
- Students who tinker have the chance to innovate.
- Students learn about the entrepreneurial mindset through tinkering.
- STEM occupations are introduced to pupils through hands-on learning activities.
- For children who are disadvantaged in their educational, social, cultural, or economic situations, tinkering can be utilised to create more engaging, inclusive, and equitable STEM learning experiences.

(Tinkerly)

## Conclusion

The objective of the Atal Innovation Mission is to foster entrepreneurship and innovation within our country. Through the establishment of Atal Incubation Centres (AICs) in universities, institutions, and corporations, AIM is creating a dynamic ecosystem for startups and entrepreneurs. These incubation facilities aim to provide support and nurture to visionary entrepreneurs and high-quality ideas, with the goal of fostering the development of scalable and sustainable businesses. (Atal Innovation Mission 2021)

AIM's operations are supported by the systematic monitoring and management facilitated through MIS systems and dynamic dashboards. As a result, government initiatives such as Make in India, Digital India, Skill India, and Atal Innovation Mission, including Atal Incubation Centres and Atal Tinkering Labs, play a crucial role in bridging the gap between existing and desired ecosystems. It is important to recognize that transforming the entire education system and industry cannot be accomplished overnight. Tinkering, whether done individually or in small groups by students, is a vital aspect of the innovation process. In reality, scientific and technological breakthroughs often emerge when diverse theories are combined in a meaningful and focused manner. Laboratories provide an environment where students can not only apply what they have learned but also experiment with altered theories and observe the corresponding outcomes. Therefore, ATIs are poised to play a significant role in ensuring widespread access to cost-effective STEM-based learning and accomplishing the mission's objectives.

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