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Study on execution of ATL: Innovation and learning ecosystem creation

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Abstract
The ATL space should be one single room with as much open space as possible, so that one area can be dedicated for lecturing and mentoring while another can be used for collaborative project work at the same time. In rare circumstances, two neighbouring rooms with internal connections could be utilised. The ATL must have safe locking and security mechanisms installed. Institutions could play a significant role in helping the ATL establish itself as a community innovation hub. Institutions can help the ATL by providing mentoring and raising awareness about the ATL's innovation activities. Start-ups, Micro, Small and Medium Enterprises (MSMEs), and large corporations are examples of corporate groups that might expose ATL students to innovative technology. While more effectively presenting information and delivering information linked to ATL in a concise manner, the online resources are easy to comprehend and are deployed with the purpose of assisting ATL in obtaining answers to the majority of questions relevant to lab setup.

Keywords: innovation, learning, ecosystem, creation

Introduction

Designing the Atal Tinkering Lab space

According to the ATL application guideline, the ATL should be put up in a 1000 to 1500 square foot area, depending on the regional locale. The ATL space should be one single room with as much open space as possible, so that one area can be dedicated for lecturing and mentoring while another can be used for collaborative project work at the same time. In rare circumstances, two neighbouring rooms with internal connections could be utilised. The ATL must have safe locking and security mechanisms installed. The ATL should be in close proximity to the school's main building. The lab must be set up in such a way that students can move around freely. The tinkering lab must have a defined location for all essential guideline documents and manuals.

ATL Design and Layout Guideline

Because ATL is an open experimentation and innovation bed, it is critical to adhere to the following design and layout guidelines:

1. Infrastructure

a. For a better working environment, adequate ventilation must be supplied inside the ATL.
b. For the students' comfort, infrastructure such as fans, air conditioners, and various plug points must be supplied.
c. For convenience, the lab should have Wi-Fi service/internet dongle, washbasin, water cooler, and other amenities.

ATL etiquette and safety guidelines

For both kids and teachers, safety is paramount. The following are important safety guidelines and etiquettes:
The ATL must include a mandatory first-aid kit. Students and teachers must receive the same training.

a. Fire Safety - At least two fire extinguishers must be strategically placed throughout the ATL.
b. Students and teachers must receive fire safety training.
c. Within the ATL, two entry/exit points (including emergency escape points) must be clearly recognised and labelled.
d. All pupils must wear covered clothing and shoes, and no student may operate any equipment without supervision unless properly trained.

Identifying the right human resource

Students get the ability to turn their concepts into working prototypes/models while working in the ATL. However, in order to attain the required results, instructors with the necessary knowledge, skills, and experience to serve as ATL In-charge must be nominated/selected. The ATL In-charge is critical to ensuring the ATL's innovative productivity and must be properly chosen.

Engaging the nearby community and non-Atal Tinkering Lab schools

The community plays a significant part in the ATL's effective implementation as a local innovation hub. Parents, community students, non-governmental organisations (NGOs), volunteers, and government entities can all have a role in offering support and raising awareness for ATL innovative activities. The ATL's real potential will be determined by collaborative efforts, and the following are some recommendations:

a. Orientation meetings for parents and students outside of ATL school: The orientation events might be extended to parents, as they are key stakeholders in cultivating the students' innovation mentality by giving the necessary support. Additionally, students from the community could participate in these sessions to expose them to tinkering while expanding ATL's reach in the student community.

b. Collaborating with local NGOs, community centres, and volunteers to reach out to the wider community: The ATL In-charge could work with local NGOs and other support groups to spread the ATL message further in the community. This will not only raise awareness, but will also encourage more students from the community to participate in ATL activities.

Leveraging content and resources from AIM, NITI Aayog website

On its website, AIM, which is run by NITI Aayog, has a wealth of content and resources for ATL schools to learn from and successfully implement the initiative. Videos, documents, and other handholding materials are included in the content to assist the ATL In-charge in conducting ATL operations in accordance with the AIM requirements. While more effectively presenting information and delivering information linked to ATL in a concise manner, the online resources are easy to comprehend and are deployed with the purpose of assisting ATL in obtaining answers to the majority of questions relevant to lab setup. Because ATL schools are located throughout India, all ATL-related content will be published in English as well as other official/local languages to increase reach and awareness.

Atal Tinkering Lab Community Day

ATL Community Day is a unique event in which the community's youthful brains join together to celebrate tinkering, learning, and invention. This is a day to honour the community's inclusiveness via creativity, a chance for everyone to join together and solve problems using the ATL infrastructure.

ATL school students and teachers organise a full day of tinkering activities for non-ATL and community children on April 14th, on the occasion of Ambedkar Jayanti across the country, especially for those who have not been sensitised about the ATL and/or have not yet had the opportunity to tinker at these labs.

Objectives of the Study

1. To study on Designing the Atal Tinkering Lab space
2. To study on significant role in helping the ATL establish itself as a community innovation hub

Collaborating for an Impactful Atal Tinkering Lab

The ATL initiative's successful execution will necessitate the collaboration of numerous institutional partners to create an ecosystem of innovation and learning in which the partner institutions provide the proper mix of support structures. Creating a positive attitude toward the effort in the community is critical to its success.

Institutions could play a significant role in helping the ATL establish itself as a community innovation hub. Institutions can help the ATL by providing mentoring and raising awareness about the ATL's innovation activities. Start-ups, Micro, Small and Medium Enterprises (MSMEs), and large corporations are examples of corporate groups that might expose ATL students to innovative technology. As a result of AIM's initiatives, entrepreneurship has advanced significantly, and successful start-up owners have fantastic stories to share with and educate the young ATL innovators. Additionally, through workshops and training sessions, local and regional maker spaces might give comprehensive support to ATL students.

Several of these institutions will play an important role in ensuring that students have a positive ATL experience.

A few schools may require additional assistance beyond the assistance offered by external stakeholders as indicated above. This is where institutional partners could make a significant contribution through ATL adoption, particularly in the case of government schools or schools in second/third-tier cities and rural areas, which may have limited access to improved infrastructure and thus affect the quality of the ATL initiative's implementation. AIM has created clear parameters for ATL adoption that any organisation wishing to make a significant contribution can follow.

- Assigning a Resource Person (RP) to oversee ATL-related activities in school, support the ATL In-charge, and assure successful implementation of the ATL initiative in the school are the major responsibilities of partners adopting ATL schools. In collaboration with the ATL In-charge, the RPs should conduct teacher training programmes, student workshops, and boot camps. They should also hold community outreach programmes to promote ATL awareness.
- Providing a steady stream of volunteers to support ATL students and instructors, which will eventually lead to the development of technological advancements?

Makerspaces and Informal Learning Initiatives

Informal learning, often known as learning by creation, can take place in a variety of settings and styles. As part of its aim to pique students' interest in STEM disciplines, the Department of Education supports after-school and summer activities that encourage creating (The White House 2014b) [4]. The National Science Foundation places a strong emphasis on extracurricular activities as a means of involving students and instructors in the production process and fostering the development of citizen scientists (The White House 2014b) [4]. Other relationships include those between the Department of Agriculture and local 4-H clubs around the country. Both the Massachusetts Institute of Technology (MIT) and the Maker's Place in Pittsburg provide a programme that allows children and teenagers to continue their education outside of the traditional classroom setting (ScienceMuseum of Minnesota 2015).

The after-school activities, private lessons, birthday parties, and summer programmes that are offered by private firms (like RoboFun and Brooklyn Robot Factory, for example) are designed to enhance informal learning. The Google Science Fair (2016) and Maker Camp (2016) [3] are two more options for young people and their mentors. Maker Camp (2016) [3] is an online community for young makers who are interested in tinkering and sharing. In areas with high rates of poverty and schools with low academic performance, there are also opportunities for after-school enrichment programmes that incorporate a maker curriculum. These programmes are made possible by a partnership between the United States Department of Education and the Exploratorium museum (The White House 2015) [5].

The Maker Education Initiative is responsible for sending out "makers," who are often college students, young professionals, or teachers, in order to set up new makerspaces, provide peer mentorship, and form regional youth maker clubs (Maker Education Initiative 2016; Peppler and Bender 2013). The Institute of Museum and Library Services has made it a priority to give monetary grants to museums and libraries in order to encourage the development of makerspaces (The White House 2014b) [4]. Other organisations, such as the Youth Adult Library Service Association and the Association of Science-Technology Centers, have donated 3D printers and educational materials to museums and libraries (The White House 2015) [5], in an effort to facilitate the movement of making into these types of institutions. Because they provide free venues that are accessible to the general public, libraries contribute to the democratisation of information, which is an aspect that is believed to be significant in the maker movement (Halverson and Sheridan 2014) [6].

It may be challenging, however, for practical librarians to obtain training on maker learning and the administration of makerspaces, depending on the resources available. On the other hand, pre-service librarians are in a better position to take use of the resources that the institution has to offer, such as obtaining hands-on experience with hardware and software and attending classes (Moorefield-Lang 2015) [7]. In the following paragraphs, we will talk about some of the opportunities and resources that are available to aspiring makers and instructors of making through higher education institutions.

Education for Makers and Maker Educators

There is a wide variety of educational opportunities accessible to grow makers and maker educators. Face-to-face offerings include a physical computing course at New York University (New York University 2015) [8], a physical computing concentration at Carnegie Mellon University (2016), and a bachelor of science degree in digital maker and fabrication at the University of Advancing Technology (UAT). All three institutions are located in the United States (2016). Undergraduate students at Utah State University (2016) can take a class called "Craft Technology" to learn how to combine their creative interests with digital tools. A network of membership technology workshops known as TechShop provides a course called Makerspace Academy. This course is geared on teaching educators and librarians how to build, equip, and run "successful, safe, and inspirational public makerspaces based on the TechShop model" (TechShop 2016) [10].

A directory of colleges and institutions that offer maker classes may be found on the website maintained by Carnegie Mellon University. The listing includes information not only on the individual courses but also on the schools' makerspaces, making philosophy, and projects (MakeSchools 2016a) [11]. The Fundamentals of Tinkering MOOC (massive open online course) offered by the Exploratorium museum is also available online. Upon its first release, the course drew the participation of more than 7,000 teachers (Bevan *et al*. 2015) [12]. The design school at Stanford University includes a customised curriculum that emphasises design thinking and allows students to learn at their own speed on the topic of the future of producing and manufacturing (Stanford Design School 2016) [13].

Empirical Studies on Learning through Making

Even though there is a significant amount of effort and commitment being put into the Maker Initiative, Maker Movement, Maker Workshops, Maker Course Offerings, and Maker Projects, there is still a need for empirical research to investigate the learning that takes place through creating activities. The results of empirical research can give a justification that is founded on evidence and can be used to support the effort as well as guide the design of maker experiences that are intended to facilitate learning.

The findings might also provide a direction for future study and assist provide some suggestions for improving maker education programmes, both of which would benefit additional generations of learners in the future. For instance, Kafai *et al*. (2014c) [14] presented e-textiles to American Indian children in the seventh and eighth grades as part of an endeavour to assist in the instruction of engineering and computers within the context of a Native Arts class. According to the findings of the study, the researchers found that integrating students' passions and identities (in this case, those of American Indians) with modern technology enabled pupils to better participate in the digital era (Kafai *et al*. 2014c) [14].

According to the findings of the researchers, imposing design limits on the students helped them concentrate more on programming and circuits. The researchers also highlighted the significance of striking a healthy balance between the amount of time spent on creating and the amount of time spent building cultural connections, which is an essential component of this specific research Endeavour. The utilization of e-textiles is appealing to a wide variety of different types of learners. E-textiles, also known as electronic textiles, are types of textiles that can have electrical components and digital components implanted in them (Buechley and Eisenberg 2009) [15]. The traditionally feminine ability of sewing is linked with the traditionally male abilities of computer and engineering through the use of e-textiles (Kafai *et al*. 2014a) [16]. Kafai *et al*. (2014b) [4]. conducted their research on 15 high school students between the ages of 16 and 18 who were enrolled in an e-textile computer science class. After finishing projects with LilyPad Arduino, which is a tiny main circuit board built for textiles and wearable projects, the students gained a new perspective on the applicability of computers to themselves, including their identities, day-to-day lives, and potential career paths. The students reported having a higher level of engagement and a larger level of confidence in their ability to programme as a result of generating individualized projects, and the projects helped students acquire a more comprehensive understanding of the subject of technology.

Table 1: Comparison Between the Types of School Students and Their Scientific Knowledge and Aptitude (ANOVA)

Variable	Group	N	Mean	SD	F	P	Significance at 0.05 level
Scientific knowledge and aptitude	Public.	314	40.63[a]	12.66	21.230	.000	**significant**
	Rural	314	37.30[b]	12.15			
	Urban	288	44.85[c]	17.49			

Superscript alphabet shows significant pair wise difference using CD (critical difference method)

Source: Primary data Inference based on P-Value

The P-value of the scientific knowledge and aptitude exam (.000) is less than (.05), indicating that the P-value is significant at the 5-percentage-point level. As a result, the null hypothesis is ruled out.

The following are the average differences in school types, scientific knowledge, and student aptitudes.

The average result on a scientific knowledge and aptitude test reveals that private urban students (44.85) outperform public (40.63) and private rural (37.30) pupils. The average score of public students is higher than that of private rural pupils. As a result, it may be concluded that private urban students have higher scientific knowledge and aptitude than public and private rural students, with public students outperforming private rural students in this regard.

The Researcher's Observation

The researcher's non-participant observation demonstrated that the students' and teachers' opinions are not particularly trustworthy. Despite having a sufficient collection of equipment and apparatus in most cases, the availability of laboratory facilities was not always fully utilized. Teachers were sometimes observed rushing through practical sessions in order to complete the syllabus, resulting in underuse of laboratory facilities. The investigator observed a sad situation in several laboratories, where the lab tables were turned upside down, indicating that there is no timely practical work in addition to theory classes. Many of the laboratories chosen for the study did not effectively incorporate modern communication technologies, despite recent developments in the education sector. For repairs and renovations, laboratories were sometimes moved inside classrooms. The laboratories in a few schools did not meet the necessary rules and requirements. Some schools were found to be ignoring recommended safety precautions, such as the permanent closure of evict doors, leaving only one door for both admission and evict. Students were allowed to conduct experiments without the use of safety equipment such as lab coats, goggles, and gloves. It was also discovered that there were no safety instructions posted anywhere in the lab. and that the majority of schools failed to conduct fire drills to prepare pupils for a similar situation. Most of the appointed lab assistants were found to be preoccupied with other tasks, leaving the practical sessions unattended.

Conclusion

The ATL initiative's successful execution will necessitate the collaboration of numerous institutional partners to create an ecosystem of innovation and learning in which the partner institutions provide the proper mix of support structures. Creating a positive attitude toward the effort in the community is critical to its success. Institutions could play a significant role in helping the ATL establish itself as a community innovation hub. Institutions can help the ATL by providing mentoring and raising awareness about the ATL's innovation activities. Start-ups, Micro, Small and Medium Enterprises (MSMEs), and large corporations are examples of corporate groups that might expose ATL students to innovative technology. While more effectively presenting information and delivering information linked to ATL in a concise manner, the online resources are easy to comprehend and are deployed with the purpose of assisting ATL in obtaining answers to the majority of questions relevant to lab setup. Because ATL schools are located throughout India, all ATL-related content will be published in English as well as other official/local languages to increase reach and awareness.

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