Kriti Program

Pilot Report

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1. Introduction

Making and tinkering play an indispensable role in helping children better understand and interact with the world around them (*Resnick & Rosenbaum, 2013*). It also prepares them for solving critical problems of the 21st century and even beyond. With the maker movement's rise, the developing world also slowly began adopting the concept of learning through making and tinkering. However, it was adopted with the preconceived notions of a maker ecosystem that it should consist of a maker space which gives access to standardized tools and machines, along with a special focus on technological builds. In the educational landscape, there are issues concerning the branding of the concept of "making" to its highly Americanized, developed-world centric view, which has led to massive inequity for learners in remote & under-resourced settings (*Vossoughi et al,* 2016). In such settings, as they cannot afford access to tools and materials, there is a lack of well-equipped maker spaces. Even if there are some, they lack motivated facilitators or resources to function and sustain. Missing culturally relevant resources, peer-to-peer sharing systems, and pedagogical practices are some of the other challenges that have surfaced as well.

In developing countries like India, there has been a recent push to provide state funding to set up makerspaces in schools across the nation called Atal Tinkering Labs (ATL) (*Government of India, 2016*) under the Atal Innovation Mission (AIM). Since 2016, they have established 5000 ATLs and intend to reach 10,000 by 2020. It is a commendable task. However, the grants provided to schools do not differentiate based on the schools' financial background or their students' socio-economic conditions, likely benefitting the well-equipped schools too, leading to inequity. As per the latest ATL program handbook (*Government of India, 2019*), minimum requirements for the initial selection include a 1000-1500 square feet dedicated space, availability of STEM teachers, computers, stable internet connection, power supply, library, and playground. Under-resourced schools and learning centers would need adequate attention if they didn't make it to the ATL shortlist. Students who are part of them require alternative ways to engage them in tinkering activities.

Besides, ATL firmly defines skill-building as one of its objectives to "enable India to create a dent in the Global Maker's movement". Though these efforts are noble, focus on imbibing creative and entrepreneurship skills among the youth, the marketed version of ATL appears similar to the proponents of the “maker” movement discussed by Vossoughi et al.

Replicating the maker model from developed nations may not help bridge the gap in learning opportunities across our society's various strata. The maker mindset is in each child, and at Unstructured Studio, this is what we want to tap even in the absence of necessary resources. Dougherty has himself remarked (*Dougherty, 2013*), “We can create a workshop or makerspace, and we can acquire tools and materials, but we will not have succeeded at creating innovative thinkers and doers unless we are able to foster a maker mindset”. In India, this is not new, and various educators have stood up to this challenge. In places where resources are limited, there is ample opportunity for creativity to flourish, echoed as well by *Prahalad & Mashelkar (2016)* that frugal innovation can also thrive in places with a lack of resources. An example of this is the Toys From Trash initiative *(Sriwastwa, 2011)* by educator and inventor Arvind Gupta, who has created a series of DIY toy projects to show how one can manage resource crunch while building projects in innovative ways.

In light of this, we began working towards engaging students from such backgrounds remotely and started a new pilot program in partnership with some schools. In the subsequent sections, we discuss the details of our efforts.

2. Program Design

In the summer of 2020, we launched a new pilot, Kriti Program, that addresses these inequities and conceptualizes learning through making and tinkering for children in under-resourced settings. We designed this program to:

- Engage students from under-resourced environments remotely in low-cost maker activities.
- Empower them to document & share their stories of creation.

- Support them in their making journey through continuous facilitation.
- Understand how a remote tinkering model could function effectively.

The pilot program was scheduled for over two months with eight maker activities, conducted at an interval of 1 per week. In a typical Kriti Program week:

- We would develop or curate semi-structured and localized guides on maker activities. We would try to focus on culturally relevant, affordable, and accessible activities.
- Distribute the maker guides and other engagement formats (e.g., demo videos, voice notes) via WhatsApp. We chose this communication medium as it seems to have greater penetration in the developing world, particularly in India.
- Facilitate engagement around these activities remotely, provide constant feedback to students on their projects.
- Encourage students to document their projects (via various formats and tools we developed in this pilot) and share them with peers.
- Observe the group's activities and communicate with students and teachers to understand the pilot's effectiveness. Incorporate feedback and apply incremental changes towards the next steps.

Throughout the pilot, we experimented with multiple formats of engagements that we had planned and developed to engage students, support their making, and celebrate their work. In this report, we highlight these formats, outcomes, lessons learned, and next steps.

3. Implementation and Research

In a two month Kriti Program pilot, we engaged 77 students from 3 organizations (2 schools and 1 NGO) based in Gujarat, India. Students who participated in this pilot were comfortable with 2-3 of these languages: Hindi, Gujarati, and English. Most of the students had a similar socioeconomic background and were either from lower or middle-income families in rural or semi-urban areas. Some students were also residing in slums and irregular habitation, usually with unpleasant social

circumstances. We aimed to design the pilot in a manner that we could include activities that had the common denominator elements in them in terms of access to building materials and resources. This way, we were able to accommodate everyone. Do note that, one organization involved in this pilot did have a maker space and a dedicated curriculum to engage children in maker activities. However, the children didn't have access to it due to COVID-19 and were mostly on par with their peers regarding availability of tinkering opportunities and resources. The organization was not set up to support children remotely in such activities.

Nevertheless, the children had tremendous support and guidance from their teachers to participate in our program, continually motivating them in many ways and through various channels (direct phone calls, WhatsApp messages, etc.). To evaluate the efficacy of our program, we incorporated suggestions by (*Brennan & Resnick, 2012*) and included artifact-based interviews and design scenarios into our process. To understand how children engaged in the maker activities, their making and documentation process, their motivations and needs, and to make enhancements to the program iteratively, we interviewed ten children who participated in the pilot. We also kept a manual track of the statistics and conversations in the chat, which were necessary to understand the overall impact. In addition, from time to time, we talked with teachers informally to get their impression.

3.1 Maker activities & projects

Fifty students developed 74 projects for eight maker activities. The activities spanned various categories. Some were as simple as coming up with a chain-reaction (inspired by *Rube Goldberg* (n.d.). In contrast, others involved developing mechanical toys that consisted of making cardboard gears, cranks, and eventually building a mini-automata. Most students were able to procure materials from their own homes.

For a chain reaction activity that requires many materials, students shared that they do not have enough stuff at home to use for their projects. In this case, they gathered recyclable materials from around the neighborhood upon slight encouragement from the facilitator. Some students gave meaningful names to their builds showing how much they cared about the "machines" they made. 22% of students' projects were unique in terms of variations in materials or shape than in the original guides or demo videos. There is certainly room here to encourage students to personalize their creations and not just copy what is in the demo videos. Activities could also allow more room for reiteration on projects and support more complex explorations. Overall, students thoroughly enjoyed working on these activities, especially in the lockdown times, when they didn't probably have many options to find joy. They also took this as an opportunity to engage their siblings & parents in the making, which was fun to watch. Quotes from a few students:

> *"In the times of Corona I like to make something like this. Because I am bored at home and I am happy at making this."*

> *"I didn't have to go out to get materials, I got everything at home. It was simple to do, I didn't have to get anyone's help. I learned a lot. I learned that in this difficult time also, we can do something interesting."*

3.2 Engagement formats and mediums

In the program, we used the following formats and mediums to engage students: guides in a PDF format consisting of step-by-step instructions, demo videos (*Unstructured Studio, 2020*) in a local language to show a project in action, audio, and text messages for facilitation, and WhatsApp groups for overall communication. We observed that a combination of these different formats worked well for us.

We based most of our activities on the work of *Tinkering Studio (2020)*, inspiring educators like Rube Goldberg and Arvind Gupta. We curated the existing guides, reduced the content, made the language easy for children to understand, made the instructions more linear, and provided alternatives for procuring materials quickly. We saw that students used DIY sticks in some creations by rolling paper, as mentioned in an activity guide.

We continued to make incremental changes to the guides throughout the program based on the feedback gathered from students by reducing the content even further, adding more visuals, and using simpler language. Students appreciated "*Instructional Scaffolding" (n.d.)* through demo videos over PDFs; it seemed to have helped students get started.

Appreciation from Tinkering Studio for our work

One of the students remarked:

> *"Pictures in the PDF were difficult to read, reading them is hard. Mihir sir's friend's video helped a lot. And, then reading the PDF again helped."*

WhatsApp seemed to have worked quite well since, in every household, at least one member has a phone with the app installed on it. Most students were using their parent's phones, and the only setback of using a shared phone was that they sometimes missed a conversation when their parents were out for work. To alleviate this, groups could be brought together for synchronous activity at a scheduled time in the future.

3.3 Documentation & sharing

One of our goals with this pilot was to empower students to document their projects and share them with their peers. A typical traditional education setting in India doesn't allow kids to be active participants in their learning. The same pattern is visible in a maker setting too. Kids do create, but they are not encouraged to be vocal about it. Through these activities, we asked them to document their projects by making a video of it and include response to the following questions:

- What name would you like to give to your project?
- What is your project about and what motivated you to work on it?
- What are the types of materials and tools you used?
- What was your making process?
- What were some of the fun and challenging moments you experienced while working on it?

27 % of projects we received were in a video and audio format. Some students included their introduction in the video briefly or a greeting message for their teachers, but only a few addressed the questions we asked them. The majority of the students in the interview shared that it was their first time performing a documentation-based activity around making. Some younger students expressed that they found the documentation questions hard; for example, they didn't quite understand what "motivation" meant and didn't know how to respond to the question around it. A few students were familiar with using the video maker tools they had used previously, and they preferred to stick with them. Some of the students also made several videos to respond to each of the questions we asked via text message in the WhatsApp chat.

We even encouraged using an app, Zub, that we specially prototyped to help students structure their thoughts and document their projects in three steps: Motivation, Materials, and Making.

Step 1: Motivation in Zub app

Only 1 or 2 students used our app for documentation. Some of them ran into technical challenges that we couldn't ultimately help troubleshoot remotely. In the initial activities, we focused on the documentation part more and completely ignored the *"Peer Learning" (n.d.)* aspect. But when we tried to promote peer interactions in the groups around projects, they mostly happened between teachers and students. One of the students in the interview said:

> *"I have made things before but I have not made or shared videos before. This is the first time I sent a video. But whatever I have made in school, my teachers would make videos and document it. I really like it. I liked that I would be able to share my video with Mihir sir and see their reaction how they liked it. And, that they might be able to give me marks.. Girls are not usually interested in activities like this. But I made it and the fact that I made it, and my sir and teachers like it so I liked it."*

Realizing that peer interactions wouldn't happen organically, we tried to instigate them by asking: "How did everyone else find a student's project?" In the groups with younger kids, we didn't see much response to such questions, but in groups with students from higher grades, we noticed that they appreciated one another's work and encouraged others:

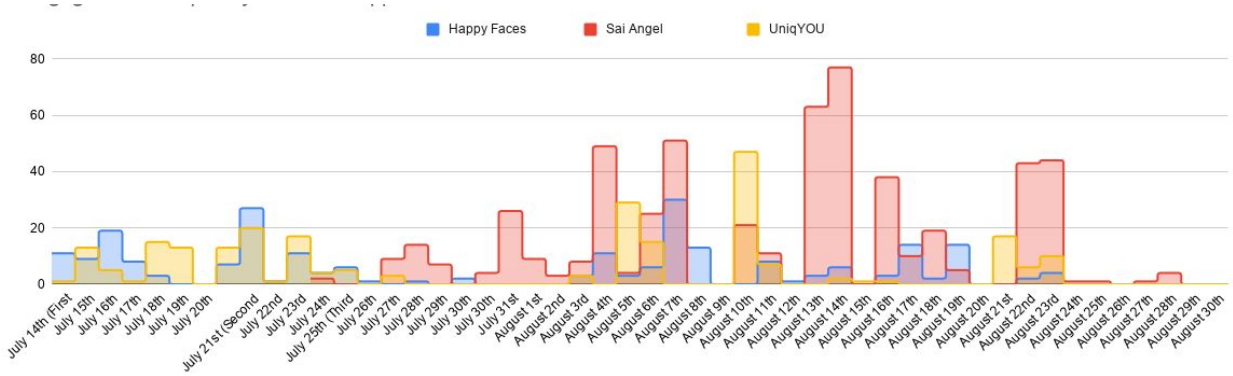
> *"सभी मित्र, जो प्रोजेक्ट बना रहे हैं, या बना चुके हैं, कृपया जितनी जल्दी हो सके उत्तर दें!"*
> *(All friends who are making the project or have made it already, please reply as soon as possible!)*

Students appreciating one another's project in a WhatsApp group conversation

Overall, documenting and learning and sharing with peers seems to be a new concept for Indian kids. We see a need to explore new ways to foster peer interactions and investigate tools like Zub further, engage children in using them, and see if they could help students structure their documentation around making process.

3.4 Facilitation

During two months, 1024 messages were exchanged in the WhatsApp groups. We witnessed that these groups would become highly active as soon as students would get done with exams or dormant when they were busy with a local festival or found an activity challenging. We observed less participation in the first two days of the introduction of activity, a slight increase with encouragement and support from facilitators, highest during the middle of the week when students were all likely building their projects, sharing them in groups, and asking questions.



Engagement frequency on WhatsApp groups (measured as messages/day)

One of the goals with this program for facilitation around making was to apply an inquiry-based approach *(Inquiry-based Learning, n.d)*. In traditional settings, typically, teachers tell students what they need to know. On the contrary, through this learning style, we wanted students to self-explore a topic by asking them questions, sharing ideas, and encouraging them to tinker with materials. We were cautious not to present any facts, hand-hold them, or influence them to reach a particular outcome. Through the conversations with students, it was clear that they were rooted in the idea that there is always a right and wrong answer that we attempted to sway them

away from it. Overall, our facilitation method and medium notably worked well. Our facilitator wouldn't give exact answers to students' questions, only provide hints, help them find their answers through self-exploration, and communicate with them via audio, video, and text messages in three different languages. Once he commented in response to a children's query:

> *"गलत उत्तर देने में कुछ गलत नहीं है। और याद रखें कोई उत्तर गलत नहीं है"*
> *(Don't worry even if your answer seems wrong. And remember, no answer is wrong!)*

Though most of these activities fostered open-ended exploration, the facilitation style helped students connect the activities with the topics they learned in their science class and have related conversations. For example, children could relate to a phenomenon they saw in an Indian TV show while working on the chain reaction activity. Quotes from some conversations:

> *"તારક મહેતા સિરિયલ માં ઐયર બબીતાની બર્થડે માટે કેક કરે છે, ઉપર થી ફૂલ પડે છે"*
> *(In Tarak Mehta Ka Ulta Chasma TV series, it's like when the flowers fall over Ayyar Babita on her birthday)*

> *"જ્યારે આપણે ચકરડી ફેરવીએ છીએ ત્યારે બધા રંગ પરસ્પર ભળી જાય છે અને બધા રંગ ભેગા થઈ જાય છે આ ધોરણ ૮ માં પ્રકાશ પાઠમાં ભણવા માં આવ્યું હતું સર"*
> *(When we spin the wheels, all colors intermix and get fused into one. We learnt this in the chapter on "light" in our science class)*

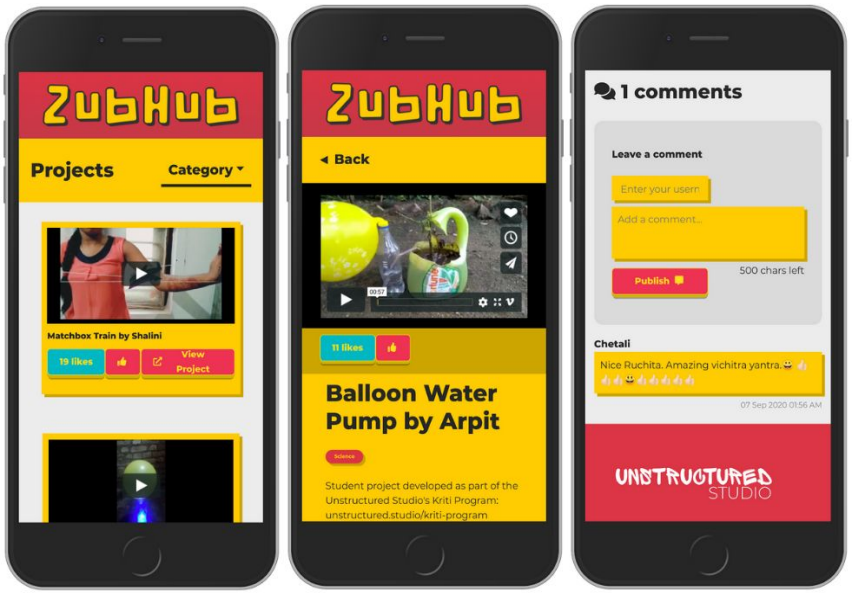
> *"જ્યારે આપણે પંખો કે લાઇટ ચાલુ કરવા દૂર થી સ્વીચ ઓન કરીએ છીએ ત્યારે પંખો કે લાઈટ ચાલુ થાય છે તેવી જ રીતે અહી આપણે એક જગ્યા એ ટચ કરવાથી પાણી ડબી માંથી માટલામાં ભરાય છે"*
> *(When we use the switch to turn on the fan or light from a distance, similarly when we touch some surface here, the water starts filling the container)*

> *टीचर: आप लोगों को गुब्बारे का पम्प गतिविधि से हवा के बारे में क्या जानने को मिला?*
> *स्टूडेंट: सर, बहार से हवा भरें तो गुब्बारा फूलता है, और बाद में छोड़ दें तो पानी निकलता है | ये हवा के प्रभाव से होता है*
> *(Teacher: What did you learn about air from the "balloon pump" activity?*
> *Student: Sir, when we fill air in the balloon, it expands, and when we release it, it releases water. This is because of the air pressure inside)*

In this pilot, we learned that a facilitator's role is the key and heart of the whole endeavour. For this program, one facilitator single-handedly operated four groups with a total of 77 students. As and when more facilitators become interested in adopting this program, what techniques to equip them with and tools to develop to help reach more kids and engage them effectively would need examination.

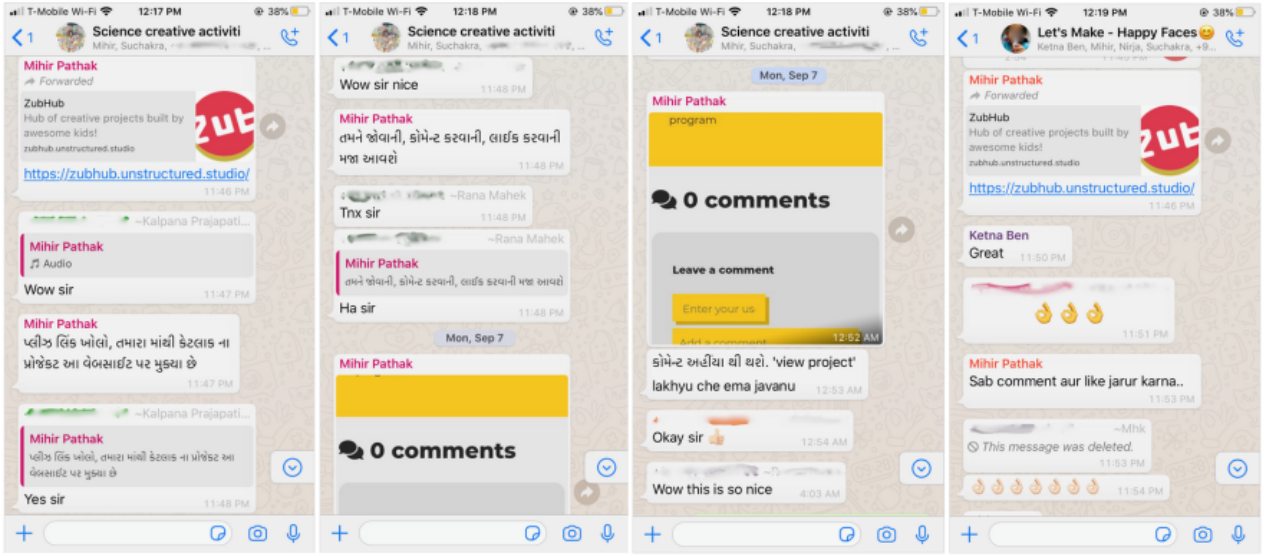
3.5 Global community

To bring students to a central place where they can share their projects and form meaningful connections with one another, we developed a project showcase platform, **ZubHub**, where they could view projects shared in the WhatsApp groups, like and comment on them. We exhibited ~26 projects on this platform for the pilot that received ~277 likes and 8 comments, out of which 2 were from students.



A project on Zubhub with a comment left by a student

As the ZubHub platform in its current version is not ready to upload multiple projects, we handpicked a few that seemed complete with decent video quality and proper orientation. The platform received a general appreciation from students and teachers in the WhatsApp groups in comments. When we announced the platform, we mentioned that if any student still wanted their video uploaded, we would be willing to do it manually on their behalf. Despite this, two parents called the facilitator expressing concern that their child's video was not in the showcase and asking the reason for the same. They were informed of the limitations and assured that soon a self-guided feature to self-upload the video would be available in future variations. In any case, we consider this a positive sign, and it re-enforces our opinion that such a showcase acts as an inspiration for making and tinkering.



Students showing their excitement after hearing that their work is showcased

4. Conclusion

Through this pilot, we helped facilitate maker activities remotely for children from under-resourced settings. We were indeed able to target the audience that was our main focus for this pilot. By encouraging the use of low-cost materials, we could engage kids in maker activities without any barriers. Even in the times of a global pandemic, they could perform these activities without stepping out of their homes to

obtain materials. From the beginning, we were interested in engagement more and not just developing resources that sit somewhere and wait to catch the eye of an educator or a learner. So, regular motivation support and facilitation to students, a combination of demo videos, audio, and text messages for guidance paved the way for active engagement. WhatsApp, which is in use by at least one member in an Indian household, also seemed to have helped. There were interpersonal connections formed between students and teachers outside the groups, which we didn't anticipate or planned for, but happened and was a pleasure to witness.

We have received appreciation from existing school partners for our work during this pilot and interest from a few other schools and teachers to replicate this program. As a next step, we intend to develop a Toolkit consisting of resources, a maker curriculum, and a facilitation program that can empower as many teachers in schools and after-school centers to initiate such programs with our support or independently, in their settings.

Message from Sai Angel Founder

We have identified a clear need to do more work to empower children to document their projects and share them with peers, and not hesitate to share their thoughts and be confident learners. We wish to evolve our documentation and community platforms to support more kids and develop tools for educators and organizers to help reflect on the engagement activity to ensure everything is ongoing smoothly and if/when they should chime in for help. There needs constant work to change these kids' mindsets, so they shift towards a more collaborative rather than a competitive outlook.

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