Fab Educators Pilot Programme at Workbench Projects: Government School Theatre Teachers leverage digital fabrication for FAB 2.0

Anupama Gowda, Pavan Kumar

Anupama Gowda, Workbench Projects
FabLab Bangalore, India
anupama@workbenchprojects.com

Pavan Kumar, Workbench Projects
FabLab Bangalore, India
pavan@workbenchprojects.com

Abstract

Educators have long-standing experience using FabLabs in many parts of the globe. In India FabLabs are at a nascent stage and available for a small community of informed users, mostly in urban settings. Workbench Projects (WP), a young FabLab/Makerspace in Bangalore, made its first headway working with a select group of government school 'theatre teachers' under its pilot initiative of the Fab Educators Programme. Teachers became the ground zero of this project because they represent a small but committed group of individuals in the system. This paper attempts to share some key processes that were set in place in selection of teacher participants, designing, preparation, conducting and reviewing the workshop. Continuation of this orientation towards a more immersive, and self-directed engagement has been charted by the teacher participants themselves as the next plan of action towards building Fab2.0 in their own small workspaces with the support of Workbench Projects, GOK[1] and GOI[2].

Keywords

STEAM Education, Models For Fab 2.0, Rural Fab 2.0, Teacher Training Programs, Project Based Learning, Train The Trainer, Fab Educators, Fab Educators Program

Abbreviations

GOK	Government of Karnataka
GOI	Government of India
WP	Workbench Projects
FEP	Fab Educators Program
SME	Small and Medium Scale Enterprise
ATL	Atal Tinkering Labs
CBA	Center for Bits and Atoms, MIT Media Labs

[1] http://www.bangaloreitbt.in/kbits.html

[2] http://niti.gov.in/writereaddata/files/Guidelines%20to%20setup%20Atal%20Tinkering%20Labs%20May%202016.pdf

Background

The word 'government school' in India generally evokes images of underprivileged children in a tight classroom setting, smelly, dingy rooms with a teacher facing her back to the children and writing away on the backboard or being a drill master reciting curriculum in monotones. While backbenchers to their mischief, frontbenchers being naïve and nodding in agreement to all that a teacher has to say. Principal, teachers and staff waiting for the last long bell of the day is the general perception of most schools. This perception, unfortunately, is a reality in most parts of India. It is only in recent times through the efforts of non-profit, voluntary agencies such as NGOs and other corporate bodies, that the outlook and operations in some of the states have changed for the better. Karnataka is one amongst the fore runners and few in the country with such privileges, thanks to the many public-private-partnership initiatives encouraged by the state government. It has led to a growing realization for the government administration, teachers and the parent community that a system-wide transformation is crucial for the attainment and sustainability of improved quality in education, and this realization has led to new and meaningful explorations.

The state has rolled out a number of flagship programs to demonstrate more promise to the system by issuing free books, uniforms, bicycles, mobile schools, award student scholarships, organising camps and festivals for students on the one end. Teacher capacity building initiatives, leadership trainings for head teachers, parents and community sensitisation towards the child/ward's for free and compulsory education up to the age of 14 at the other. At the heart of every program lies the betterment of the school student and the conditions in which he/ she gains education. But, no matter how well these programs are implemented, how grand the infrastructure provided, what really matters most in the student's education is the quality of teaching.

The Challenge for a nation such as India is that the school teacher's profession is undervalued and the quality of teachers in the system has been on RED alert over the last few decades. This has reflected in several reports published by both the government and private agencies. Under the constitution of India, education being a concurrent subject, with a sharing of responsibilities (including legislation) between the Centre (Ministry of Human Resource Department) and States (Departments of Education), management of schooling that is traditionally controlled by the mainstream state and district administrations is focusing on the content for teacher development.

According to a paper published by ASME[3], "Strengthening pre-college Science, Technology, Engineering & Mathematics (STEM) education in the US. A technological literacy & Workforce imperative - General position paper", the focus should be on involving various stakeholders like, parents, educators, government and the private sector to ensure the right set of skills and critical competencies can be cultivated. The emphasis is also to encourage women and underrepresented groups to pursue STEM courseworks and careers.

With the intention to provide the best to the teaching community, the government, NGOs and private agencies have rolled out several training programs and workshops under the in-service capacity building mandate of the department. Unfortunately, with too many offerings without discretion towards need-based training by the administrative heads, teachers are often over burdened with trainings, and not enough focused on implementing the training they receive in the classrooms. In some districts, ad hoc nomination of teachers to undergo the training out of relevance has compounded to teachers' callous attitude towards most trainings.

[3] https://www.asme.org/getmedia/9de8356f-ce22-4b15-9541-8c5d552e19a1/PS1020.aspx

Fortunately, there are some extremely committed and talented teachers who share a different view to these trainings. It is no surprise that these few that have different response were recruited as theatre or drama teachers. In the Indian education system, theatre teachers are generally seen as out castes. From the perspective of the subject (STEM) teachers and the parent community, theatre teachers are not formally trained in education, neither are they degree qualified and to top it all teach theatre, which is considered as extra-curricular by the system, which in simple terms means unimportant.

I first interacted with these teachers when I worked as an Arts Education Programme Executive in the field administering a program called Kali-Kalisu: An Arts Education Teacher Initiative.[4] I right away noticed that these teachers had a highly open-ended approach to education, and were willing to explore different models for understanding and experiencing the arts. Overall, they impressed me as some of the most optimistic, energetic and innovative teachers placed in the system of education. Over the six years of the program they displayed a high commitment to exploring their domain expertise in school education, took many unconventional paths to make a difference in the lives of the children. Some of the outcomes were that the children improved their reading and writing abilities, reduce absenteeism and also increase enrolments in school year on year.

This distinct quality of these theatre teachers led Workbench Projects to design a special pilot version of Fab Educators Program for government schools where resources were limited, aspirations were high, and change makers on the ground available to pilot the initiative.

Research Objective

The overall research objective of this paper is to review the Fab Educators Pilot Programme that was conducted to capacitate select arts teachers in government schools to use digital fabrication for their own personal development and to nurture their skills for cross-disciplinary explorations in their subject teaching and consequently to leverage Fab 2.0 in their schools through Workbench Projects for sustained engagements.

The first question addresses the issue of the highly contextual content generation for such digital fabrication training given the limited core subject specialisation of these teachers. We felt that though they came with limited understanding of science and technology, yet they were the ideal figures to set an example as Fab Educators given their positive attitude to life and learning. Also, importantly, these teachers are highly creative and are attuned to the trending technologies given they are constantly exploring smart devices and technology for their own creative processes. These reasons made them a strong case for introduction of digital fabrication, as opposed to other subject teachers who limit to curriculum framework and conventional teaching methodologies.

These teachers have charted their own approach to the government issued guidelines to their subject teaching. They are constantly exploring new ways of providing learning experiences in theatre. For example, one of the teacher led a project that had a two-pronged approach, where, as a corrective to the corroding effects of popular culture on the school ethos, it empowered students to creatively link their process of learning in the classroom with local folk art traditions that they were immersed in. As students developed a theatre script on a topic of their choosing, they simultaneously embarked on a process of community engagement by learning and documenting a range of folk traditions that stretched from a repertoire of domestic work songs of women to the more established theatre and dance forms available within the community. Aided by series of workshops from local artists on scripting, set and costume design, lighting, and rehearsal, the project culminated in performances in

[4] https://sites.google.com/site/kalikalisu/project

school and the community that showcased the adaptation of text to relevant art forms, and highlighting the dialogic relationship between the school experience and the life of the community.

Several of such examples have proven that these teachers aligned to the creative-innovative-facilitator group that WP looked for to initiate the Fab Educators Program. WP strongly believes that talent lies everywhere but only a few embark on such explorative journeys to make a difference in students' lives. This creative bent of mind is most needed to influence the coming generation to become more creative and responsible innovators.

The second question addresses the dynamic and unconventional approach we are taking to set up Fab 2.0 in a manner to present one pilot centre for the government to capture the mechanisms of such altruistic lab in remote location. Firstly, the geographical location under consideration is both educationally and economically backward. Secondly, the migrant population is high and students' enrolment to school is at a very slow pace.

Selection of teachers for Fab Educators Programme at WP

A select group of 10 teachers from theatre training were invited to attend a weeklong residential Fab orientation programme at WP during their annual break. Five of the 10 confirmed their willingness to take time out of their annual break to attend the programme, which reassured WP on its first assumption that despite the demands of personal engagements, interested teachers will always make time for new learnings even in the absence of monetary incentives.

The final five attendees represented five different educational districts of the state. One female and four male teachers attended the programme. (One must note that the opposite is true in schools with regard to the statistics of female teachers to male teachers to the ratio of 4:1)

Facilitator Selection

With a committed group of in-house staff at WP, the facilitators were thoughtfully selected based on their awareness and interest in working with government schools teachers. Mostly maker facilitators with sound technical skills and good Kannada (local language) proficiency were appointed for the programme. Sessions that demanded external resource people were well briefed on the teachers' competency levels to ensure smooth incremental processes for all sessions. Through the entire six –day engagement, I played the role of a co-facilitator during all sessions ensuring they understood the educational research taking place in other parts of the globe and how teachers were using digital fabrication as part of that research and implementing them in school.

Workshop Plan

The overall six days of Fab Orientation was broken into two parts. The first part was Machine Play i.e; introduction to machines, tools and Fab Projects. The second part was User Centred Design Thinking exercise resulting in making of prototypes. By the end of the sixth day, teachers had to present their very first working prototype to an Open House.

Sessions

- Day-1: An introduction to Maker, Maker Movement, Makerspace, FabLab, its history, philosophy, practice was covered during the first half of the day. Second half started with the exploration of corrugated sheets (material that they were most familiar with in schools) to map their understanding of 2D and 3D objects. Being well informed of teachers' hesitation/

resistance to technology, the first machine introduction was to a sewing machine, something they have seen growing up and also had the experience of working on. This engaging session put them in a comfort zone to elaborate on complex machines and their use. This session shifted to discussions around digital technology such as mobile phone applications, digital photography, animation and more, by which time they were on laptops exploring cloud based CAD modelling using OnShape.

- Day-2: Introduction to CNC laser and a router, creating sample files and testing them. Introduction to basics of electronics, soldering, de-soldering, circuits, Arduino and Little Bits. And during their free time, introduced them to a hot knife to cut Styrofoam.
- Day-3: Introduction to 3D scanner and 3D printing. Second half a detailed session on Arduino where the teachers were provided with the library in their local language-Kannada to understand the basics of Arduino programming. The day concluded with a detailed feedback session.
- Day-4: Introduction to User Centric Design and ideation on problem statements. Idea pitching
- Day-5/6: Prototype-Testing-Back to drawing board-Iteration-Working Prototype-Presentation at Open House

Prototypes

With this exposure teachers built prototypes[5] to test as teaching materials in their schools. Gururaj built a 3D scaled model of different styles of theatre stages to help introduce children to world theatre and its distinct stage designs. He had detailed the elements of each stage where children could pick and place the elements to understand the technical details of the stage. Ramappa was excited to replicate a hot wire Styrofoam cutter to make headgears and costume designs for school productions. Mallesh built an electrical board game for students to engage in a fun and playful manner to learn mapping of each Indian state to its pertinent art forms. This would help students better their memory skills. Ashok, with an interest in light design, fabricated a spotlight with a controller to understand the light intensity variations for his school productions. Prajna spent hours working with an Arduino facilitator to build a metronome to introduce her students to rhythm, tempo and beats.

Documentation & Feedback

Documentation and feedback was the most important part of our pilot program, where according to a paper in the Fablearn series, "Meaningful Making, Projects and inspirations for fab labs and makerspaces[6]" they have identified that peers become the most valuable asset in this process. The process demands peers to give real criticism to another peer formally presenting through verbal, interactive and written formats. We have used this for both the participants while building their projects[7] and for ourselves for this work.

All sessions were documented in the form of texts, video and still photography. Notes made were used for end of the day sharing sessions to discuss experiences, learning outcomes and charting the next day's plan of action. Some comments/ feedbacks were:

[5] https://www.youtube.com/watch?v=YyXF6ulZsSI&feature=youtu.be

[6] http://fablearn.stanford.edu/fellows/sites/default/files/Blikstein_Martinez_Pang-Meaningful_Making_book.pdf

[7] https://www.facebook.com/workbenchprojects/photos/a.1010675952333986.1073741908.627241924010726/10106760190000646/?type=3&theater

- 'There is so much to learn and experience. It is overwhelming and has made us restless thinking of the possibilities of such machines and tools at our disposal at our place of work'- Gururaj.L, Drama Teacher, Govt High School, Jahagirgudadoor, Koppal District
- 'Rather than mindlessly appointing teachers for all kinds of training; be it Yoga, English vocabulary training, Scouts and Guides etc for record purposes, one should be given a choice to dabble in individual interest areas. Fab Education to also be provided for teachers to choose rather than appointing at the whims and fancies of government order.' – Ramappa A.K, Drama Teacher, Govt High School, Jigajivani Chadachan Division, Indi Taluk, Bijapur District
- 'Always thought that technology was not for me and even if I attempted, I would not be successful. Soldering has taught me that anything is possible and this is just the beginning.' - Mallesh M, Drama Teacher, Govt High School, Kalghatgi, Dharwad District
- 'As theatre teachers we are looked down by our colleagues and often reminded that we have nothing important to impart to our children. The little we know, we know it well and that has made a difference where we teach. Now with this new exposure to makerspace/Fablab, I wonder what it would be like when our children get to use them in villages. It would be a levelling ground for both children and us to do some meaningful work.' - Ashok Thotnalli, Govt High School, Jakanapalli, Sedam, Gulbarga District
- 'Understanding music comes with a keen ear, but programming a metronome comes with codes that I am yet to understand. Wonder who sits and writes these codes that is so much harder. Isn't it far easier to spend few hours each day to develop an ear for tempo and rhythm?' - Prajna Hegde, Drama Teacher, Govt High School, Mantagi, Haveri District

The intensive orientation programme with its outcome has become testimony to the FEP given that it met with the core objectives of what WP set out to do as ground work for Fab 2.0.

a) Teachers were engaged intellectually, emotionally, playfully, socially, soulfully and physically.

b) Teachers actively engaged in asking questions, experimenting, being curious, solving problems, assuming responsibility, being creative and constructing meaning throughout the orientation program

c) Teachers while tinkering with their project ideas experienced success and failure in good stride and were more prepared to take risks in trying alternate ways to achieving their project goals. Uncertainty was accepted as healthy.

d) Teachers were open to constructive criticism from their peers and younger facilitators displaying a highly matured learner attitude

e) Teachers continually drew linkages from the programme to their work back at school assuring the relevance of such programme as timely and as in need of the hour

f) Teachers expressed that the learning was personal and on prototype completion gave them a sense of pride and purpose to now return to school work with more skills and ammunition

FEP toward Fab 2.0

FEP feedback sessions were designed such that triggers for discussions around Fab 2.0 was presented carefully. Over the course of the FEP, it had become clear that the teachers found the program compelling enough to stay invested in the idea of Fab 2.0. Several discussions stemmed around the possibilities of how these teachers role would change if they were to lead it, secondly children's enthusiasm to come in to school more regularly, thirdly how their colleagues would now shift their attitude towards them more positively. With all of these discussions and deliberations, teachers

mustered the courage to ask what if one of them chose to volunteer to pilot a Fab 2.0 in one of their school.

Recommendations for Fab 2.0 by the participating teachers

There was a consensus to pilot Fab 2.0 in one of their schools where the management would firstly be willing to initiate and support the teacher to do such experimental work. Secondly, where the community would support when needed w.r.t to resources. For example; to build the physical space, the community to pitch in with their skills for brick and mortar job, draw additional electrical lines if needed etc given such a lab relied heavily on infrastructure. Third, the school management, teachers, children and the community to well understand that the lab is of collective ownership and does not belong to an individual even though WP initiates it through its trained teacher. Fourth, the lab to draw up its own manifesto such that each lab set up could be unique yet under the guided vision of WP to fuel the educational quality and experience of learners to move towards new age innovation literacy. Lastly, to set up the lab, making it highly inclusive and sensitive to the environment in which it would be set up.

Preparatory work for Fab 2.0

With the given understanding that the lab would be set up within the school premise, other preparatory work has to begin with a baseline study of what making practices exist in the region. For egs: teachers, students, individuals, NGOs, SMES (if any) and the community working with their hands. Be it home-grown hand-made products, arts/ crafts, agriculture, wood work, metal work etc. This will further define the lab use. With the permission of the education board and the buy-in of the school headmaster, invite a gathering of neighbouring school teacher, local makers, youngsters in the skill development space, artists and artisans, SMEs, workshop/ studio practitioners and the parent community to present the idea of Fab 2.0. Use the gathering platform to solicit ideas, volunteers towards drafting a vision document for the lab. Subsequently, have smaller working group meetings to plan, design and implement the lab to suit the local need.

Space

With some consensus, Fab 2.0 has been decided to be set up in Ashok's school in Gulbarga (North Karnataka). The school is in the border region of Karnataka and Telangana. With strong leaning toward Telugu speaking community, Fab 2.0 will have to take into account both Kannada and Telugu medium of operational ownership. Given Ashok is a natural initiator, open and willing to discuss the possibilities of the lab in his school, the first site has been identified and preliminary discussions are underway with GoK. Big and open school campus with sizeable indoor and outdoor work areas allow for a dedicated 800 sq.ft space to be ear-marked and built for the lab. Using the better judgement of local volunteers and the space design team of WP, the lab design will be presented to the govt to start structural work end of October 2016.

Administration

Ashok will spend a week at WP to understand the nitty-gritties of setting up the lab and optimally managing it. During this period, he will engage with space designers, content creators in co-designing the lab ensuring the basics for Fab 2.0 is set in place leaving ample room for development over a period of time. Quarterly plans w.r.t programs, workshops, trainings etc will be charted with WP team's assistance for the first entire year. Subsequently, Ashok will be encouraged to draw up annual plans with performance indicators both for the users and the lab. These indicators will be drawn based on the larger objectives of FEP along with the number of exceptional projects that stem out of the lab. Basic

training in inventory management, tools/ equipment/ space maintenance and daily finance log maintenance will be provided.

Facilitation and Execution Style

Ashok in the past has proven as a good facilitator and highly regarded by his students and fellow colleagues. As a model Fab 2.0 facilitator, he would be well trained and equipped with good mix of instructional, demonstrative and virtual styles of facilitation. He will be encouraged to co-facilitate with different resource persons to better his skills at co-facilitation. During the training, he will administer different engagements at WP to understand cross functions of an administrator to play along as an open-ended free stylist.

Machines and Equipment

We would like to build the machines and equipment list with choices by engaging the community in a democratic way including their pre-occupations rather than subscribing to the list of machines and equipment by CBA[8] and Fablab Inventory[9]. The idea is to also collect these tools over time through focussed sourcing and installation. Crowd sourcing tools for the space would be good to start with.

Some of the criterion for these machines and equipment are:

- Machine manufacturers who are home grown or those who have a local presence
- Local Servicing and distribution networks
- Low cost
- Rugged and fairly durable
- Consumables that can be sourced locally
- Largely open source
- DIY kit style or self assembled
- Off the shelf spares and supplies
- Smaller learning curves and easier UI's
- Agile and modular

Some of the basic must and should haves are:

- Hand tools
- Power tools
- Good configuration PC's, Tablets and Laptops
- Basic Electronics Work Station
- Parts, consumables and materials
- Junkyard and e-waste collection
- DIY digital fabrication machines
- Safety and cleaning equipment
- Stationary

[8] http://mtm.cba.mit.edu/

[9] http://www.dflc-usa.org/downloads/fab_lab_inventory.pdf

Content

Content for the users will be co-created by all the stakeholders of the lab. Learning outcomes will specifically be tied to the processes and outcomes from the range of engagements such as:

- Projects
- Trainings
- Workshops
- Grand Challenges
- Meetups
- Talks etc.

Basic criterions for content creation for Phase I would be:

- Open-ended and explorative in nature
- Crowd source /Open source
- Localised and contextualised

Ecosystem

The ecosystem is envisioned to evolve organically through active participation of all stakeholders of the lab. Collaboration with countrywide makerspaces, fablabs and tinkering labs would help build exchange programs, residencies and look outward for field inspirations and good practices to be set in place for sustained growth of the ecosystem.

Conclusion

For WP envisioning Fab 2.0 is a dream come true. Ever since FEP was launched addressing different teacher constituencies (rural/urban/private/government), the most creative and receptive audience of the program has been these government theatre teachers. Their exceptional commitment to their profession is well recognised and now added to it their FEP training takes them a couple of notches higher to introduce new and more exciting ways for them to make a difference at grassroots level, now powered by digital fabrication. As per plan and the direction in which WP is headed, preliminary discussions with Karnataka Biotechnology and Information Technology Services (KBITS) shows a promise to realise the first pilot Fab 2.0 before the end of 2016 academic year. With key processes in place followed by both internal and state review recommendations to the state education board one wouldn't doubt the many Fab 2.0(s) mushrooming in the state. In fact, one could say that the trend has already begun given the NITI Aayog, GoI (Planning Commission) has called for applications country-wide to set up 500 Atal Tinkering Labs (ATL) through a selection process. ATL holds more or less similar objectives such as Fab 2.0 but more skewed towards electronics, physical computing and IoT given the program is powered by Intel India. WP on its expert consultative committee sees Fab 2.0 in its many avatars in the coming days.

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