

# What do teachers need to become a maker-teacher?

Lessons learned from conducting workshops for first time maker-teachers in Thailand.

Nalin Tutiyaphuengprasert  
Darunsikkhalai School for  
Innovative Learning  
Bangkok, Thailand

<http://dsil.kmutt.ac.th/fablearnlab/en/home/>  
Nalin@alumni.stanford.edu

Nusarin Nusen  
Darunsikkhalai School for  
Innovative Learning  
Bangkok, Thailand

<http://dsil.kmutt.ac.th/fablearnlab/en/home/>  
Nusarin.nus@kmutt.ac.th

## ABSTRACT

The Ministry of Science and Technology of Thailand has rapidly created 150 fabrication labs, also known as makerspaces, in 150 schools throughout the country in one year following the policy called Digital Thailand 4.0 in early 2018. As part of the provided professional development, KMUTT and Darunsikkhalai School for Innovative Learning (DSIL) were assigned to mentor teachers from 16 schools. DSIL has been a leading digital fabrication school in Thailand since 2013. In two four day workshops for 34 teachers in September and October 2018, we collected interviews and learned from teacher's reflections about what important skills or knowledge novice maker teachers need to feel prepared and ready to start their new teaching adventure.

## Keywords

Professional development; Maker-teacher; Pedagogy for maker education; novice maker teacher. Teacher education; digital fabrication; makerspace.



Picture 1. Getting to know prototyping



Picture 2. Learning to use the laser cutter



Picture 3. Learning how to reflect and learn from experiences

## 2. DESCRIPTION

### 2.1 Description of your setting

Darunsikkhalai School for Innovative Learning (DSIL) established the first digital fabrication in school in Thailand in 2013. In 2018, we conducted two workshops for 16 public schools who received digital fabrication labs, also known as makerspaces, or FabLabs from the Ministry of Science and Technology. There were 34 teachers in total, 12 teachers from Bangkok, 12 teachers from the northeastern region, two from the north region and eight from the central part of Thailand. All of the teachers had a background in science and technology. 19 teachers had no experience in coding and 15 teachers could code and use a microcontroller. There were two teachers teaching in primary school and the rest were teaching in high schools or vocational schools. None of them had any idea what a makerspace or digital fabrication was, or how it related to their classes.

### 2.2 Description of the educational experience

We designed a four day workshop to provide direct experience for teachers to put them in student's shoes as novice makers in a real makerspace. We combined the ideas of a design sprint, design thinking and Constructionism pedagogy to expose them to the process of idea generation, creating quick prototypes, learning the benefits of putting prototypes in hands of users, and getting feedback early. Then we let them use the design process with a project of their own interest on the second day and they worked on those projects for two days. All the participants gave a presentation the last day of the workshop. In the meantime, while the instructor modeled how to conduct the class, we assigned all participants to observe their feelings and responses to classes or to facilitators and take notes. What did they like or dislike? What helped them do better or made things worse? Then the class would bring those notes to the group reflection at the end of the day.

While they working on their projects, teachers also got to work side by side with other students who came to work in our lab. We hoped that the teachers would get a real sense of what a working lab feels like by observing the atmosphere in the lab and informally chatting with real students working on projects.

We collected data from participants as a part of my action research. My assistant conducted structured interviews with eight random teachers and recorded audio from all the reflection sessions to learn about their perception of the course. All this data will be used to improve the course design in the future.

### 3. CONCLUSION

#### 3.1 Results

The data from the two workshops were very similar. Based on the most common feedback, we came up with these seven themes to help teachers understand what they need to be ready to teach in a digital fabrication lab or makerspace.

**1. Positive psychology and coaching are necessary.** Teachers realized that working on projects is tough especially with time constraints. Empowerment and positive reinforcement really help students feel safe and encourage them to develop their work further. One of the teachers said that “When the teacher didn’t put pressure or put any expectation on us to be perfect, I, myself, do want to make it better everyday.” “They were not forcing students to do things in this room but it’s more about creating motivation for students to do things on their own.” Motivation was high, with many teachers continuing their work after class and some continued working at night in their hotel rooms. This was new kind of learning experience for all the teachers. The majority of reflections mentioned the power of compliments and constructive feedback. “Just one little compliment made me feel good and filled me up with hope and made me want to make my project better.”

**2. Prototype = evolution of something greater than what it looks like!** The other most common feedback was about prototyping. It was their first time making a prototype. It was uncomfortable for the teachers to build and put unfinished work into user’s hand to get feedback. However, the teachers found that they received valuable feedback from users and that made them even more eager to make things better. The concept of ‘prototype’ and ‘getting feedback’ made them feel safe to be ‘not perfect’ and accept that everything is in progress. Even the most beautiful product has its ‘ugly’ look at the beginning. They learned to separate process from product by creating many imperfect prototypes. We reflected on this issue in class together, that teachers are so familiar with expecting good products that sometimes those expectations were not met after students received discouraging feedback. Teachers expressed that they have made many students feel “not good enough” because we always pay attention to what is missing rather than pointing out what are the good ideas that could be improved. Many teachers reflected that they had made this mistake for many years by giving such feedback to students all the time. As a result of this workshop, they now they realize that it’s much harder to give compliments, but it is something they are willing to practice.

**3. Using a simple design model as scaffolding is very helpful.** Teachers reflected that the simple steps they learned will make them feel confident enough to carry on projects on their own. Some teachers mentioned that these steps help students be able to articulate their ideas and process. It can be overwhelming when they are facing real problems to break them into steps and get started. Working on projects in the real world is not always nice and easy. Models with clear working steps helped remind them where they are and what do they need to do to continue further.

**4. The teacher is not the judge!** Teachers mentioned that it felt good when the teacher just provided suggestions and students had to think, decide the next steps, and try things out on their own. They liked that the teacher doesn’t need to judge a student’s idea if it’s right or wrong. The teacher can share their opinion and respect the student to make decisions on their own. The teacher does not to be the one with the answer, sometimes students who are working next to you can help and create solutions that work!

**5. Giving heart and watering the plant.** We use two flags to symbolize the atmosphere we wanted to create during feedback sessions. One flag had a mini heart sign and the other one had a picture of watering a small plant. The mini heart flag was used with the Thai word “Hai-Jai” which means “I give you my heart.” This flag was a sign for giving compliments on what you like about projects or ideas. The watering a plant flag was used as a sign with the word “Term-Tem” which in Thai means filling you up, as in giving constructive feedback that helps people grow. Teachers said these two words created a different atmosphere in the feedback sessions and made them feel safe and open to all comments. They recognized that it’s harder for them to give compliments, but shared that they were getting better over the four workshop days.

**6. Learning to scaffold is as important as learning how to use the laser cutter.** Teachers love laser cutting and 100% of the teachers agreed that learning to use the laser cutter was empowering and built confidence by allowing them to make professional-looking projects. However, one teacher said that scaffolding is very important in all the steps. Teachers observed how the activities were put together in steps of increasing complexity, and providing the appropriate amount of time to make students feel comfortable to move to the next steps. In this course they learned a lot about how to use scaffolding to help manage the classroom and support multiple projects at the same time.

**7. Paper prototypes are helpful and made it feel safer to fail!** Many teachers came to our workshop with the understanding that digital fabrication equipment and materials are expensive. This created fear in them and an attitude of not wanting to make any mistakes. At the start of the workshop, they all had the mindset that their work had to be perfect even in their first prototype. Over the course of the workshops, they understood that paper prototypes with other cheap construction materials such as straws, wooden sticks, recycled paper, and balloons can also help students represent their ideas. Teachers learned 3 ways to fail very quickly; fail fast, fail cheap and fail forward. They accepted this idea and started to feel more comfortable with playing around with papers and popsicle sticks or something from a dollar store instead of trying to move immediately to laser cut acrylic plastic at the beginning of the project.

### **3.2 Broader Value**

We think this action research project helped me understand hidden concerns and hidden fears of novice maker teachers much better. There is a lot to be afraid of in starting a new adventure of bringing unfamiliar tools into your classroom. Teachers need to know how to control their new learning contexts, not just how to use the tools. These findings helped me see that the foundation of what to expect or what to see as learning in classroom needs to be changed. The mindset of the “perfect” assignment need to be replaced with the idea of “prototype” which increases the ability of teachers to see incremental change in each version of a student’s work and learn to provide feedback with appreciation regardless of how it looks from outside. In a makerspace, students are active and doing all sorts of things, so teachers also need a new strategy to handle a dynamic classroom by orchestrating the classroom rather than by controlling the classroom. By putting teachers into the role of students, we hope to make teachers feel safe and know that it’s ok for students to move and talk a lot in classroom. As trainers, we modeled multiple strategies to handle this kind of diverse, action-oriented classroom which I think helps teachers understand those interactions better than talking or telling them what teachers need to do. We hope this paper can contribute some ideas to professional development for teachers on a broader scale.

### **3.3 Relevance to Theme**

While digital fabrication is spreading out so quickly around the world, it is known that starting a physical lab is the fastest and easiest task. We are interested in building a sustainable makerspace for school community and we are interesting in observing how making experiences in community of teachers, students and parents can affect each other’s learning. Teachers are important gatekeepers in the school who will support making experience in classrooms or not. We think it is important to create effective and sustainable professional development and share important findings that support the mysterious fancy FabLab box, which are having the right mindset, people, and process to keep it running successfully in the long term.

## **4. BIOS**

Nalin Tutiyaiphuengprasert (Tukta), co-founder and senior vice provost of Darunsikhalai School for Innovative Learning in Bangkok, Thailand. I have background in cinematography (BA) and master degree in Business Administration(EMBA). I also got a master degree from Stanford Graduate School of Education in Learning, Design and Technology class 2015. I involved in Constructionism application in Thailand both in formal and informal education since 2001 as teacher in project based learning, school administrator responsible for academic and international affairs. I was a co-founder of the first FabLab called DSIL FabLearn Lab in Thailand in collaboration with Stanford's FabLearn program since 2013. I am currently working as interaction designer, trainer for teachers and director of the upcoming social enterprise project to scale up Constructionism and Digital Fabrication for Learning in Thailand.

Nusarin Nusen (Nu), FabLearn Lab facilitator and trainer assistance of Darunsikhalai School for Innovative Learning in Bangkok. She worked as science and project facilitator at DSIL for 5 years in primary education. She has her background in computer engineering from Chiangmai University and involved with project that developed programming tools for kindergarten students. She became instructor assistant since 2016 and collaborated with Nalin to design and teach workshops for young students and adults.

## **5. Links to projects of participants who attended workshops**

A fan page created by a group of science teachers showing their cleaning robot.

[https://m.facebook.com/%E0%B8%88%E0%B8%B4%E0%B9%8B%E0%B8%A7-RTC-349230962317834/?ref=content\\_filter&hc\\_location=ufi](https://m.facebook.com/%E0%B8%88%E0%B8%B4%E0%B9%8B%E0%B8%A7-RTC-349230962317834/?ref=content_filter&hc_location=ufi)

A fan page created by a group of students to update about their fablab class in school.

[https://www.facebook.com/Kit-Chee-Woo-The-Series-Fab-Lab-1131161813697794/?hc\\_location=group](https://www.facebook.com/Kit-Chee-Woo-The-Series-Fab-Lab-1131161813697794/?hc_location=group)

Video showing how their project works. Lazy bin project. (Bin that helps bottles recycling process.)

<https://www.facebook.com/261019417948335/videos/709016042794426/>

Forget me not! (A project to help solving problem of leaving kids in the school bus.)

<https://www.facebook.com/972349492972674/videos/2307128512692013/>