# How to Incorporate Local Wisdom and Powerful Ideas into Creation of Innovative STEM Projects for Sustainable Agricultural Development

**Ruetai Chongsrid, Sukasem Awnpoon, Naruemon Sukkasame**

National Science and Technology Development Agency, Ministry of Science and Technology (Thailand)

## Abstract

*In Thailand, the National Science and Technology Development Agency (NSTDA), in close collaboration with 10 universities, has been supporting altogether 150 high schools and vocational colleges under the Fabrication Laboratory project to encourage students to become innovators through creative activities. In 2020, NSTDA and its partners launched a national contest under the topic "STEM Project for Strengthening Agriculture for Sustainable Development."*

*In the contest, four enterprising and outstanding STEM projects out of a choice of 55 were unanimously chosen by the selection committee: Automatic Crab Molting Warning Application, Farmer Bot, Aueng Sae Greenhouse and Solar Herbs. All of which incorporated local wisdom and powerful ideas for agricultural applications.From our point of view, there are three principal contributing factors playing a vital role in the successful implementation of the STEM projects for sustainable agricultural development. Firstly, its suitability for local areas and practicality in solving real problems affecting the community. Secondly, multiple on-site experiments, not only in a laboratory, with results' adjustments and improvements as required to be most practical for the community. Lastly, full support of required equipment and devices from the Fabrication Laboratory such as sensors, 3D printers, and laser cutters for implementation of the STEM projects conveniently.These outstanding selected STEM projects are good examples of Education for Sustainable Development (ESD), as they can motivate and stimulate students to acquire new knowledge and to develop new skills, proper attitudes, and values necessary for shaping a sustainable future from their own local contexts. Furthermore, these STEM projects encourage students to take action and be resourceful through critical thinking, imagining future scenarios, and making decisions collaboratively the skills they developed from their creation of these STEM projects which can significantly help them achieve actual sustainable development in any specific area in the future, not only in agriculture.*

Keywords: *local context, powerful ideas, STEM project, sustainable development, Fabrication Laboratory*

## 1. Introduction

The STEM Project for Strengthening Agriculture for Sustainable Development Contest is part of the National FabLab2020 Contest, aiming for creating innovations for the community. The thematic areas were divided into 3 categories which are 1) Strengthening Agriculture for Sustainable Development 2) Social Lifestyle and 3) Future Community.

The objective of this national contest is to encourage students to be innovative makers by using fabrication tools to developed prototypes suitable for their communities and inspire them to develop valuable work by realizing and understanding their communities' problems and conditions

.On the way of formulating a project. Students collaborated with their teachers, engineers and members of the local communities with an aim to solve the community problems. Furthermore, the contest can be considered as a new platform for enhancing their design thinking, design capability and engineering skills to apply for their community and well beyond. Students have an opportunity to develop and practice scientific communication skills, as well as build up on teamwork competency on the national stage in the era of Thailand 4.0 society. STEM projects were submitted from students nation-wide and the nature of the projects were of a wide variety. We aim to investigate the important factors for successful STEM projects for strengthening agriculture for sustainable development.

## 2. Program design and Methodology

The process of studying factors of successful STEM project for Strengthening Agriculture for Sustainable Development is divided into 6 steps as below:

Step I: Students submitted conceptual project for solving community issues through an online contest and presented them via video clip. There were 55 projects for submitted.

Step II: The committee chose 20 interesting projects from 55 projects by evaluating conceptual project and video presentation clips.
Step III: Twenty teams of students presented their project implementation progress to the selection committee and then the committee made a selection for 4 outstanding projects.
Step IV: The committee visited the students' communities for determining and guiding how useful and achievement of project to local communities.
Step V: Students adjusted their project and then they presented the final project to the committee who determined the winning team.
Step VI: The committee discussed and summarized important factors of successful STEM project for Strengthening Agriculture for Sustainable Development.

## 3. Result and discussion

### 3.1 Result

There were 55 projects from high schools and vocational colleges under the FabLab project participating in the "STEM Project for Strengthening Agriculture for Sustainable Development." contest. In the first round, the committee considered the project background and execution plan as the main criteria for selection process. Twenty projects were selected for entering into the second round. In the second round, the committee considered selecting from the presentation of the prototype inventions and the progress of the development. The selections got through an online form due to the situation of the coronavirus outbreak 2019 (COVID-19). The competitors received some guidance to modify the inventions to be more effective in response to the community circumstances before the inventions can be applied in their respective communities. In the third and final round, the committee attended to the worksite, evaluates and provided advices on some issues. The Board of the committee then selected outstanding work, a total of 4 projects as follows:
Project 1: Automatic notification of crab molting through an application developed by a tema of students from Chulabhorn Royal College Satun.This college situates in Satun Province, in the south of Thailand. Soft crab is an economic aquatic animal in their local community, which is in the vicinity of the sea. The crab molting occur very quickly to detect in time for sale and the crab molting observation rely to local expertise to inspect the laying of the crab with the naked eye for every 3-4 hours. In order to reduce the amount and hour of labor, save cost on employment and also for the more desirable life of the workers, this automatic crab molting alarm monitoring system was created by using the principle of infrared reflection of crab shells. This device can be connected directly to the phone, is portable, as well as being able to view the stored data by visualizing graphs to estimate production and marketing as well.
Project 2: Automated planting and plant caring robot with smartphone controller (Farmer Bot) by Islamic Education Demonstration School Prince of Songkla University, in Pattani Province which is in the southern part of the country. This project was developed because the farmers in their areas lacked information about technology, incorrect maintenance, hence leading to poor quality of their production. This project would like to help the farmers to be more efficient in their work environment, use less stamina and have more free time available to carry out other activities or jobs. The robot planting and caring for plants automatically controlled via smartphones (Farmer Bot) was designed and developed. It has the ability to plant the seeds into planting holes. Fertilize and irrigate the plants, which will follow the instructions from the user via the application with a wireless connection or the robot can be operated automatically. Therefore, growing plants by robots not only provide growth but can increase the survival rate of plants more than 60 per cent in various conditions compare with self-cultivation.
Project 3: Aueng Sae Greenhouse by Mae Sariang Boriphat School.This school is located in Mae Hong Son Province which is in the northern most part of Thailand. Students in this project designed and developed a smart greenhouse for growing orchids. The greenhouse was invented to preserve a critical indigenous orchid species of the community. Its flower can be transformed into perfume. Aueng Sae Greenhouse can control the temperature, humidity, light, as well as the amount of fertilization that is suitable for growth. It has multiple displays and can use the Internet of Things (IoT) system via smartphones. Not only in areas in the northern part of the country where this project was implemented, Aueng Sae Greenhouse can potentially be re-constructed and used for growing orchids in other parts of Thailand as well. Another advantage is this smart greenhouse design can help to prolong the flowering period that is 2 times longer than before.
Project 4: SMEs drying and Processing Herb Machine by Sakon Nakhon Technical College. The Solar Herbs is powered by a solar panel. KidBright board, Thai embedded board was used to monitor, control the temperature and humidity via mobile phone. The machine will dehydrate the herbs to the standard moisture value, conserve its medicinal content and decontaminated from bacteria. This

device is currently used in the Thai Traditional Medicine Club, Sakon Nakhon Province and hasreceived a high satisfaction rate so far.

### 3.2 Discussion

From the analysis of project observation and interviews with the teachers of students who proposed their projects including other personnel involved in the projects. There are three common factors contributed to the 4 successful projects out of 55 projects are as followings. Firstly, the developers can identify project-related problems based on local issues and concerns found in the surrounding neighborhoods of their schools. Students understand the implications of the problem very well which then leads to the collaboration between students and their communities to design and solve such problems. As a result, the projects implemented are suitable for the local community. The participants have learned to plan and set up work procedures, practice designing and developing prototypes then examining with target groups and eventually solving the community's problems. Secondly, a prototype has been tested in the local community several times during developing and testing stages. The results are not just laboratory experiments but an effective solution to issues faced locally and the improvements are made to maximize the advantage of the community. Thirdly, educational institutions have important roles to play during project implementation. Students had a full access to engineering equipment required for researching and developing the prototypes. Machines and tools in FabLab such as laser cutters, 3D printers, computers, sensors and hand tools were made available for use. Through project implementation, students learn to take actions, developing skills through critical thinking, creativity and collaboration as a team. These skills, which are developed through project invention, will help them achieve truly sustainable skills for their future endeavors.

## 4. Conclusion

The factor of successful project which has high benefit to the community is the suitability for local areas and practicality in solving real problems of each community. Furthermore the project should do multiple on-site experiments by not only in a laboratory. And the last factor is the project should have maker facilities to support for implementation of the STEM projects conveniently. STEM project is an excellent tool for developing new knowledge, essential skills, good mindset for shaping a sustainable future from students own local contexts.

## 5. References

[1] Blikstein, P., Martinez, S.L. & Pang, H.A. "Meaningful Making: Projects and Inspirations for FabLabs and Makerspaces", USA, barnes & noble bookstore, 2016
[2] Chongsrid, R. "Prung Khrong Ngan Witthayasat Hai Aroi", Thailand, NSTDA bookstore, 2018.
[3] National Science and Technology Development Agency, "Fabrication Lab Project (FabLab)". Retrieved December 2020 from https://www.nstda.or.th/fablab/