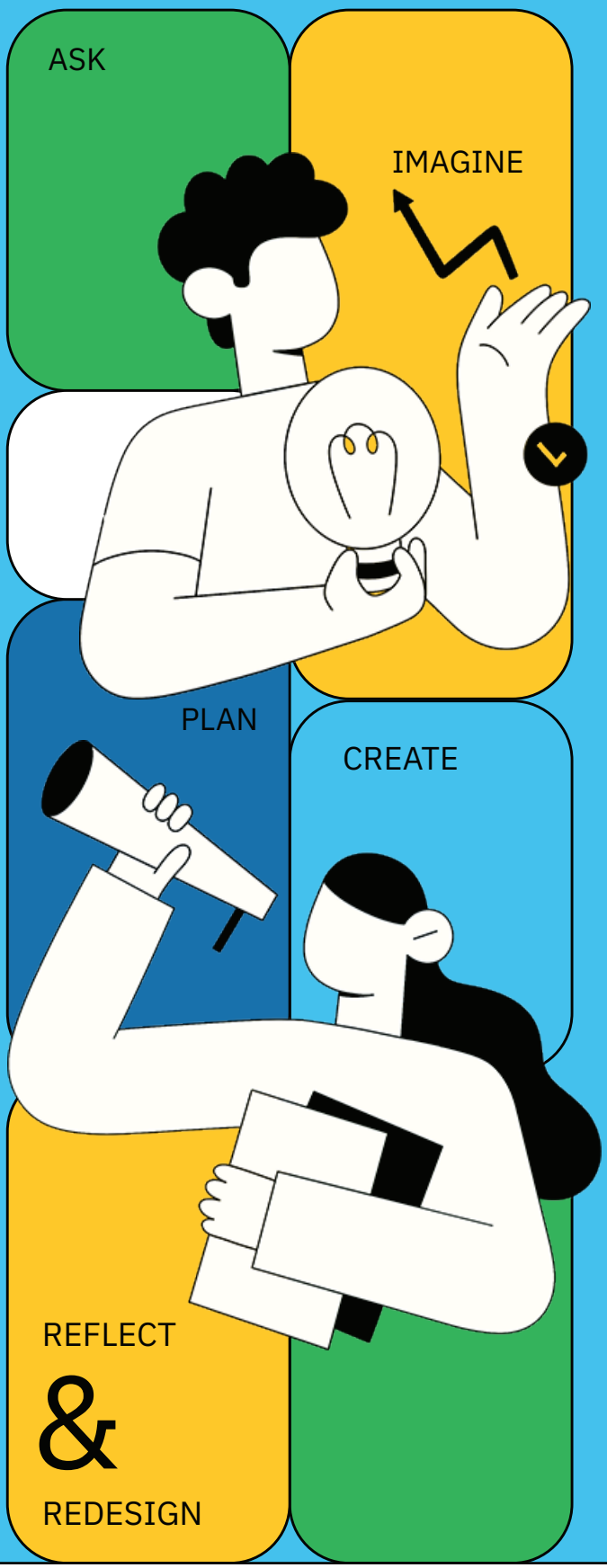
MAKERSPACE
Learning Space
For Everyone

Starfish Maker in Thailand



STARFISH EDUCATION

Starfish Education Social Enterprise.CO.,LTD.
Starfish Education Foundation
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Introduction

Maker Education is a unique and revolutionary learning system of learning experiences that opens opportunities for learners to take control of their own learning. It provides opportunities for them to ask, imagine, plan, create, reflect, and redesign. It is an Integrated Learning Management system (STEAM - Science, Technology, Engineering, Art and Mathematics) that provides learners with hands-on experimentation and innovation.

Starfish Education has been utilizing and promoting the concept of “Maker Education” in Thailand since 2017. It has developed the “Design Thinking” process, teacher training, and methods for establishing Makerspace in schools, homes, and in various areas for activities. Furthermore, in schools with both abundant and limited resources, or in schools located in remote areas.

This document presents information and the format of “Makerspace” in Thailand, in which Starfish Education has played a role in has played a role in development, both in Starfish School and in school networks spanning over five years. Networks spanning over five years. This illustrates that managing education in the “Maker Education” format, which focuses on cultivating skills and competencies in the future for learners, is achievable within the context of Thai schools. It is considered an important educational innovation that drives quality education with relevance to the 21st century.

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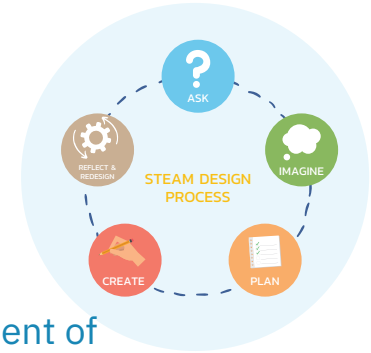
Starfish Maker in Thailand



2017

1 Establishment of **4 Makerspace demonstration centers**

Chiang Rai, Mae Taeng, Chiang Mai, Samut Sakhon

2018

2 Memorandum of Understanding (MOU)

60 Schools

Chiang Mai & Bangkok

Model School	Teachers	Students
8	6K	18K

2019

3 School X TSQP, 1st Generation

60 Schools

Starfish Education and the Equitable Education Fund (EEF.) collaborated to develop project schools, elevate the quality of education throughout the system in medium-sized schools in Chiang Mai, Lamphun, and Samut Sakhon provinces.

2020-2022

4 School X TSQP, Generation 1 + Generation 2 (consecutive 3 years)

93 Schools

Continuously Expanding by adding Generation 2 in Chiang Mai, Lamphun, Nakhon Pathom, Samut Sakhon, and Ayutthaya, totaling 33 schools.

2023

5 Makerspace Learning Center (MLC)

7 Model Schools

In the areas of Chiang Mai, Lamphun, Bangkok, Nonthaburi, and Kanchanaburi provinces.

Managing Makerspace Education in Various Aspects

Makerspace and the STEAM Design Process are being adapted in various ways in schools as tools to develop students' skills in different areas, aligning with the school's objectives.

- **61.5%** Occupations and Entrepreneurs
- **21.3 %** Creative Thinking
- **5.1 %** Environment
- **5.1 %** Language and Communication
- **5 %** Technology and Innovation
- **2 %** Ethical and Moral Principles

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Starfish Maker in Thailand

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Managing Makerspace Education in Various Aspects

Makerspace and the STEAM Design Process are being adapted in various ways in schools as tools to develop students' skills in different areas, aligning with the school's objectives.

Occupations and Entrepreneurs

Develop innovations into a Business Model using the community as a foundation to add value to products, create differentiation, and encourage students to engage in what they are skilled in or interested in, based on the school's context.

61.5%

Creative Thinking

Fostering creative learning to encourage students' abilities to develop new ideas, explore new directions, adopt new perspectives, and understand and view problems in new ways. This approach helps create innovation that yields clear results, tailored to their abilities and interests.

21.3 %

Environment

Students actively participate in environmental conservation, take responsibility, promote sustainability, and utilize environmental resources in a responsible manner. They encourage creative and rational thinking processes, such as engaging in activities that repurpose unused items and developing innovations to combat PM2.5 air pollution.

5.1 %

Language and Communication

5.1 %

Promoting self-expression through activities such as creating small storybooks and narrating tales that children create, providing opportunities for children to take on leadership roles in communication, enhancing confidence, and developing language skills.

5 %

Students design innovations based on their interests, inventing new creations and making modifications to existing items to make them more innovative, effective, and beneficial, utilizing technology to share their work.

Technology and Innovation

Ethical and Moral Principles

2 %

Fostering interpersonal ethics and providing opportunities for students to explore issues within the school, brainstorm systematic methods or innovations to solve problems, such as developing manners, discipline, and responsibility through activities related to school waste management.

Makerspace

Learning Space for Everyone

Makerspace innovation leads to a teaching and learning model that places students at the center, reduces the role of teachers, and opens up opportunities for students to experiment, try, and work independently. This helps promote students' confidence, allows them to discover their untapped potential, and enables them to independently practice problem-solving processes, transforming them into critical thinkers and effective problem solvers.

The Story of Starfish School. At Starfish School, every afternoon, students gather in Makerspace activity rooms based on their interests to participate in a two-hour activity before the end of the school day. One day, the writer had the opportunity to visit.

Each unique classroom can support can support interesting learning experiences for both students and teachers. When entering the studio, a 1st-grade student is searching for information about their favorite cartoon character using an iPad, copying the information to create content for a presentation on Canva with agility. As for the 4th-grade students, they are editing videos using an iPad and confidently exchanging ideas on video editing with their friends. Additionally, the 6th-grade students are diligently learning and experimenting with coding programs.

The adjacent room is filled with is filled with the aroma of kaffir lime leaves,as students from one group are diligently working together to make kaffir lime soap, while a teacher stands nearby, offering assistance and encouraging the students to carry out their planned activities. Simultaneously, excitement emanates from

another corner of the room, capturing the writer's attention. Students from different grades engage in lively conversations, discussing what they have observed through a microscope. They have been experimenting with water collected from the school's water source, discovering various living organisms.

The writer walked into the sewing room, which was adjacent to the laboratory. Upon entering, the atmosphere of the activity was distinctly different from the two rooms visited earlier. It was intriguing. In the room, there were students with various levels of skill in sewing and fabric weaving, whether it was a young female student gracefully weaving a pastel-colored scarf by hand using textile materials and weaving tools, or a male student sewing bags from leftover fabric.

With their adept use of electric sewing machines, a group of students were gathered in another corner of the room, honing their fabric sewing skills. The writer was somewhat surprised by the atmosphere, which reflected not only sewing and weaving skills but also design proficiency and fabric color selection. The students' ongoing work on scarves and bags showcased a variety of skills, highlighting their versatility in creative and textile-related abilities, including the art of embroidery.

Afterward, the writer went to the art room, where students were divided into groups, passionately creating stories of their interests through oil pastels. One group of 6th-grade students joined the writer's group and presented an intriguing narrative about oil pastel scenes. These students talked about molding the weir near the school's area, including the surrounding environment and the significance of this weir in the community. Additionally, they reflected on the process of planning and shaping the oil pastel artwork to be more realistic. These students demonstrated their reflective learning processes and engaged in natural conversations and exchanges with their friends.

The writer hurriedly walked to the workshop room because there were 6th-grade students preparing to narrate the story of the "Air Fan" project and demonstrate how it works. The students sat there with the air fan that had undergone multiple modifications, transforming it into an efficient and effective air fan. Then, the students

began narrating the history of creating the air fan with gleaming eyes and pride, considering it's a project that had been experimented with multiple times to reach this point. They conducted research to find information about how to use motors and assemble them with foam boxes. While they were the initiators of the idea, their friends also helped in building this invention until it became functional. They believed that there were still many ways to improve this air fan machine, and they felt happy and wanted to continue making it better.

In the last room, there was both the scent of sweet coconut from Khanom Krok (ขนมครก) and the fragrant aroma of somtum (ส้มตำ) emanating from the dining area. Students were busily cleaning their equipment while another group entered and shared a story about making Khanom Krok that day, mentioning that things didn't go as expected because the mixing of the dough and scooping it from the mold didn't result in very appealing shapes. This meant they would have to prepare a new batch of dough and increase the time for cooking the coconut desserts in the molds for the next attempt. Despite the errors, the lesson of the day didn't make the students afraid to continue; instead, it made them want to try again with a new, potentially more effective approach.

The opportunity to visit Starfish School on that day revealed that learning in the 6 Makerspace rooms was diverse, exciting, and intriguing. This served as a significant starting point that piqued the writer's interest in delving deeper into the concept of Makerspace and its application in various other contexts for the benefit of the school, educational personnel, and the community.

Makerspace in other countries.

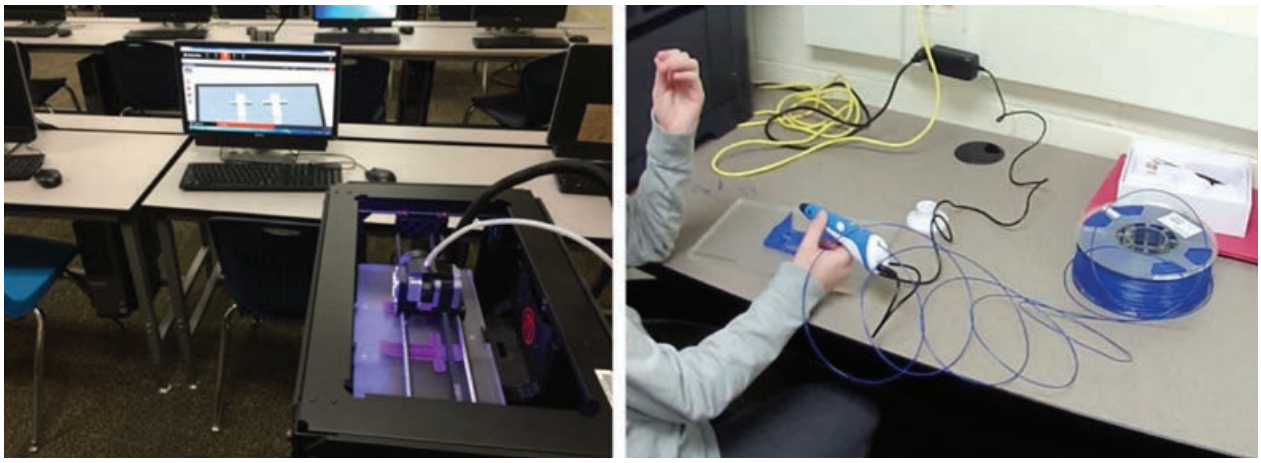
If we explore “Makerspaces” around the world

Every Makerspace is a place where people from various backgrounds, professions, and ages come together to create and innovate various things, as well as collaborate to brainstorm and learn new things. These spaces or programs can exist within schools, libraries, government facilities, private entities, or communities, and they work together to make create or innovate.[1]

Whether it’s a FabLab, Maker Program, or Hackerspace, all of them are learning space concepts that are similar and can replace the term Makerspace in practice. FabLab emphasizes the use of digital technology, while the Maker Program may be just a small corner, a cart, or a cabinet in a museum or library equipped to facilitate collaborative learning. Hackerspace usually refers to providing a space for people interested in programming or various technologies to meet, exchange, and learn from each other. [1] While Makerspace is the most used term, it focuses on diverse creative activities involving hands-on making, and as a result, the creation of Makerspace can take various forms and often have no fixed components. In summary, the locations may not be as important as the aspects of the learning process through hands-on making, which is the core of Makerspace.

• FabLab in Lisbon, Portugal [2].

In the United States, Makerspace originated from the Maker Movement, a trend of hobbies and skilled craftsmanship such as woodworking, sewing, and repairing various electronic devices. Initially, this concept was more connected to activities outside the classroom and was largely in the context of adults rather than children. However, with the emergence of STEM (Science, Technology, Engineering, and Mathematics) or STEAM



• The picture shows students participating in FUSE Studio activity, creating things of interest using a 3D printer (on the left), and a 3D printer pen that one student brought into FUSE Studio. [4]

(Science, Technology, Engineering, Arts, and Mathematics), educators began to show interest in applying the concept of hands-on learning within the school context [3].

To provide students with the opportunity to engage in hands-on, real-world scientific and engineering processes within the STEM-focused science and engineering classroom, this process will stimulate curiosity, generate interest, and motivate students to want to learn more, as well as allow them to see the connection between science and engineering.

The concept of Makerspace was widely adopted in various vocational classrooms through STEAM activities in schools. For example, FUSE Studio is a Makerspace designed for students in the 5th and 6th grades. It operates from Monday to Friday and is implemented in many schools over a two-year educational period. It is a part of the required curriculum that allows students to dedicate continuous time to their own projects. It takes place in an environment that offers freedom in designing and solving challenges, although there are limitations in terms of the provided equipment. Teachers observe students' learning processes and draw interesting conclusions from them [4].

> **FUSE Studio provides students with the opportunity to bring their interests and knowledge from outside of school into problem-solving activities. Conversely, it helps create memories and an understanding that they can apply what they have learned in FUSE Studio elsewhere.**

• The key conditions that enable this learning process are

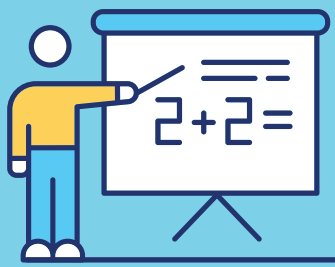
the “socio-material” conditions of activities in FUSE Studio, which must resemble real-life situations involving collaborative work with others, facing resource constraints, and encouraging students to independently plan their learning paths. Teachers facilitate learning by prompting questions and providing guidance to students, fostering opportunities for students to have agency in choosing practices or methods from the outside without immediately providing answers.

Key components

of a successful Makerspace.

The stories of students in the Makerspace classrooms at Starfish School and schools in the United States learning through FUSE Studio **highlight 3 essential key components of successful Makerspace utilization.**

01 – Prototyping tools may include digital equipment or various devices.



02 – The community (students and teachers) is what promotes interaction among people in the community, both in the building, location, platform, activity participation, and groups of students and teachers.

03 – The Maker Mindset is a way of thinking that recognizes the importance of playing or experimenting (Playful Learning), focuses on self-development (Asset- or Growth-oriented), and is not afraid of failure (Failure-positive) [4].

The results of Makerspace

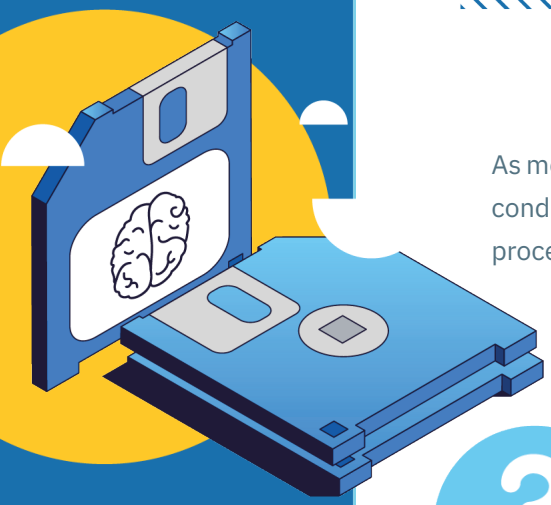
with a group of schools in the Bang Phlat District.

It's not just the cases mentioned above; there are also many government and private schools in Thailand that have adopted the concept of Makerspace in various ways, bringing wide-ranging benefits. These include 91 schools participating in the Teacher and School Quality Program (TSQP) for self-improvement, as well as schools under the jurisdiction of the Bang Phlat District, Bangkok, that have joined the Starfish Makerspace Learning Center (MLC) project with Starfish Education. They have engaged in skill development and experimental activities tailored to their own school contexts for over one year.

The group of schools in Bang Phlat has chosen to adapt Makerspace and the STEAM Design Process to align with the school's schedule and context effectively. They utilize these approaches in their subjects, activities, clubs, student development programs, and teaching methods based on projects. This reflects that school principals and teachers can apply this knowledge to enhance their problem-solving skills, such as by using them in core subjects to make the learning process more goal-oriented and to empower students to take ownership of their learning through project-based learning. This can be seen as a form of integration.

They integrate real-life challenges with classroom content, they are used in the Makerspace room and during club hours, for example, DIY activities and cooking or music activities are emphasized to develop life skills, with a focus on nurturing life skills.

The significant observations from the utilization of Makerspace and the STEAM Design Process by the teachers are that these approaches are applied in various situations, whether they are High-tech or High-touch. This enhances students' learning experiences effectively.



As mentioned above, the location, the activity room, is merely a supporting condition, but the essential core of the Makerspace activity is the learning process.

The STEAM Design Process consists of 5 steps, which are:

01 | Ask

Teach children to ask questions and be curious about their surroundings.

02 | Imagine

Encourage children to imagine and brainstorm solutions.

03 | Plan

Guide children to create step-by-step plans.

04 | Create

Let children put their plans into action.

05 | Reflect & Redesign

Encourage children to reflect on what they've learned and make improvements for the next time.

Teachers in some Bang Phlat schools not only adjust their teaching methods but also transform themselves in various aspects from the reflection results of teachers and principals through the UPRISE impact assessment framework, which shows that more than 91% of teachers and principals reflect that they have experienced meaningful learning as a result of the STEAM Design Process and Makerspace. One teacher mentioned that instead of giving instructions, they increased questioning to engage students, encourage more thinking, and involve them more in hands-on activities. Good questions are followed by deep understanding, and this process helps us significantly develop active listening skills.

In line with this, another teacher highlighted the importance of being a coach to create space for students to learn and take ownership of their learning. Therefore, it can be said that learning about the STEAM Design Process and Makerspace brings significant benefits, both to oneself and to students. Although Makerspace is considered a crucial physical starting point, it may not be sufficient.

Because teachers are crucial in creating a learning space in the hearts of children, preparing them, and providing encouragement.

Teachers need to allow children to have freedom, so they must let go of their own fears, whether it's the fear of children being in danger or the fear of children getting hurt.

When entering the activity room, students will have the opportunity to experiment and learn. Sometimes, there may be risks associated with experimentation using various tools, as the leading teacher has mentioned.

Because if you look at it from another perspective, it's a great opportunity to enhance children's abilities in an environment we can still supervise. When children learn and experiment, they develop proficiency and competency. Sometimes, this activity can be highly surprising for teachers, especially when they witness the capabilities of the children. **Therefore, in the role of a teacher, it is essential to constantly seek new knowledge (self-directed)** because sometimes, even if it's not our forte, we cannot let children go on their learning journey without support. To increase our understanding of what students are doing and to support them with the STEAM Design Process.

Students take pride, see value in learning, **and develop self-esteem.**

It is considered an opportunity to broaden students' experiences and opportunities. In turn, **teachers learn alongside students by enhancing their experiences together.** The changing role of teachers in the learning process and the creation of experiences that connect to real-world life make interactions between teachers and students change, and they can create valuable results for students (impact).

From interviews with groups of teachers at Bang Phlat schools, it can be seen that

> **Teachers recognize the diverse potential of students, as if they discovered the students in ways they have never seen before.**

Especially among the group of students at the back of the classroom who seemed disinterested and not focused on learning, they were quiet and unresponsive. However, when they entered the Makespace room and used the STEAM Design Process planning sheets, it showed that students could systematically plan and be creative. Therefore, **it can be said that this process opened the potential for teachers to see students as innovative inventors and creative thinkers.**

Problem solvers, and developers, whereas the traditional process often limited students to being mere recipients of information. This increased student interest and enthusiasm, making them happier to participate in activities. Although the results may not always meet expectations, the essential aspect is the learning process in which students take ownership. **This leads to students having greater pride, recognizing the value in their learning, and developing self-esteem.**

The Makerspace learning environment not only facilitates learning but also helps students discover themselves, their interests, and their strengths through hands-on experiences. This is a fundamental principle of Makerspace for students. For some, Makerspace and the STEAM Design Process are more than just learning activities, **and the processes enable students to enhance their abilities and create careers** beyond anything else. **The significant outcome is that students develop life-planning skills, as reflected by teachers in the Bang Phlat school group.**

An interesting example is that some students apply the STEAM Design Process to their exam preparation, aligning with the findings of the FUSE Studio case study that students use what they create in creative spaces in their personal lives. Conversely, they may apply real-life experiences to their creative activities, creating a continuous learning cycle.

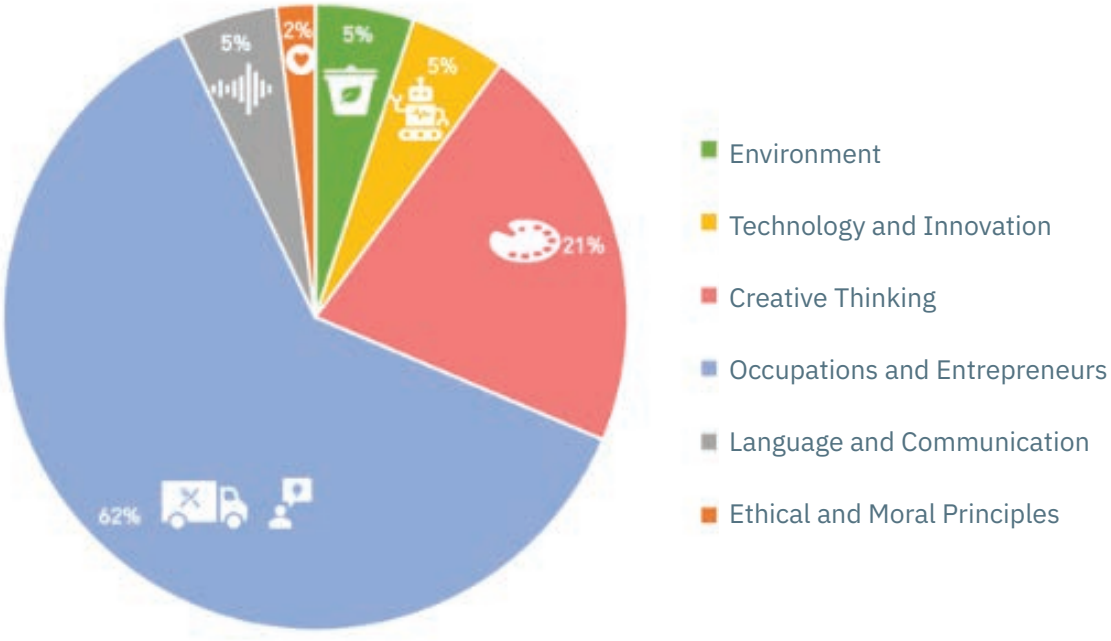
Developing life skills through various Makerspace rooms in government schools across the country

In addition to the Bang Phlat school group, there are also nearly 100 schools across the country with diverse backgrounds and different affiliated organizations that have implemented Makerspace innovations such as the School Transformation X (TSQP) program. The key lesson that can be summarized may be:

“Makerspace and the STEAM Design Process are innovations that can be applied in every context and can meet various needs.”

MAKERSPACE STEAM DESIGN

Information from schools participating in the Self-Development School Project (TSQP), the EEF, and the Makerspace Learning Center (MLC) program.



Makerspace and the STEAM Design Process are innovations that can be applied in every context and can meet various needs.

Developing careers and entrepreneurship to 62%, with the process involving innovation development for business model using the community as a foundation

Teachers manage active learning using the STEAM Design Process, enabling students to connect with social resources and local culture for further development or innovation.

It may involve adding value to products or innovative modifications. Subsequently, the emphasis is on fostering creative thinking, accounting for 21%, which opens opportunities for students to connect their knowledge, personal experiences, and environmental awareness. They use resources in the Makerspace to design and invent new things, meet needs, or solve problems. This process focuses on brainstorming, asking questions and being curious about their surroundings, and comparing various ideas, making it a fundamental creative thinking process. that can be applied to other relevant issues, such as environmental and technological innovations. Schools can encourage students to use creative thinking to find collaborative solutions in areas of responsibility, conservation, and the efficient utilization of environmental resources. Examples include value-added activities for upcycling, problem-solving innovations for PM 2.5 air pollution, local resource conservation, waste separation promotion in schools, and natural disaster technology innovations.

STARFISH
CLASS

Starfish Class
(Assessment tool in the Makerspace)

The development of student skills in Makerspace occurs continuously and throughout the process. For coaches who oversee and facilitate learning effectively, it is necessary to know each student individually and accurately compare the progress of students in each aspect. Having tools to assist in recording data and assessing students, like Starfish Class, will help coaches document results and compare data on an individual, group, or class basis. This allows coaches, students, and parents to clearly see the development of various aspects of students over different periods.

The Makerspace room and the STEAM Design Process

contribute to the development of creative thinking and academic skills.

Furthermore, many other schools have applied the STEAM Design Process and utilized Makerspace in their teaching and curriculum. This approach is not only interesting but also serves as evidence that this innovation can be applied to academic and creative thinking skills development, much like life skills development.

Learning Box (Makerspace in a Box)

A Learning Box is designed to allow learners to plan their learning activities using the core materials provided in the box, along with additional materials that may be acquired or found at home. Teachers design activities based on the content and students' interests, fostering contextual learning. The accompanying activity materials offer various choices based on individual interests and can be completed at scheduled times. All activities follow the STEAM Design Process, which enables reflection and new design. They can present their work through written reports and online media.

The learning experience of students using the Learning Box can be similar to using a Makerspace. in which teachers and parents take on the role of coaching in the Makerspace.

Ban Den Mai School in Chiang Mai utilizes the innovation of Integrated Learning Activity Kits [5] to develop students' competencies for the 21st century. Teachers adapt their thinking and teaching methods to implement Active Learning across all grade levels, developing both vocational and academic skills. They integrate the STEAM Design Process with various learning contents, enabling students to engage in hands-on learning within the Makerspace area. This innovative approach has a significant Effect Size of 1.560, resulting in students developing systematic thinking and holistic development. This innovation is considered a crucial process that teachers can further develop across diverse subject areas.

Establishing Makerspace for interested schools

Sharing the stories of using Makerspaces and the STEAM Design Process above highlights their unique and intriguing aspects. However, delving deeper into the behind-the-scenes of this success shows the administrative infrastructure that needs to be in place. Effective leadership is essential to taking the initiative and ensuring that both teachers and students engage in meaningful learning. Aligning the envisioned potential of this innovation with practical operational systems is the key to achieving equitable outcomes.

> **Schools do not necessarily need a large budget or extensive equipment, but they must commence a collaborative exchange among administrators where every member of the school shares their thoughts on needs and expectations.**

This shows the expected outcomes for students, and the author believes that every school, regardless of its background, shares similar expectations to schools like Starfish School and TSQP schools. These conversations serve as a pointer, indicating whether schools are ready to embrace Makerspaces and the STEAM Design Process with determination and confidence, without yet considering resource-related concerns.

When everyone is ready to embark on this journey together, the school administrators must continuously communicate with everyone, creating awareness among teachers that Makerspace and the STEAM Design Process are one of the methods for active learning and the teacher's work process. This means that teachers can use Makerspace as a learning resource that aligns with the content they are teaching. Teachers can also integrate the STEAM Design Process into student's projects and works. Before teachers integrate these methods into their mainstream or extracurricular subjects.

Furthermore, one must consider the teachers' professional development. School Administrators can clarify the alignment between managing learning through the STEAM Design Process via Makerspace and creating Performance Agreements (PAs) by setting challenging tasks. [7] Maintaining clear and consistent communication will enable teachers to grasp the significance of these changes, boost their confidence, and prepare them to work collaboratively in this transformative approach. This empowers teachers to effectively link their work, the learning process, and the Makerspace environment when tackling challenging tasks.

Integrating Makerspace and the STEAM Design Process throughout the school may be one sustainable approach to enhancing the school's quality. However, teachers must receive consistent support, particularly in terms of academic support, followed by other resource support, whether it's budget or equipment.

A school may consider the directors own Makerspace, where they demonstrate their role in academic leadership. Even though this space might have limited resources, the directors can use their freedom to innovate management strategies that support teachers in effectively utilizing Makerspace and the STEAM Design Process. When viewed this way, it becomes a challenging task for the principal, which can be applied to creating performance agreements (PAs) with the district directors, much like teachers do with their professional development. It's a space where learning and professional growth can occur alongside student's kill and competency development. We often perceive the success of innovation, such as well-equipped activity rooms, students acquiring more skills, teachers changing their teaching methods, and directors focusing more on academic leadership.

Managing it all is like the tip of the iceberg. However, when delving into the iceberg's base, one can see numerous interconnected factors, including teachers, directors, the learning management system, and other support systems. Teachers and directors are the key to integrating new innovations. If these innovations are not aligned with the classroom and school context, and if there are no adjustments in thinking, work processes, or learning management systems, even useful innovations can become problematic. Therefore, creating a system that supports the utilization of innovation and professional growth must be seriously considered. This ensures that those at the forefront, such as teachers and directors, are prepared and confident when deciding to introduce new innovations into the school environment.

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