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# Building a Professional Learning Community with Team Endeavors while Creating Elementary-focused STEM-integrated Lesson Plans

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**Abstract.** This longitudinal study examined the development of pedagogical knowledge of teacher's participation in a 2-year professional development program that enhanced teacher's self-efficacy and prompted changes in science instruction in the elementary grades. The purpose of this research was to implement STEM activities which are developed by a professional team. A professional learning community (PLC) was used as a professional development tool helping the teacher increase her Pedagogical Content Knowledge. Collaborative design of STEM science lessons, implementation of the lessons and reflection on outcomes. Collaboration among the educator and teachers was offered in the form of online learning materials, exemplary lessons and the availability of an expert. The researcher participated for one year in the program. Results showed significant increases in teacher's overall self-efficacy in teaching science, personal efficacy, and outcome expectancy efficacy during the 2 years. The increase of self-efficacy was presented with changes in improved instructional practices, particularly student participation activities. The educators and experts were important in providing pedagogical support during the design and implementation, and reflected with teachers on how to improve on their teaching.

## 1. Introduction

Building individuals with good knowledge and understanding of Science and Technology have become the main goals of national education programs. Thai science education has advocated infusing 21st century skills into the school curriculum and several educational levels have participated in such efforts. Thai educational institutions that focus on STEM, such as the Office of Basic Education Commission (OBEC), The Institute for the Promotion of Teaching Science and Technology (IPST), Phuket Rajabhat University STEM Education Center (PKRU STEM Education Center) and Chevron Enjoys Science projects.

STEM is a curriculum based on the idea of educating students in four specific disciplines — science, technology, engineering and mathematics. Integrated approaches to STEM (science, technology, engineering, and mathematics) education are increasingly popular, but remain challenging and elusive. There is much hope that integrated approaches to STEM education can help the next generation of students to solve real-world problems by applying concepts that cut across disciplines as well as capacities of critical thinking, collaboration, and creativity [1]. However, most teachers have



received training in only one discipline [3], and most schools and classes at all levels still have separate departments and class periods for the STEM subjects. Therein lies a significant challenge for educators and administrators interested in promoting integrated STEM.

Lesson design, Planning is an essential aspect of effective teaching. Planning begins with a design of units of study, and continues in the development of a sequence of lessons crafted to achieve the goals of the unit. Units are large chunks of the curriculum. Each unit contains multiple lessons and the lessons provide a pathway to mastery of the big idea. Each lesson should be an important step toward the goals of the unit.

#### Characteristics of a Good Lesson [2]

To plan effective lessons, you begin with the end – what are the outcomes you want from the lesson? What knowledge, skills, and attitudes will students possess if the lesson is successful? All lessons have the same basic structure: clear objectives, activities that provide students opportunities to meet the objectives, an introduction that activates prior knowledge and introduces questions that the teacher uses to check for understanding, and independent work in which students apply the concepts under varying degrees of difficulty.

So the essential elements of the lesson design are:

1. The objectives are set first and drive the design.
2. There is an opening that activates students' prior knowledge.
3. The lesson provides clear direction for students.
4. The teacher models or demonstrates the work to be done.
5. There is an opportunity for guide practice.
6. There are opportunities for teachers to check for understanding.
7. There is an opportunity for independent work.
8. There is a closing and summation of what was learned.

Goals identified in the framework include building STEM literacy and 21st century competencies; developing a STEM-capable workforce; and boosting interest and engagement in STEM. In terms of outcomes, the framework considers learning and achievement; and the ability to transfer understanding across STEM disciplines. Regarding the nature and scope of integration, the framework addresses which subjects are connected; which disciplines are dominant; and the duration, size, and complexity of an initiative. With respect to implementation, the framework focuses on instructional designs involving problem-based learning and engineering design; professional development and development of professional learning communities; and adjustments to the learning environment, such as extended class periods, extended lesson planning, team teaching, and partnering between STEM educators experts and teachers.

Watsuwankeereewong School is located in Patong, a major tourist attraction in the world. The students have migrated or have moved out from parents who come to work in Patong, and many of the student's behaviors have been observed. Students in school have lower academic achievement. Most lack the ability to think and solve problems without reason and are tired of learning, are lazy, and unable to connect their knowledge from the classroom to everyday life. As a result, students do not see the importance of science.

For the above reasons. If the teacher cooperates to adjust the teaching and learning and plans together the design of learning management, along with observation of teaching together and activities that focus on the students, they will be able to practice and think for themselves. Sharing the STEM activity design of teachers reflects and improves teaching the community of professional learning teachers. It develops students to their full potential, helps people in the 21st century and brings research results to effective teaching and learning through professional community processes. It will encourage students to recognize the importance and relevance of STEM (science, technology, engineering and mathematics)

Other paragraphs are indented (BodytextIndented style).

**Purpose of study**

To develop teachers in Watsuwankeereewong school to be able to design teaching and learning together.

To build a professional learning community in Watsuwankeereewong school Patong Phuket.

**Research Questions**

What processes of collaborative STEM lesson design enable teacher design teams to develop a STEM integrated lessons?

**2. Methodology***2.1. Research Methodology*

This Study is based on the classroom action research. The data analysis focused on processes of collaborative STEM lesson design enable teacher design teams to develop a STEM integrated lessons. This study was conducted for 1 year following the research framework which is presented in Picture 1.

*2.2. Research Participations*

The research participants were 4 science teachers and 2 science student teachers in major of General Science, Faculty of Education at Phuket Rajabhat University, themselves teach in Watsuwankeereewong School and educator from The Department of General Science Faculty of Education at Phuket Rajabhat University. The four science teachers and two science student teachers cooperative indicated their willingness to participate in the study choosing to focus their curriculum design within Force Lesson.

*2.3. Research Instruments*

In order to study the processes of collaborative STEM lesson design and enable teacher design teams with the Professional Learning Community (PLC). The researcher used data from, a design lesson observation meeting, classroom observation, individual interviews, a questionnaire, an inquiry-based lesson plan, reflection, and group discussions. In this research, classroom observations, interviews, questionnaires, case studies and documents were used as research methods to provide opportunities for participants and the researcher to generate an understanding for a particular situation. Research participants presented their lesson plan design through writing lesson plans, teaching, reflecting, meeting and answering or discussing topics in the interview process. Additionally an understanding of their PLC and STEM was transcribed and explained by the researcher who has used the inductive approach to generate the article.

*2.4. Teacher design team descriptions***Team lesson design**

The Team Lesson Design consisted of four teachers and two student teachers in major of General Science, the Faculty of Education at Phuket Rajabhat University, six of whom worked in the same schools. Two teachers participated in the Chevron Enjoy Science Project the previous year.

**Team to the reflect**

The Team to the Reflect consisted of an administrator and an educator from the Department of General Science Faculty of Education at Phuket Rajabhat University.

**Table 1.** Professional development overview and data collection timeline

Weeks	Activities	Data collected
1	-Design lesson. Collaborate with colleagues on designing and activity. How will it be assessed?	- Individual participant reflections - Field notes
2	-Teach Teach from the lesson plan design. -Assess How did your students do? -Share Share your assessments with your colleagues. -Reflect How did our students do?	- Individual participant reflections - Field notes
3	-Evaluate Are we making an impact? What changes do we need to make? -Inquiry What learning needs do our students have?  How do we improve the lesson plan?	- Individual participant reflections - Field notes
4	Cycle repeat from wk2-3	

### 3. Data Collection

Classroom Observation was used in the ways of formal and informal observation of teaching while it was taking place in a classroom or other learning environment. It was conducted by fellow teachers, administrators, experts or instructional specialists.

Practice Reflective Journal by classroom teacher/ researcher.

Reflective Feedback Journal by PLC team.

### 4. Data Analysis

The researcher analyzed documents and underlying knowledge of participants in speaking and writing. Data from multiple sources such as teachers' journals and interviews, field notes from observations and card sorting were analyzed by the process of open coding to get the transcripts from the first interview, observation, reflection and card sorting, developing initial categories of the participant's technological pedagogical content knowledge and their practice. In developing categories, the researcher used a constant comparative method of analyzing multiple sources of data which served to triangulate the data in order to increase trustworthiness of the research findings and assertions made.

### 5. Result and discussion

The results of this research are as follows.

1. Form of community building, professional learning in schools. The use of STEM instruction on the strengths of Mathayomsuksa 3 of Watsuwankereewong School consists of 4 main components and 10 sub-components as follows.

The main element is as follows

1 Organization for Learning consists of two sub-components:

1) Prepare the environment within the school with a focus on cleanliness, cleanliness, and health rate of personnel

2) Creating a corporate culture that is conducive to learning: being a good person, being open minded, listening to friends, enhancing the mental state of student teachers by organizing psychological activities.

The second element, the value creation and the shared vision, consists of two sub-components:

- 1) Co-ordinate the student's learning goals for understanding.
- 2) Define learning together based on the PLC concept: taking experience, exchanging experiences, visualizing success, exchanging expectations.

The Third element 3: Learning from the common practice consists of 3 sub-components: 1) Learning together. Collaborative Learning: Designing / Planning / Producing Exchanges. Reflect the teaching, and improve teaching

- 2) AAR (After action review): Successful exchange not less than one time a month.

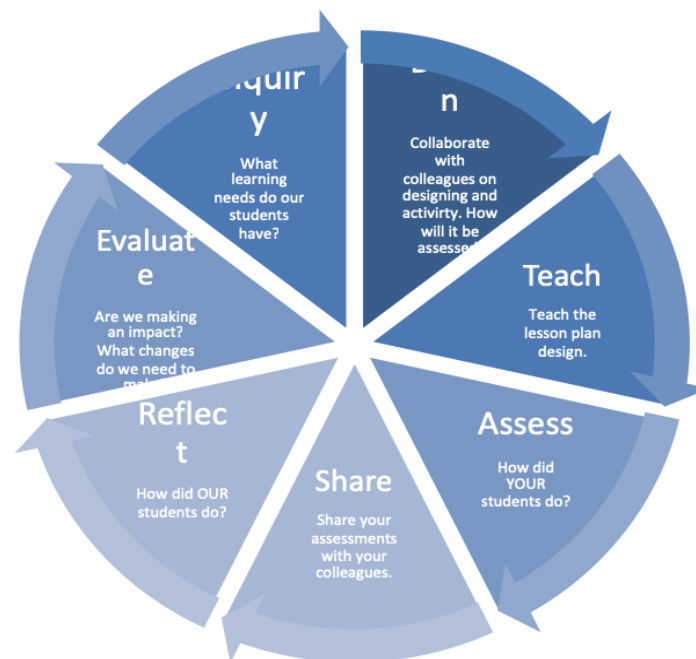
The main component 3 evaluates the expected results.

- 1) Strong student achievement.
- 2) Student behaviour in STEM
- 3) Teacher Satisfaction The pattern of creating a professional learning community in schools.

The results of the evaluation of the community-based learning model in vocational schools in Wat Suwankeereewong School by contextual experts on the benefits. The possibility and the accuracy are at the highest level. The students in grade 7 - 9 had an average score of 73.14 percent. The teacher of Watsuwankeereewong School STEM teaching behaviours were at a higher level. Teachers were satisfied with the model of community building, professional learning in schools at a high level.

## 6. Conclusion

For one year with a collaborative STEM lesson design, and STEM teaching development by building a professional learning community, the results showed increases in teacher's overall self-efficacy in teaching science, personal efficacy, and outcome expectancy efficacy. The increase of self-efficacy was presented with changes in improved instructional practices, particularly student participation activities. This enabled the ability to build a professional learning community of teachers.



**Figure 1.** Research Frame work

Lesson Design consists of these elements:

- Understanding the prior achievement of the class.
- Clear learning objectives that specify the concepts or skills to be mastered;
- Modeling or demonstrating the skills or concepts;
- Guided practice to allow students to apply the skills or concepts; and
- Checks for understanding that permit the teacher to monitor student progress and when necessary adapt instruction to meet the needs of individual students.

In the Lesson design, teachers were asked to discuss:

- Group of Team Learning
  - Member's role; Group leader, supervisor, communicator, collectors, time controller.
- The Cognitive Demand of Classroom Tasks
  - Construction of knowledge, through disciplined inquiry, to produce discourse, products, and performances.
- Formative Assessment
  - Observations of student work, student responses to teachers' questions, or on the use of techniques that allow students to give continual feedback about whether they understand the material.

## 7. Research Implication

Results showed significant increases in teacher's overall self-efficacy in teaching science, personal efficacy, and outcome expectancy efficacy during the 2 years. The increase of self-efficacy was presented with changes in improved instructional practices, particularly student participation activities. The educators and experts were important in providing pedagogical support during design and implementation, and reflected with teachers on how to improve on their teaching.

University researchers/ experts are currently facilitating academic-year professional development for science coaches within the division to pilot STEM activities in classrooms. This continuing investment will build upon the school Professional development model for STEM integration and respond to the expressed needs of the participants. The sequential actions of experiencing, questioning, analyzing, adapting, envisioning, and reflecting on STEM lesson plans as a vehicle for STEM integration in science classrooms

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