

## Working Together to Promote Science Learning in the Context of Sustainable Agriculture: A Collaborative Action Research

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### Abstract

*This research aims to enhance local science teacher's ability to manage learning activities that promote the implication of scientific knowledge and sufficiency economy principle to sustainable agriculture. Collaborative action research which was utilized to improve instructional process and professional development simultaneously contained the following stages; 1) the successful cases of sustainable agriculture management were analyzed to build a framework for learning activity development, 2) research participants collaboratively planed the research project together, 3) basic information was collected, 4) learning activities was designed, 5) the 4 stages of action research cycle (plan, do, observe, and reflect) were implemented in the classroom by the participating teacher and researchers, 6) the learning activities were revised after the implementation. The result of reflecting the successful cases of sustainable agriculture management indicated that scientific knowledge and skills played an important role in sustainable agriculture and sufficiency economy principle because they are parts of knowledge and rationality in the principle. The result of professional development showed that the teacher had an ability to organize learning activity that improved student's inquiry skills by having students observe, pose questions and find the answers by themselves. The result of student's learning indicated that student's understanding of sustainable agriculture was at high level, student's understanding of sufficient economy was at moderate level, student's problem-solving skill was at moderate level, and student's awareness about the importance of sustainable agriculture for the conservation of natural recourses was at high level. Moreover, the learning activities from this collaborative action research could be used in the school to which the context is similar.*

**Keywords:** *sufficiency economy, sustainable agriculture, professional development, collaborative action research*

### 1. Introduction

General purposes of teaching science depend on the individual nation standard. Mostly, science teaching is one of the compulsory knowledge and skills to prepare students to ready to be good citizens based on scientific knowledge based society. State curriculum then recommends how students should progress toward science what the students should know, understand, and be able to do by the time they reach certain grade levels. Each country assigns general science learning goals but did not inform teachers specifically of what to teach. However, a number of science educators have tried to learn more how students learn and also explore novel teaching methods to address that aim. Context-based learning is one instructional strategy that engages students to learn science because it connects scientific knowledge with real life situations, making science more attractive and interesting for students. The students view familiar contexts as interesting and attractive and thus make connections between scientific content and their everyday lives. These contexts also facilitate meaningful learning <sup>[1]</sup>

In order to teach science to be more meaningful to the student, scientific learning activity has to be mean something to the students and relevant to their context. Lopburi province is located in the middle of Thailand where most of the population is agricultural workers. To design and develop science learning activity is, therefore, challenging tasks for science educators and educational stakeholders to cooperate in developing such learning activity to meet the expected goals. The theories based on the development of learning activity are sustainable development (SD). The SD has emerged as the latest development slogan which a wide range of nongovernment as well as government organizations around the world have embraced it as a new paradigm of development. Since 1980, the term sustainable development had come into prominence after the International Union for the Conservation of Nature and Natural Resources (IUCN) presented the aim of achieving sustainable development through the conservation of living resources. However, it is still unclear of its



definition. <sup>[2]</sup> A number of the SD definition and framework were proposed such as World Bank, Asian Development Bank, and the Organization of Economic. Among other things, this study focuses on the sustainable agriculture where the agriculture is one of the foundations of human society and a major activity at the human-environment interaction. <sup>[2]</sup> Among the confusion and un-pattern firmly of the term usage are sustainable agriculture, low-input agriculture and organic farming, this action research study based on the theories of sustainable agriculture of the Sufficiency Economy Philosophy (SEP) that the His Majesty the late King Bhumibol Adulyadej introduced in 1974. After the First National Economic and Social Development Plan was launched in 1961 (2504 B.E.), Thai farmers were introduced to change how to do agriculture from natural agriculture to be more chemical one in order to accelerate to have more product. As a result, doing long-term chemical agriculture continually destroys surround environments and barely to turn it back to be good environment as before. This previous mention challenges the research team how to educate and motivate the young generation in this context to value how to maintain their family career as well as reduce chemical usage to save the environment at the same time.

To address the above concern, this study thus aims to pull stakeholders and chair holders of education and related to successful farmers for sustainable to cooperatively working together with aim of designing the science learning activity that have more meaningful for the young generation. The successful chemical free farmer, an experience science teacher, school administrators, and university researchers from both agriculture science education programs were invited to share their own tacit knowledge of practicing experience to help the Thai young generation to maintain their family career and apply science concept in the meaningful ways through this cooperative action research.

## 2. Research Objectives

1. To develop a set of scientific learning activities to promote the introduction of the sufficiency economy to sustainable agriculture
2. To enhance the ability of a local science teacher to manage the learning activity
3. To increase students' learning outcomes in three aspects: understanding the principles of sufficiency economy and sustainable agriculture, problem solving skills, and the awareness of environmental conservation in agriculture

## 3. Research Method

The research objectives aimed to develop professional teacher through a cooperative action research. To be professional teacher is considered as an important variable that helps the teacher develop her career profession as well as her instruction at the same time. <sup>[3]</sup> Outcomes of this study expected to see the development occurs both the teacher as well as the students. Furthermore, the products from this study are the set of scientific learning activities with aim to improve students' learning outcomes in the following aspects: comprehension of the sufficiency economy principles and sustainable agriculture, problem solving skills, and student's awareness of environmental conservation in agriculture.

This study consists of 3 stages of processes: 1) lesson learned from sustainable agriculture farmers and cooperatively designing science learning activities, 2) action research process and data collection, and 3) summarizing research finding and improving the activity. Details of each step are presented in Table 1.



Table 1 research stages

Research stages	Activity	Research tools
1. Lesson learned from sustainable agriculture farmers to design learning activities	<ol style="list-style-type: none"> <li>1) Sustainable agriculture lesson learned from the role model farmers.</li> <li>2) Collect fundamental data</li> <li>3) Design learning activities</li> </ol>	<ol style="list-style-type: none"> <li>1) Observation</li> <li>2) Semi-structured interview</li> <li>3) Field note taking</li> </ol>
2. Action research process and data collection	<ol style="list-style-type: none"> <li>1) Planning and scheduling together to implement the learning activity</li> <li>2) Implementing the learning activity to the students</li> <li>3) Classroom observation and collected evidence of the implementation</li> <li>4) Reflection on what had happened and discuss to find the better way to improve the existing lesson plans.</li> </ol>	<ol style="list-style-type: none"> <li>1) Classroom observation</li> <li>2) Semi-structured interview</li> <li>3) Field note taking</li> <li>4) After action reflection</li> <li>5) Student exercise along with each lesson plan</li> </ol>
3. Summarizing research finding and improving the activity	<ol style="list-style-type: none"> <li>1) Summarizing the result of the operation and document what count as change in practice, what evidence of student learning outcomes</li> <li>2) Revising and improve the developed learning activity due to the result of the implementation</li> </ol>	<ol style="list-style-type: none"> <li>1) Observation</li> <li>2) Semi-structured interview</li> <li>3) Field note taking</li> </ol>

#### 4. Results and Discussion

The learning activities were collaboratively developed by the participating teacher and the researchers based on the lesson learned from the role model farmers. The learning objectives of those activities were to enhance student's understanding on sustainable agriculture and sufficiency economy principles, student's problem-solving skill and student's awareness of environmental conservation in agriculture. The result of classroom observation indicated that the teacher played the crucial role in the promotion of student's inquiry skills and the role was depended on the activity, for examples, the teacher performed all of the roles when the activity was organized with an open-ended question and the students had an opportunity to design their own experiments. On the other hand, if the activity focused on demonstration or playing game, the teacher would focus on supporting students to develop scientific explanation and connect the explanation with scientific knowledge. The results suggested that the teacher already had skills for supporting students' inquiry. Therefore, this collaborative action research would not to develop new teacher skills. Instead, this research provided an opportunity for the teacher to use those skills again to support student's learning. Teacher's roles are presented in Table 2

Table 2 Teacher's roles for supporting student's inquiry skills

Teacher's roles	Learning activities				
	1	2	3	4	5
encourage students to pose scientific oriented question	✓	✗	✓	✗	✗
scaffold students to design how to collect scientific evidence	✓	✗	✓	✓	✗
support students to develop scientific explanation	✓	✓	✓	✓	✓
encourage students to connect the explanation with scientific knowledge	✓	✓	✓	✓	✓
support students to communicate and examine scientific explanation	✓	✗	✗	✓	✓

This result is consistent with research by Tseng, Tuan & Chin <sup>[4]</sup> which suggested that experienced teachers could design inquiry learning process and encouraged students to explore, collect data, analyze and presents the result. Moreover Ireland, Watter, Brownle & Lupton <sup>[5]</sup> had interviewed experienced teachers and concluded that teacher's view about science teaching had influence how they organized inquiry learning activities. Those views include 1) experience-centered



conception 2) problem-centered conception and 3) question-centered conception. The teachers expressed their view about science teaching related to the feature of the activities.

However, Golding <sup>[6]</sup> suggested that science teachers should not had a role like a guide tour who lead students through steps according to the lesson plan too strictly. This may make the students lack of the opportunity to practice self inquiry skill. Instead, the teacher should act like an expedition-educator who walk through the problem with the students even the destination is unknown. To promote science inquiry in classroom is not an easy task for teachers, especially when they need to cover all contents in the national curriculum. Edward <sup>[7]</sup> studied how middle school teachers organize active learning activities in the context that the students need to get high score for the national examination. There were challenges including 1) system 2) learners, 3) content and 4) the teachers themselves. However, teachers can beat the challenges with the concentration to the students learning and an experiment with new teaching strategies.

The result of student's learning indicated that student's understanding of sustainable agriculture was at high level, student's understanding of sufficient economy was at moderate level, student's problem-solving skill was at moderate level, and student's awareness about the importance of sustainable agriculture for the conservation of natural recourses was at high level. Many factors had influence student's learning from inquiry activities. Smart & Marshall <sup>[8]</sup> studied student's dialogue during learning from inquiry activities and found that level of question, complexity of the question, communication pattern and interaction in classroom had positive effect to student's learning. In our study, the participating teacher posed many questions to engage the students to be involved in inquiry activities. Moreover, students learnt concepts of sustainable agriculture by exploring real situation and reflection. These form of activity affects cognitive engagement and bring about student's learning outcomes.

The reason why student's understanding of sufficient economy was at moderate level might be the fact that the students need to understand philosophy of this principle and also reflect their experience related with the principle, for example, the financial crisis may induce people to apply sufficiency economy principle to survive from the situation. Lacking this experience and deep understanding of the philosophy might explain why the student's understanding was at moderate level. Student's problem-solving skill tend to be increase during the series of the activities. This result indicated that inquiry learning process support the students to practice problem-solving skills. Madhuri, Kantamreddi & Goteti, <sup>[9]</sup> also found the similar result when they changed learning process in chemistry class from traditional lab activity to be inquiry with real life problem. The students had improved learning achievement and realized the importance of science to solve real life problem. Student's awareness about the importance of sustainable agriculture for the conservation of natural recourses was at high level. This means that the students realized that sustainable agriculture decrease toxic in the ecosystem and also conserve environmental resources. The result might relate to the student's understanding of sustainable agriculture.

In conclusion, this collaborative action research helps us to construct knowledge from practice with was related to the context of the participating teacher and the students. There is always possibility for science teacher to use real life context (sustainable agriculture for this case) to design meaningful learning experience for the students.

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