Applying the philosophy of sufficiency economy and STEAM knowledge of Grade 11 Students in the STS biodiversity Unit

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Abstract. Learning biology through social context local wisdom helps to encourage students to appreciate the value of what is available in the community. This research has purposed to develop Science Technology and Society (STS) based on Yuenyong, 2006 according the Philosophy of Sufficiency Economy (PSE) with science on biodiversity learning activities consist of 5 steps: (1) Identification of social issues, (2) Identification of potential solutions, (3) Need for knowledge, (4) Decision-making, and (5) Socialization stage. In addition, learning activity was used according to PSE that includes three elements: moderation, reasonableness and self-immunity, as well as two conditions which are knowledge and moral. Eleventh grade student from high school in Khon Kaen, Thailand were selected for the study. However, this research is a qualitative research. Focus on interpretive paradigms of phenomena occur in the classroom. It is a way to study and analyze the Philosophy of Sufficiency Economy in Biology classes about biodiversity of the tadpoles that local name is Huanh. There are tools to collect data. Record of observation of class notes after teaching and student work. As a result, learning of STS approach enables stimulation students to apply Philosophy of Sufficiency Economy and STEAM knowledge in the biology class through social cohesion related to the local wisdom of the local community.

1. Introduction
Education in the 21st Century focuses on learning for life. Its main purpose is study for education, society, economy, politics and culture. It is well known that a good education is the driving force that keeps society has evolved and progressed to the good side. The changes in education over the past century have resulted in science becoming a central part of learning. Science is also an important intermediary in advancing technology because we bring science to new technologies. As a result, science and technology are inextricably linked. However, this century has transformed education into a special aspect that is important for future-oriented education. The first thing to focus on is the integration of knowledge and application to create more knowledge into the application. This has resulted in a major turning point in education not just the use of knowledge. It is the knowledge to innovate to apply in the daily life reasonably creative and virtuous [3]. Especially, linking science to the well-being of local people and local wisdom helps students to develop and promote the creation of new technologies that consistent with the need and demand for people in the community. Moreover, the science associated with the local help students realize the value
and importance of the resources that are around the students. They can create new things from the wisdom that they may have forgotten to return to the new value again. To see that science is not just a question of what we suspect. They can create new things from the wisdom that they may have forgotten to return to the new value again. It is the knowledge and understanding that is used to develop the environment and resources around us to be stable, balanced and sustainable [4].

However, to create a balanced and sustainable community economy, it is necessary to have quality human resources development. Create intensity Which is an important learning resource for quality human resource development, which is school by developing knowledge in science, technology, engineering and mathematics (STEM) [7]. STEM education guidelines that have been integrated knowledge between subjects such as scientific knowledge, technological knowledge, engineering knowledge and mathematical knowledge combined [5]. In 2016, Georgette Yakman [8] and her team put forward STEAM education (science, technology, engineering, art and mathematics) on the basis on STEM education. From the perspective of science and technology, interdisciplinary concept of different subjects will be integrated for the development of modern society to provide excellent human resources support. Schools are learning STEAM learning programs to provide students with the skills and knowledge necessary to develop in the 21st century. But will produce designers and engineers tomorrow only to develop innovative ideas and problem-solving abilities to ensure that our students become technology builders, not just consumers. Student should study ensures contextualized and meaningful learning.

In Thailand, His Majesty King Bhumibol Adulyadej has brought the philosophy of sufficiency economy (PSE). This is an approach that will encourage people to become stable, balanced and sustainable. It can be applied to any situation, not just science education or country. The philosophy of sufficiency economy includes three elements: moderation, reasonableness, and self-sufficiency, and requires two conditions in order to work: knowledge and moral [6]. The application of the philosophy of sufficiency economy of science class will encourage students to learn science that is close to real conditions. Yuenyong and Narjaikaew [10] reported learning education science technology and society (STS) approach in conjunction with the application of the philosophy of sufficiency economy support encourage students to learn throughout life.

In 2004, UNESCO [1] reported that an important tool in teaching students to understand the issue of sustainability in schools is good. Teachers should teach about biodiversity. Because diversity affects all living things in the community and affects the ecosystem. In addition, biodiversity can directly affect people in the community from ecological dependence. Thus, learning about biodiversity does not only encourage students to learn about local organisms. It also aims to develop social, political, economic and cultural life of people in the community. Encourage students conserve resources with the community [2].

For this reason, this study focuses on the application of the philosophy of Sufficiency Economy and STEAM knowledge in biodiversity by learning concepts through Yuenyong (2006) [9] science technology society (STS) class of biology students in grand 11th.

2. Research Methodology
This research is a qualitative research focusing on the paradigm of interpretation to study the application of the Sufficiency Economy Philosophy of students in grand 11th in During the first semester of 2018, Khon Kaen University Demonstration School a high school in Khon Kaen, Thailand. Focus on education on the application of sufficiency economy in biology classes. During STS learning activities, the application of the philosophy of economic sufficiency and the study of how students apply the philosophy of sufficiency economy observed of planning behavior among groups, work piece and journal writing.

2.1. Participants
The participants consisted of 70 students that were divided into groups of 5-6 persons from a high school in Khon Kaen, Thailand who entered in science program in grand 11th about biology class. Most students in the classroom have a different way of lifestyle than a rural one. It is a family town. Therefore, students do not understand the way of people in local the community and do not know the local biodiversity as they should.
2.2. Lesson plan
Lesson plans, the concepts based on biodiversity, science, technology and society of Yuenyong (2006). The purpose is to study the application of the philosophy of Sufficiency Economy and can link the scientific knowledge and local wisdom in the biology classes. The lesson plan was developed by the following steps:

- Study the curriculum content and structure Standard measure and indicator in Teaching Plan based on Science Curriculum in Basic Education Core 2008 on biodiversity of students in grand 11th.
- Create a Lesson plan on concept of Science, Technology and Society (STS) approach of Yuenyong (2006). The concepts based on biodiversity for student can the application of the philosophy of Sufficiency Economy. The teaching of STS consists of 5 steps: including step 1 identification of social issues stage, step 2 Identification of potential solutions stage, step 3 Need for knowledge stage: step 5 Decision-making stage and step 5 Socialization stage.
- Expert panel for reflections on the STS Biodiversity lesson plan.
- Improve learning management plan based on the guidance of Experts.
- Use learning plans with target students.

2.3. Intervention
Activities learning in biology class does not have a strategy to entice students to learn in a context that can be linked to local communities. Therefore, activities to define the intervention strategy by using the STS method. It encourages and encourages students to learn through social context and to know what is available in the community. The pedagogical intervention took place over two weeks. In title biodiversity and applying the philosophy of Sufficiency Economy in biology class, it covers the organisms existing in the Northeastern of Thailand community. Classes were developed to encompass support to love the homeland, watch videos that link to the philosophy of Sufficiency Economy, group activities, discussion and creation the project.

Table 1. Overview of “Huanh-Kob (Tadpoles)” Biodiversity Lesson Plan through STS Yuenyong (2006) and applying of the philosophy of Sufficiency Economy (PSE)

| Stage                                      | Learning activity                                                                 |
|--------------------------------------------|----------------------------------------------------------------------------------|
| 1. Identification of social issues stage. | 1. Teacher ask student about organism in around for into meaning of biodiversity. |
|                                            | 2. Teacher opened music VDO " Hor Mok Huak Bpai Faak bpaaa " meaning bring steamed of Tadpoles bake to leave offer aunt. With music about eating culture and broad-mindedness of people in the Northeast of Thailand |

Figure 1. Song " Hor Mok Huanh Bpai Faak bpaaa "
(Source: https://www.youtube.com/watch?v=FudAnrJkOb4)

Questions for students:
1. How are our daily lives linked to biodiversity?
2. How can people in the community make money from biodiversity?
3. "If students are members of the community who like to eat tadpoles, what are some ways to make biodiversity of tadpoles and the community of students have revenue from tadpoles a stable and sustainable how is the balance caused?"

2. Identification of potential solutions stage.
1. Students identification of potential solutions to the problems of the community as possible about generating revenue and maintain a variety of sustainable tadpoles.
2. Each group of students brainstormed on problem solving about revenue and biodiversity of tadpoles. “what the existing knowledge solve this problem and have any knowledge that students need more used to solving the problem?
3. Student see the video on the application of the philosophy of Sufficiency Economy in daily life.

Figure 2. Sufficiency Economy?
(Source: https://www.youtube.com/watch?v=2CjE6RWrB5I)

3. Need for knowledge stage
In need for knowledge stage used 5E inquiry for learning activity:
1. Engagement: Teacher opened the VDO about “Father African Bullfrog help tadpoles” for show the relationship of tadpoles with another organism in ecosystem.

Figure 3. Father African Bullfrog help tadpoles
(Source: https://www.youtube.com/watch?v=325Xz26Z7Tk&t=4s)

Questions for students: How do tadpoles and frogs interact with the ecosystem?
2. Exploration: Teacher gives the question on worksheet about biodiversity and the application of the philosophy of sufficiency economy and allow each group to brainstorm ideas for answers.
3. Explanation: Each student grout showed the idea the question on worksheet and the information is summarized as their own knowledge.

4. Elaboration: Teacher explain about general knowledge about frogs and tadpoles, habitat, culture and living by applying the philosophy of sufficiency economy in daily life.

5. Evaluation: Student present what they have learned from their classrooms.

4. Decision-making stage.
   1. The students in each group to share their opinions and decisions by choosing the best way to how to solve diversity and generates revenue from tadpoles to the community.

5. Socialization stage.
   1. The students in each group to share their solutions by infographic through an online community on Facebook for 1 week.
   2. The students in each group written report describing the work of the group.

3. Data Collection and Data Analysis
The researcher collected data by using 2 Science Knowledge Management Plans based on Science, Technology and Society (STS) approach and apply to the philosophy of Sufficiency Economy titled “Huanh-Kob (Tadpoles)” with the target group, total duration of 4 hours. The participant's observations were recorded report, worksheet and student performant was taken through a paradigmatic interpretation. To examine the application of philosophy of sufficiency economy of students in each of the STS stages of learning in biodiversity content. The information is subject to quality assurance by experts, depending on the researcher's framework. In designing this learning activity, STS will support students to apply the philosophy of sufficiency economy. It consists of includes three elements: moderation, reasonableness, and self-sufficiency, and requires two conditions in order to work: knowledge and moral.

3.1 Data collection and data analysis of worksheet.

Table 2. Data collection and data analysis of worksheet by discusses and determine in each group.

| Science, Technology and Society (STS) approach | The Philosophy of Sufficiency Economy | Example answer |
|------------------------------------------------|--------------------------------------|----------------|
| Three Elements:                                 |                                      |                |
| 1. Identification of social issues stage:      | 1. Moderation: Sufficiency, not much and not too little, without causing detriment to others. | Students realize the consumption of tadpoles. |
| Questions for students in worksheet.           |                                       | Growth of tadpoles in each age range. |
| - What is biodiversity?                        |                                       | Recognizing that eating too much tadpoles can affect the ecosystems of the offspring and other organisms. |
| - What are the tadpoles?                       |                                       | Students are aware of their livelihoods and need to rely on |
| - If we eat too much tadpoles, how will it affect us? |                                       |                |
| - How do tadpoles affect                       |                                       |                |
biodiversity?  
- How can students make money from tadpoles?  
- Can the tad be enough for the needs of the community?  
- What should I do to get rid of the tadpoles from nature?  
- How does the loss of tadpoles from nature affect the ecosystem?  
- Do students agree with eating tadpoles?

2. Identification of potential solutions stage.

Questions for students in worksheet.
- What knowledge do students need to address the social issues associated with tadpoles and the sustainability of their community?

3. Need for knowledge stage.

Questions for students in worksheet.
- General Information about tadpoles.
  - How to make a tadpole?
  - The importance of tadpoles to the ecosystem.
  - The main reason for the number of tadpoles down.
  - Why study the diversity of tadpoles?
  - How to business planning?
  - How to market planning?
  - How to prepare for business?
  - How do the tadpoles in the community?
  - How to promote the income of people in the community?

4. Decision-making stage.

Questions for students in worksheet.
- How does the student solve the problem in order to sustain the environment to balance the ecosystem.
  
  Students are aware of the consequences after the loss of biodiversity.

2. Reasonableness: The decision to do something carefully and through contemplation.

Students need to know why these issues are important.
  
  Students must know why sufficiency economy is essential to life.
  
  Students can use scientific reasoning to answer questions.
  
  Students are aware of the importance of losing diversity by bringing the scientific knowledge to the rational explanation.

Students plan the feasibility of doing business under the possibilities.

3. Self-sufficiency: To prepare for the impact of the changes that occur.

Bringing scientific knowledge to solve problems related to tadpoles.

Predict the feasibility of business planning and marketing using tadpoles.

Prepare to cope with the problems and consequences of eating tadpoles.

Know how to make money and reduce the impact caused by the loss of biodiversity on Tadpole population decline.

Indicates possible ways to address diversity and downstream tadpoles in their communities.

Two conditions:

1. Knowledge: Round knowledge in different fields of knowledge that will be instrumental in linking the planning and decision-making.

Bringing scientific knowledge to help solve biodiversity problems without the emotions of the students.

Planning guidelines for answers that make sense.

It can link knowledge about biodiversity and knowledge in other fields.
community sustainably and by making money from tadpoles to balance the biodiversity?

5. Socialization stage. Questions for students in worksheet.

- "If students are member in the community who like to eat tadpoles, student will be what are some ways to make biodiversity of tadpoles and the community of students have revenue from tadpoles a stable and sustainable how is the balance caused?"

| 2. moral: Being aware of things in an ethical and honest intelligence unit in lifestyle. | Students are aware of the loss of habitat and extinction of tadpoles. Students aware of the consequences that would happen to the environment and recognizing the importance of tadpoles. Students are aware of the impact that will come to the community during do business. | The knowledge that exists to solve the problem. |

4. Finding

The results showed that the teaching of biodiversity based on Science Technology and Society (STS) approach through Yuenyong (2006) promotes and supports the application the philosophy of Sufficiency Economy (PSE). This shows students make the process revenue from biodiversity in local. The learning process of the students is under the application the philosophy of Sufficiency Economy includes three elements: moderation, reasonableness, and self-sufficiency, and requires two conditions in order to work: knowledge and moral could be analyzed. On the way of students’ developing solutions related the tadpole, it indicated that they applied STEAM knowledge.

4.1 Students’ generating ideas of application of sufficiency economy philosophy and STEAM knowledge. Students’ generating ideas of application of sufficiency economy philosophy and STEAM knowledge could be interpreted through students’ completion on the worksheet.

It is a worksheet that occurs during the STS learning activities. The worksheet aimed student can connect biology education style with social issues and application of sufficiency economy philosophy in science classroom. In addition, student should have created new idea or innovative for to solve that the problem. The worksheet provided student can connect biodiversity content with PSE and STEAM knowledge by STS learning activities.

This worksheet may illustrate the students' thinking processes about the application of sufficiency economy philosophy in the biology class. The worksheet is stored procedurally. Identification of the social issues stage, Identification of potential solutions stage, need for knowledge stage and Decision-making stage, as shown in the following table.

| Group | Description | Involved from PSE |
|-------|-------------|-------------------|

Table 3. Result of applying the philosophy of sufficiency economy of worksheet in Identification of social issues stage.
|   |   |
|---|---|
| **1** | Students can link to listen to the song and help each question. The question brings a sense come into the question. Why take such foods made from tadpoles to leave her, what other things to leave? Some questions and represents a realized number of tadpoles in the community, if people eat a lot of tadpoles. By the question “Is there any way to breed tadpoles to meet their needs?” In addition, the students also take into account the ecological system in that case “If control of the tadpoles and release of the tadpoles back to the natural habitat would result in tadpoles’ survival and as a result, the environment would not have any impact on the food chain” |
|   | From the description of the students found, students can positively address social issues and question their scientific knowledge. And that the tadpoles can significantly affect the balance of ecosystems. It represents an important link with the main philosophy of sufficiency economy are moderation, reasonableness, knowledge and moral. |
| **2** | After listening to music, students can identify social issues. Why tadpoles are popular among people in the community. However, the students went on to explain that the fact that people in the community eat tadpoles makes the tadpoles in the community balanced because community members are part of the ecosystem in the community. |
|   | Based on the student's suggestions, show that Students can link scientific knowledge to social issues. And it can be said that the eating of people in the community does not encroach on life. But it shows that people and the environment are dependent on each other. It illustrates the linkage the philosophy of sufficiency economy that students can link the philosophy of sufficiency economy are moderation, reasonableness and knowledge. |
| **3** | From listening to music to identifying social issues. Students use the feeling to ask questions. Why do I have to leave the tadpoles? Is it possible to leave? And explain that in the community there is enough volume. Because of the source of the farmland, which is the frog's habitat, there are frog spawn. |
|   | By explaining that students do not understand the way of life of the rural Northeast. And students do not understand about the environment of the tadpoles and frogs. It is based on the knowledge that students have in predicting the wellbeing of life. Which links the main philosophy are reasonableness knowledge and moral. |
| **4** | Students identify social issues. “How to need to eat tadpoles in any season to be appropriate. And to explain that should have control of the population to eat, the survival rates of tadpoles suit the environment. |
|   | Indicates the amount of tadpoles that are sufficient for survival in the community to grow into frogs. This can be linked to the philosophy of Sufficiency Economy are moderation, reasonableness and knowledge. |
| **5** | The social aspect that students identify. “How do tadpoles’ taste? Is there any way to make delicious taste of tadpoles?” And explaining that eating tadpoles represents the local identity of the Northeast. |
|   | It shows that people have not eaten tadpoles but know that they are local foods. This can be linked to the philosophy of Sufficiency Economy are reasonableness and knowledge. |
| **6** | Social issues identified by students. “Why are people in the community to eat the tadpoles.” Eating tadpoles during spawning season. As a result, the tadpoles are reduced |
|   | Students' explanations show that students are aware of eating too much natural tadpoles. This can be linked to the philosophy of Sufficiency Economy are moderation, reasonableness and |
in nature. People in the community should keep their natural balance. Although tadpoles and frogs are local food.

7 Identify social questions “How do people stop eating tadpoles?” And explaining that eating too much tadpoles can result in lower tadpoles in the community. As a result, the ecosystem is not fertile. Frogs may be extinct in the future. Students demonstrate awareness of the nature and loss of ecological balance in the community. This can be linked to the philosophy of Sufficiency Economy are moderation, reasonableness knowledge and moral.

8 The question of social determinants is that. “How delicious, why eat?” The students explained that. In the Northeast there are many interesting creatures. Why do you have to eat tadpoles? Eating tadpoles and frogs, resulting in the balance system. If the tadpoles decrease, the frogs will decrease. And more insects. Cause the effect on the food chain because the frog is a member of the ecosystem. The explanation shows that students never eat tadpoles and do not know how tastes are. Proposed solutions to the problem of eating other organisms instead of eating tadpoles and linking them to how ecstasy affects the ecosystem. This can be linked to the philosophy of Sufficiency Economy are moderation, reasonableness knowledge and moral.

9 The questions that students make about social issues. “How does the population of tadpoles in the water dive?” Overdose may affect the survival of frogs in the community. Therefore, people in the community do not eat up too necessities. Show that students are aware of the tadpoles' survival rate and point out that they should be eaten in moderation that will not affect the ecosystem. This link the philosophy of sufficiency economy moderation, reasonableness, knowledge and moral.

10 Social issues What is the survival rate of frogs? People in the community are very tadpoles, resulting in shortages and income in the community. Although tadpoles are the food that people in the community like to eat. If we let it grow into a frog, it will help to generate more income. The students' explanations show that students can bring social issues to explain about the income generation of people in the community. And point out that students are into the tadpole's way of life towards the community. This can be linked to the philosophy of Sufficiency Economy are reasonableness knowledge and moral.

| Table 4 | Result of applying the philosophy of sufficiency economy of worksheet in Identification of potential solutions stage. |
|---|---|
| **Group** | **Description** | **Involved from PSE** |
| | ||

9
1. Students explain the two main approaches to finding answers: how to make the right income for the community. Increasing variety of tadpoles and breeding methods. And students link to whether they should educate people in the community to make money by making food from tadpoles. Export of tadpoles and tadpoles are OTOP products.

2. The student explains that the student's response to the question is to have knowledge of the environment and the life of the tadpoles, Farming methods, Cost, Breed selection, how to allocate space that does not affect the environment and how to make money in the community.

3. Students are interested in researching on the philosophy of sufficiency economy and information on raising frogs and behaviors that farmers need to know.

4. Students plan how to solve problems by farming frogs and tadpoles.

5. Students interested in planning a farm system, ecology of the tadpoles, breeding methods, production marketing and advertising.

6. It is planned to study the processing of products for export, general knowledge about tadpoles, seeding and marketing.

7. Learn about the tadpoles, allocation of space business, administration tadpole conservation in the community and to generate revenue through online methods.

8. A study of general knowledge about nature and living tadpoles, how to preserve the tadpoles, how to advertise, how to farm Life style of the community and the season should not eat tadpoles.

9. The thing to know about tadpoles and economic philosophy is just enough. Study of the life of the tadpoles. Create a new image for the tadpoles. Exports are genetically modified farming product design.
Study the environment suitable for tadpoles, market demand, natural tadpoles and off-season eggs of frogs. Students use knowledge as a way to find answers and plan marketing. The three links to the philosophy of sufficiency economy as follows self-sufficiency and knowledge.

Table 5. Result of applying the philosophy of sufficiency economy of worksheet in Decision-making stage.

| Group | Description | Involved from PSE |
|-------|-------------|------------------|
| 1     | Group members offer solutions to problems. Whether it’s a frog farm to rearing tadpoles. The tadpoles that no longer cause disease. However, students make a decision on how to farm frogs. There is a negligence in educating people in the community. The community members have ideas and different businesses in the community. | Which show moderation, reasonableness, self-sufficiency, knowledge and moral. |
| 2     | Students propose ways to solve many problems, such as the use of biotechnology to increase the number of tadpoles to meet the needs of the community. To create a product that is stored for three cars, such as pickling, drying extends the life. Community educators are encouraged to cultivate the tadpoles naturally. Reduces chemical contamination. As a result, people in the community eat non-toxic food. | Can be linked moderation, reasonableness, self-sufficiency, knowledge and moral. |
| 3     | Students present frog farming. Fed by natural methods that are readily available in the community. Fundraising from the community. To educate and bring productivity to be built into the product. To make money for the community. People in the community have a professional well-being. And the balance of ecosystems. Reduce pollution in the community due to natural products. The tadpoles that have been processed such as meatballs, Tadpole-fried and tadpoles dry. | Can be linked moderation, reasonableness, self-sufficiency, knowledge and moral. |
| 4     | Frog culture is sufficient to meet the needs. When large populations of frogs are found, tadpoles are sufficient for the needs of the community. The frogs must take into account factors related to many frogs. In order to get the right amount of eggs for the needs of the community. | Can be linked moderation, reasonableness, self-sufficiency and knowledge. |
| 5     | Set up a community breeding center. To increase the population of tadpoles to balance the needs of the community. Tadpoles can be processed into the OTOP products to generate revenues were adding value to productivity such as steamed tadpoles, tadpoles dry and tadpole’s basil. Import duties on processed products exported to other communities. Establishment of ecotourism area to educate tourists and people in the community. | Can be linked moderation, reasonableness, knowledge and moral. |
| Group | Description | Involved from PSE |
|-------|-------------|------------------|
| 6     | The tadpoles have been introduced to educate and advertise tadpoles to the public and promote local conservation. Genetically engineered for different and diverse varieties. | Can be linked reasonableness, self-sufficiency and knowledge. |
| 7     | Do breeding tadpoles the system closed which makes the tadpoles are clean and safe. This care can be thoroughly. The survival rate is higher than the natural system. The benefits of choosing this method is that many tadpoles. And the impact frogs and tadpoles may lose due to various breeding in consanguinity. | Can be linked moderation, reasonableness, self-sufficiency, knowledge and moral. |
| 8     | Creating a breeding ground for frogs and tadpoles in the community by raising funds from people in the community and creating jobs for people in the community. Raising and breeding frogs for sale. The villagers eat and sell throughout the year. And processed foods are to add value. | Can be linked reasonableness, self-sufficiency and knowledge. |
| 9     | Farm produce tadpoles and increase biodiversity by genetically modified brush to get the frog and tadpole species. Then bring the community products such as soap-tadpoles, fried-tadpoles, and then send them online, inside and outside the country. Production processes by the people in the community. | Can be linked reasonableness, self-sufficiency and knowledge. |
| 10    | Increase the number of tadpoles to meet the needs. And is distributed outside the community. The production and the sale will be assigned to those knowledgeable in the community helping each other accountable. There is growing awareness in the community to conserve natural resources for the tadpoles grow into frogs next. | Can be linked reasonableness, self-sufficiency, knowledge and moral |

4.2 Student Product and application of PSE and STEAM knowledge

Students have a way to resolve the social issues by creating products about Tadpole on the biodiversity community to have a stable and sustainable prosperity. The analysis of data from Student performant of students on the application of the philosophy of sufficiency economy and STEAM knowledge. Which can be grouped as follows:
Table 6. Result of applying the philosophy of sufficiency economy of Student performant.

| Groups                        | Description                                                                 | Involved from PSE and STEAM knowledge                                                                 |
|-------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 1. Farm for created new product. | Frogs were cultured in a natural way to increase numbers. Bring frogs across the breed to meet the needs of consumers. And to process a variety of products on demand. Evaluate the quality consistently to meet customer needs. | They can connect PSE are reasonableness, self-sufficiency and knowledge. From picture show that student use STEAM knowledge. Students can connect knowledge in science and technology by interbreeding many tadpoles. It is illustrated science, technology, engineering, art and mathematics. |
|                               | ![Farm Tadpoles](image1.png)                                                 |-------------------------------------------------------------------------------------------------------|
| 2. Dim Sum Huak (Tadpoles)    | Applied as a food of another culture to offer food in a new way. Learn about the tadpole propagation of habitat from natural sources using technology to help in propagation. Plan your marketing by giving customers and give your neighbors tastes to improve the recipes. To be formulated into dumplings stuffed tadpoles by cooperation of local members. | They can connect PSE are reasonableness, self-sufficiency, knowledge and moral. From picture show that student use STEAM knowledge by plan, design, create food and science education. It is illustrated science, technology, engineering, art and mathematics. |
|                               | ![Dim Sum Huak Tadpoles](image2.png)                                       |-------------------------------------------------------------------------------------------------------|

Figure 4. Group work of Farm for created new product.

Figure 5. Group work of Dim Sum Huak (Tadpoles)
| Groups                          | Description                                                                                                                                                                                                 | Involved from PSE and STEAM knowledge                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 3. Frozen Food Mok Huak (tadpoles baked) | Planning the finished product from the tadpoles. Action Plan, Brainstorming, Strategy Development, Business analysis, testing and market introduction the goal of the community and people interested. Can eat during hustle. Investment from farming. Cooking and advertising materials. | They can connect PSE are reasonableness, self-sufficiency, knowledge and moral. From the piece showing how students can connect to STEAM knowledge by designing frozen food from local animals to be in line with the present age. It is illustrated science, technology, engineering, art and mathematics. |

**Figure 6.** Group work of Frozen Food Mok Huak (tadpoles baked).

| 4. Spray drying of Tadpoles | Start by selecting a target market. Design a memorable product. Thai people in foreign countries Export focus Prepare by finding a marketer who makes space in online advertising. Create jobs and income in the community. | They can connect PSE are reasonableness, self-sufficiency and knowledge. The work shows that students can connect STEAM knowledge by processing food to be able to keep for a long time and export to sell abroad. It is illustrated science, technology, engineering, art and mathematics. |

**Figure 7.** Group work of Spray drying of Tadpoles.
5. Chinsuwan farm

It is a tourist attraction. Information on how and how to grow. Farm layout design Breeders Raise funds to people in the village, government and loans. Make a deposit from the tadpole product. They can connect PSE are reasonableness, self-sufficiency and knowledge From the implementation plan, it shows that students can connect STEAM knowledge by planning, operating and planning finances. It is illustrated science, technology, engineering, art and mathematics.

![Figure 8. Group work of Chinsuwan farm.](image)

6. Farm and Research Centre.

Founder of the research on tadpoles to reduce the problem of loss of children on the land. By breeding frogs and tadpoles raised area. The frogs and tadpoles were used to generate income for the community by making museums and aquariums. Export products from tadpoles and restaurants. They can connect PSE are reasonableness, self-sufficiency, knowledge and moral. From produce show that students use STEAM knowledge by science knowledge to cultivate, apply engineering knowledge to design farm structures Which is a new technology for breeding tadpoles, art by design project and math.

![Figure 9. Group work of Farm and Research Centre.](image)
7. Chips Tadpoles

Farm to increase the number of tadpoles to meet the needs. The product is exotic. Expand the market from neighboring communities to foreign export.

They can connect PSE are reasonableness, self-sufficiency and knowledge.

The work shows that students can link STEAM knowledge by creating a farm. Cooking, processing and making products for export abroad. It is illustrated that they can connect STEAM knowledge (science, technology, engineering, art and mathematics).

Figure 10. Group work of Chips Tadpoles.

8. Tadpoles Can

Plan to analyze product objectives, find promotional events Quality as required. Ask for product reviews from customers, Ads by people in the community, Investment from various sources.

They can connect PSE are reasonableness, self-sufficiency and knowledge.

The work shows that students have designed and developed technologies to preserve food for a longer life. Which can link STEAM knowledge. It is illustrated science, technology, engineering, art and mathematics.

Figure 11. Group work of Tadpoles Can.
| Groups | Description | Involved from PSE and STEAM knowledge |
|--------|-------------|---------------------------------------|
| 9. GMOs tadpoles | Genetically modified tadpoles to a variety of species. Leading breeder and breeder rearing frogs to sell to people in the community. Conservation of local zoning tadpoles. Product processing such as smoothies, health tadpoles | They can connect PSE are reasonableness, self-sufficiency and knowledge. From the work piece showing that students use science knowledge, technology and engineering in planning concepts for creating GMOs and art in design work. |
| 10. Chips Tadpoles | Business planning is by providing information about the tadpoles. Design, manufacture, package, trial, sell, refine, formulas and distribute by shop. The appropriate amount of tadpoles was prepared using natural methods. The investment consists of food tadpoles, Frogs and raw materials used in processing. The products are offered for all ages | They can connect PSE are reasonableness, self-sufficiency and knowledge. From the picture shows that students have designed and developed technology to preserve food to be eaten in free time. Students are aware of the income, expenditure in making products linked to mathematics. It can be seemed that they can connect STEAM knowledge (science, technology, engineering, art and mathematics). |

*Figure 12. Group work of GMOs tadpoles.*

*Figure 10. Group work of Chips Tadpoles.*
5. Conclusion and Discussion
From the learning process, STS, based on through Yuenyong (2006), can promote the application of the philosophy of sufficiency economy and STEAM knowledge as follows:

5.1 *Students can apply knowledge in product design. To solve the problem of income to the community.*
Students can use the knowledge gained from science in decision making to solve problems, which methods can support the best approach. Students have invented a new concept with local creatures. Which some have not yet found before in the local area of Thailand, showing students being linked to technology. In addition, students also have a plan to solve social problems that occur systematically in accordance with the application of engineering knowledge. Student has used the design knowledge to design the work to increase the value of the product. And some students can use mathematical knowledge to design the work to calculate costs and planning on using money.

5.2 *Students can link social issues to the events.*
Students can relate to what students encounter in everyday life. Although what students have learned from social issues is far away. Such as crispy tadpoles which is similar products that students like to eat and are sold in the market.

5.3 *Students make plans to solve the problem in a systematic and teamwork.*
However, in the application of the philosophy that students can promote their applications in all stages.STS, but each step may not cover all aspects of the philosophy of sufficiency economy. Moreover, this study allows students to learn in a new social context in which students have never met before in biology class.

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