Thai students’ existing ideas about plant biological energy

Nannabhat Surat¹, Siripohn Charuchun¹, and Chokchai Yuenyong¹*

¹Science Education Program, Faculty of Education, Khon Kaen University, Thailand

* Corresponding author’s email address: ychok@kku.ac.th

Abstract. This study explored students’ existing ideas about biological energy. The study employed the Interview semi-structured interviews. Findings indicated that students explained that the plants are not hot or have high temperature, they think that things which have energy are always hot, have high temperature, can explode or can destroy anything. Moreover, Students called plants energy as 2 frameworks, Include Plants energy including to the plant processes and Physics energy framework. And they instanced plants processes that use energy, include Photosynthesis, Respiration, Water-Nutrients Transportation process, Transformation energy process, Combustion process, Osmosis, Nitrogen fixation process, Stimulus responding process, and Reproductive process. Their explanations are based on their understanding. Regarding constructivist perspective, Teachers need to know students’ prior knowledge in order to take into consideration these viewpoints for designing and implementing teaching interventions (Trumper, 1990; Duit & Haeussler, 1994)

1. Introduction

Energy is one of the science concepts that cuts across all science disciplines and is experienced in our everyday life situations (Saglam-Arslan & Kurnaz, 2009). Teaching and learning is so difficult because energy is not realized by seeing that is realized from Degradation energy. and There is difficulty to choose suitable pedagogical for the Energy concept instruction. We can describe about that “Teaching energy concept is mystery” This mystery of the energy concept is related with its usability in different disciplines, as well as its abstract and theoretic identity (Diakidoy et al., 2003; Lemmer & Lemmer, 2006).

Diagnosing students’ understanding of energy and its related concepts in biological context explored that student understand that Biological Systems Have a Unique Kind of Energy. Many students used processes to make up a name for a type of energy, such as respiration energy, photosynthetic energy and nutritional energy. (e.g. Kruger et al., 1992; Mann, 2003; Trumper, 1997).

In fact, Photosynthesis is the chemical process by which green plants convert sunlight into sugar. In essence, this process transforms a wave of light energy into chemical potential energy, which the plant then stores in the molecular bonds of sugar molecules. A sequence of chemical reactions transfers the sun’s light energy into the chemical bonds that hold together special, energy-carrying molecules (the most common of which are called ATP). The energy originating from the sunlight is being stored in the ATP molecules as chemical potential energy.

Many people do not know that plant have energy to live example there need energy to manufacture food, transporting water, soluting across cell membranes, using during reproduction, germinating seeds, and processing all of metabolic in plant cells. [4]
In Thailand, Science is explicitly separated. Physics rarely link with others science. Energy is mostly known about Physics. Few Thai people realize that Energy connects all of science. Student who study about Science is the best of representative and bring reliably results of the research. Therefore, the aim of this research “Student’s understanding of plant biological energy concepts.” is studying understanding of plant biological energy concepts of 4 major from Science education student Khon Kean University.

In Science, Plant have two principal forms of energy, there are kinetic energy and potential energy. (Kinetic energy is the energy of movement such as the motion of molecules. The second form of energy, potential energy is stored energy in cell.). Plants kinetic energy such as Radiant energy of Photon from Photosynthesis, the moving electrons energy, and other energy from charged in atom. In addition, Plants potential energy is chemical potential type, most of them is made by diffusing across cell wall.

One statement tested students on whether living matter (biological organisms) is governed or has a unique kind of energy different from non-living matter. This kind of thinking is referred to as vitalism (Barak et al., 1997), and it was tested using the statement living organisms have a kind of energy which is different from the energy we learn about in physical science. (Kruger et al., 1992). Barak et al. explained that this erroneous thinking has been exacerbated by the idea that living matter is made of special constituent materials which differed from non-living matter and requires a ‘vital force’ (i.e. a unique form of energy) different from other forms of matter. The current scientifically acceptable view of energy is that whilst living systems are unique, biological phenomena can be understood within the framework of concepts applied to physics and chemistry [1].

Faculty of Education, Khon Kean University, is educating student who is going to be teacher. Science education is one of popular major that the youth want to admission in. There are four programs educating, include Physics, Chemistry, Biology, and General Science. Each program has different instruction, but the most important thing is all of program must have the right science concept, especially Energy concept that is related every science branch.

Thus, the research is going to record and analyze data to conclude what students’ plant energy ideas are, how students understand the different between process and energy, and How different the plant energy ideas concepts between 4 majors of science.

2. Methodology

2.1. Method
The present study was a naturalistic inquiry conducted within a constructivist paradigm. Students’ existing ideas about energy were elicited by dialogue between researchers and participants (Johnson & Gott, 1996).

2.2. Participants
The sample consisted of 29 students from the science education, including 6 chemistry students, 6 physics students, 9 biology students, and 3 general scientists from Khon Kaen University.

2.3. Data collection
Data collection identifies students' existing ideas about energy using semi-structured interviews. All interviews were recorded and recorded in full. Interviews started with researchers asking questions about whether plants have energy. And ask the next question. To test the understanding of energy in plants. If students say that the plant does not have energy Researchers will ask questions to guide students but without any effort to modify their initial ideas.

3. Results
All interviews were audio taped and fully transcribed. Students’ responses relating to each questions were analyzed and then categorized as students’ framework as plants energy. Each category was
explained with students’ answers of 6 question. These include Do the plants have energy?, Why do you think plants have energy?, Which energy do plants have?, What are type of each energy in plants?, What do processes inside plants?, How different between energy plants and process plants?. How related between energy plants and processes plants? And the result of this study are:

- **Do the plants have energy?**
  Students referred that the plants do have energy. Students’ explanations from year 2nd and year 3rd based on their prior knowledge. The researcher interviewed the 29 participants from 117 students of Faculty of Education, Science at Khon Kean University. The data were analyzed by the statistical include of frequency, percentage are as follow 20 females (69%) and 9 men (31%), they are separated as 6 Physics major students (20.7%), 6 Chemistry major students (20.7%), 9 Biology major students (31%), and 8 General Science major students (27.6%). The results of this study are 27 students who answered plants have energy (93.1%), 2 students who answered plants do not have energy (6.9%) and the result of this study are.

- **Why do you think plants have or have not energy?**
  Students explained their reason about plants have energy. Researcher separated their answers as 4 framework, and the answers of this question are as follow:

| Category                      | Students’ responses |
|-------------------------------|--------------------|
| Plants have processes that produce and use energy | 9                  |
| Plants is nature, All of nature must have energy no matter what they are | 2                  |
| Plant are producer who need energy for works. | 2                  |
| The law of Thermodynamics     | 1                  |
| Plant do not have high temperature. | 1                  |

60% 0f students replied that The Plants have energy because they have processes that produce and use energy e.g. Respiration, Photosynthesis, Reproduction, and Growth. 13.34% of students think that plants is nature, all of nature must have energy no matter what they are. 13.34% of students told researcher that Plant are producer who need energy for works, and 6.66% of students replied that They have energy is as a results of the law of Thermodynamics that explain transformation of energy. and 6.66% replied that plants do not have energy because They are not hot or have high temperature, they think that things which have energy are always hot, have high temperature, can explode or can destroy anything.

Students know what Photosynthesis is and what this process produce that bring many benefit for others organisms, Moreover, They know that Plant use chemical energy for photosynthesis and respiration the most common of which are called ATP. But a few participants have misunderstanding and use prior knowledge about fuel and bomb that can see better that plant energy in their real life, So they answered plant do not have energy as result of They do not look like fuel.

- **Which energy do plants have?**
  Students called plants energy as 2 frameworks, Include:

| Category                      | Students’ responses |
|-------------------------------|--------------------|
| Call as Plant processes       | 25                 |
| Called as Physics energy      | 21                 |

Plants energy including to the plant processes e.g. Growth energy, Water Absorption or dehydration energy, Diffusion energy, Photosynthesis enrgy, Respiration energy like ATP ADP NADPH+. According to the plant processes are known by Science student. On the other hand They
called plant energy that Physics energy framework e.g. Heat, Chemical potential energy, Light energy (Photon), Machanical energy, Kinetic energy.

- What are type of each energy in plants?

| Category                        | Students’ responses |
|---------------------------------|---------------------|
| Physics energy framework        | 32                  |
| Nutrients                       | 1                   |
| Unknown                         | 1                   |

Most of students have basics knowledge that plants energy can be grouping in Physics energy framework about 94.10%, i.e. Plants energy are Kinetic energy like transportation energy of water and nutrients because there are movement, moreover they were been grouping Absorption and Dehydration energy Photosynthesis energy and Respiration energy as Potential energy because they do not have movement but work. There are 2.95% of student who replied that plants energy can be grouping in nutrients like Starch, and 2.95% of students do not know how can answer this question.

- What do processes inside plants?

| Category                                      | Students’ responses |
|-----------------------------------------------|---------------------|
| Photosynthesis                                | 21                  |
| Respiration                                   | 12                  |
| Water-Nutrients Transportation process        | 11                  |
| Transformation energy process                 | 3                   |
| Combustion process                            | 1                   |
| Osmosis                                       | 1                   |
| Nitrogen fixation process                     | 1                   |
| Reproductive process                          | 2                   |
| Stimulus responding process                   | 1                   |
| **Total**                                     | **53**              |

There are known that Plant have Photosynthesis, Respiration, Water-Nutrients Transportation process, Transformation energy process, Combustion process, Nitrogen fixation process, Stimulus responding process, and Reproductive process.

- How different between energy plants and process plants?

All of student responded Energy is absolutely as different as processes.

Student instanced 9 plants processes that use energy, include Photosynthesis, Respiration, Water-Nutrients Transportation process, Transformation energy process, Combustion process, Osmosis, Nitrogen fixation process, Stimulus responding process, and Reproductive process.

4. Conclusions and Suggestions

The Participants who accounted for 24.8% of Science Education Students at Khon Kean University, include Physics major, Chemistry major, Biology major, and General Science major are interviewed about learning student’s understanding of plant biological energy concepts. The data were analyzed by the statistical include of frequency, percentage, and grouping to frameworks in each issues. Interestingly, Students’ explanations from year 2nd and year 3rd based on their prior knowledge. The results of this study are as follow 27 students answered plants have energy (93.1%), 2 students answered plants do not have energy (6.9%) and they explained that The plants are not hot or have high temperature, they think that things which have energy are always hot, have high temperature, can explode or can destroy anything. Moreover, Students called plants energy as 2 frameworks, Include Plants energy including to the plant processes and Physics energy framework. And they instanced plants processes that use energy, include Photosynthesis, Respiration, Water-Nutrients Transportation process, Transformation energy process, Combustion process, Osmosis, Nitrogen fixation process,
Stimulus responding process, and Reproductive process. Their explanations is based on their understanding. Regarding constructivist perspective, Teachers need to know students’ prior knowledge in order to take into consideration these viewpoints for designing and implementing teaching interventions (Trumper, 1990; Duit & Haeussler, 1994). Additionally, Science teacher students who will be Science teacher in the future is important person who should be correct their misconception about all of Science knowledge for the better educational in Thailand.

References
[1] Boundless biology Energy and Metabolism [website] Retrieve from URL: https://courses.lumenlearning.com/boundless-biology/chapter/energy-and-metabolism/.
[2] Chokchai Yuenyong, and Jirakarn Yuenyong 2007 Grade 1 to 6 Thai Students' Existing Ideas about Energy Science education international 2007 pp 289–298.
[3] Boundless biology. Transport of Water and Solutes in Plants [website] Retrieve from URL: https://courses.lumenlearning.com/boundless-biology/chapter/transport-of-water-and-solutes-in-plants/
[4] Vivien Mweene Chabalengula, Martie Sanders and Frackson Mumba 2011 Diagnosing students’ understanding of energy and its related concepts in biological context Retrieve from URL: https://link.springer.com/article/10.1007/s10763-011-9291-2