CONSTRUCTIVISM IN SUSTAINABLE DEVELOPMENT OF ENERGY

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The objective of this research was to study the body of knowledge construction in sustainable development for energy, using the constructivist theory with Mathayomsuksa 4 students. There were 4 knowledge innovations used to construct the body of knowledge.

1. Participatory Learning
2. Storyline Approach
3. Appreciate Influence Control (AIC)
4. Mind Mapping

The target group of this research was a group of 16 students studying in Mathayomsuksa 4 of Santirat Wittayalai School. The group consists of 14 females and 2 males.The researcher gathering the data by interview , group discussion , observation and forms for implementing teaching activity :

1. The importance of energy
2. The energy problems
3. The sustainable development of energy
4. The method of sustainble development of energy

The result revealed that by the constructivist theory , students constructed the body of knowledge in sustainable development of energy as the assign assumptions. With regard to the body of knowledge that the target group constructed, they could better developed the knowledge than the expectation.

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การศึกษาวิจัยครั้งนี้ วัตถุประสงค์เพื่อศึกษาการสร้างองค์ความรู้ เรื่องการพัฒนาแบบยั่งยืนในด้านพลังงานของนักเรียนชั้นมัธยมศึกษาปีที่ 4 จากกระบวนการเรียนรู้ตามทฤษฎีคอนสตรัคติวิสต์ โดยใช้นวัตกรรมการเรียนรู้เพื่อสร้างองค์ความรู้ 4 วิธี ดังนี้

1. Participatory Learning
2. Storyline Approach
3. AIC (Appreciate Influence Control)
4. Mind Mapping

กลุ่มเป้าหมายที่ใช้ในการวิจัยครั้งนี้ เป็นนักเรียนชั้นมัธยมศึกษาปีที่ 4 โรงเรียนสันติราษฎร์วิทยาลัย กรุงเทพมหานคร จำนวน 16 คน ประกอบด้วย หญิง 14 คน ชาย 2 คน เก็บข้อมูลจากการสังเกต การสัมภาษณ์ ใบงาน จากการดำเนินกิจกรรมการเรียนการสอน 4 เรื่อง

1. ความสำคัญของพลังงานต่อชีวิต
2. ปัญหาในด้านพลังงาน
3. การพัฒนาแบบยั่งยืนในด้านพลังงาน
4. แนวทางการพัฒนาแบบยั่งยืนในด้านพลังงาน

ผลจากการศึกษา การสร้างองค์ความรู้เรื่องการพัฒนาแบบยั่งยืนในด้านพลังงาน ภายใต้ทฤษฎีคอนสตรัคติวิสต์ โดยดำเนินการเก็บรวบรวมข้อมูลเชิงคุณภาพพบว่า ทฤษฎีการสอนแบบคอนสตรัคติวิสต์ช่วยให้นักเรียนสร้างองค์ความรู้ เรื่องการพัฒนาแบบยังยืนในด้านพลังงานได้ตามสมมุติฐานที่ตั้งไว้ และจากการพิจารณาองค์ความรู้ที่กลุ่มเป้าหมายสร้างขึ้น พบว่า กลุ่มเป้าหมายสามารถสร้างได้ดี เพราะนอกจากจะสร้างได้ตามที่ตั้งเกณฑ์ที่ตั้งไว้แล้ว ยังมีบางส่วนเกินเกณฑ์ที่ตั้งไว้ด้วย

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CHAPTER I

INTRODUCTION

Historical and Background

The environmental education whether formal or non-formal system are not accomplishment because of the teaching practice almost is emphasized on rote skills (Ajchara Keawmanee, 1997 : 23) and often give the essential on superficial learning. These are inefficient method in developing students' creativity or the body of knowledge.

In term of producing the teaching activity, it should be reformed the teaching roles from instructors who prepared the assigned problems to creating the situations to aim at students can solve the problems themselves and can well distribute the results to be advantages for others. (Nussara Eamnauwarat, 1999 :2) Constructing the body of knowledge is the way to solve the problems that given the solvers aware their value and importance. This method is the way to prevent and improve the environmental quality. Beside this, the educational activities will support the students in creating relationship, liberal-minded, heeding others and being unity that will comprise of integration in solving problems. The education that create environmental conscious will make thinkable students by meditative experience and developing from past knowledge or conscious and creating new body of knowledge as the eighth economic development plan (A.D. 1997 – 2001). This plan was targeted to develop the competency of Thai people that can face new situation by implementing some activities as follow:

1. Reform the education that helps the student can generate analysis, reasonable thinking, creativity, and knowledge self-discoverable and getting practice from real experience.
2. Apply various technology with educational systems from experience.
3. Let the students being social reaction.
4. Stimulate and support knowledge inquiry from books and communities.

These activities harmonize with the Constructivist theory that stress the information inquiry, analysis, compiling as well as interpretation the context and self-knowledge. Those will result while internal motivation being created and do not depend on external purpose (Condy, and Chambers, was quoted in Paichit Saduakkarn paper, 1996: 6) and believing that the power of the society can force any situations in the communities. (Steedman, 1991: 10) So, the communication must take place in the creating knowledge and cooperation process.

The study is found that the learning method from Constructivist theory can help students better in creating the body of knowledge in Mathematics (Piazza, 1995: 3124 – A) and can help teacher develop their teaching. Applying this theory with the environmental education should help students in creating the good problem solving body of knowledge. This will be the most continuous and long-term method to demolish the intention that whenever problems do not reach them, those are not their own by emphasized on creating roles and self-conscious in environment responsibility. Creating the body of knowledge is the method to transform teaching by practice to creating knowledge, aim, favor, responsibility as well as conscious.

For environmental study, it was found that the sustainable development of energy is so essential that everyone should know because of the rapid development

affect losing the resources and the environmental quality that necessary for human being. (Kasem Chankeaw and others , 1998:) This will be effect to everyone in the world and should have been corrected by educating people to know and understand about energy learning to adapt their behavior and aware to conscious in cooperation with others for conservation and sustainable development.

Teaching education for sustainable development will consider in supporting the mental characters and emphasize the body of relationship of mental, behavior and intelligence as the core of study and to be the ethics development that is the understanding, satisfaction, realization and acceptation in their action. The learning activity should reflect to support individual capability and stimulate student's behavior to discover knowledge and learning about the environment to catch up the global technology and develop the moral characteristics, which induce to quality of life and environment development. (Somchit Savathanaphaibul, 1998: 4 – 5)

The teenagers in secondary school are the most appropriate in learning and understanding for the sustainable development because they can construct the knowledge and the body of knowledge as well as understand the human life effects and induce for cooperation to take care the environment through out the community.

The environmental education activity consists of several methods as follows : (Ministry of Education ,1999:22)

1. To infuse in other subject.
2. To integrate in the subjects as the school assignment.
3. To arrange in teaching activities both in side and outside classroom as well as external classroom.
4. To set up the learning activities with the community.

5. To set the environmental learning sources in school to be environmental information for students and communities.

The environmental learning techniques can be set indoor and outdoor as well as education. The efficient activities that can construct the sustainable energy conservation and environment must have good community cooperation.

In additional, the environmental study must emphasize the self-study students by using several processes and teaching methods that construct the body of knowledge while setting linkage the study results from old and new experiences themselves. This is the student center teaching management style. (Science and Technology Teaching Supports Institute, 1999: 11) The researcher selects 4 learning techniques as follows :

1. Participatory Learning
2. Storyline Approach
3. AIC
4. Mind mapping technique

The reasons of 4 learning innovation selection are described ...

1. Participatory Learning is the active learning and the students own their learning. (Sophon Chulotok , 1998 : 13) The principle of this technique harmonize with the Constructivist theory because this technique

1) Use the old experience of the students.
2) Construct new and challenging continuous knowledge from enhancing knowing network
3) interaction among students and between students and teacher.

4) Communicate by conversation and writing.

2. Storyline Approach is the integrated technique that the teacher will construct the stories and events and have to plan orders by setting the core questions to stimulate or induce the activities while students are the key story creators from the activities using skills such as thinking, planning, implementing through imagination. The students will construct the body of knowledge and discover themselves new body of knowledge. (Uttaphol Anuntavorasakul , 1999 : 1)

3. AIC technique is the brainstorming technique used for operational seminars or meetings. This technique comes from the believes that the individual, people community and society have extreme concealed power if they can use this in creative way, it will easily make the prosperous and peaceful society. (Voravit Avirutevorakul and Monnika Sunksakda , 1995 : 65) This technique is useful in constructivism.

4. Mind Mapping technique looks like mirror that reflect the shadow of all-around thought to receive and understand their thinking system and contribute the independence of thinking in the cognitive diagram style with all-around and infinite writing.

The researcher is interesting in studying the constructivism in sustainable development of energy to find out the way for environmental problem solving especially in energy resources and reflect to the development for more efficient environmental education by the above reason.

The Research Objectives

To experiment the learning process by applying the Constructivist Theory in sustainable development for energy .

The Assumptions of Research

The students who study the Constructivist concept can construct the body of knowledge of sustainable development of energy.

The Scope of the Study

1. The samples of this research are students who study in Mathayomsuksa 4 , Santirat Wittayalai School , Bangkok.
2. The content of the research is the sustainable development of energy.

Operation Definitions

1. The Constructivism is the learning process that help the students themselves generate body of knowledge with concept : The students face the problems that they cannot be fixed by old experiences and construct the cognitive conflicts that induce the students reflect and can construct new knowledge that link to the original experience. This is the meaningful knowledge and self-generate that did not make by teacher. There are 4 learning activities such as

1) Participatory Learning
2) Storyline Approach
3) AIC
4) Mind Mapping

2. The sustainable development of energy is the subject that the researcher want the sample construct the body of knowledge in 4 items :

1) The importance of energy
2) The energy problems
3) The sustainable development of energy
4) The method of sustainable development of energy

The concepts of the Research

The constructivism by Constructivist theory is cyclical as shown in the figure.

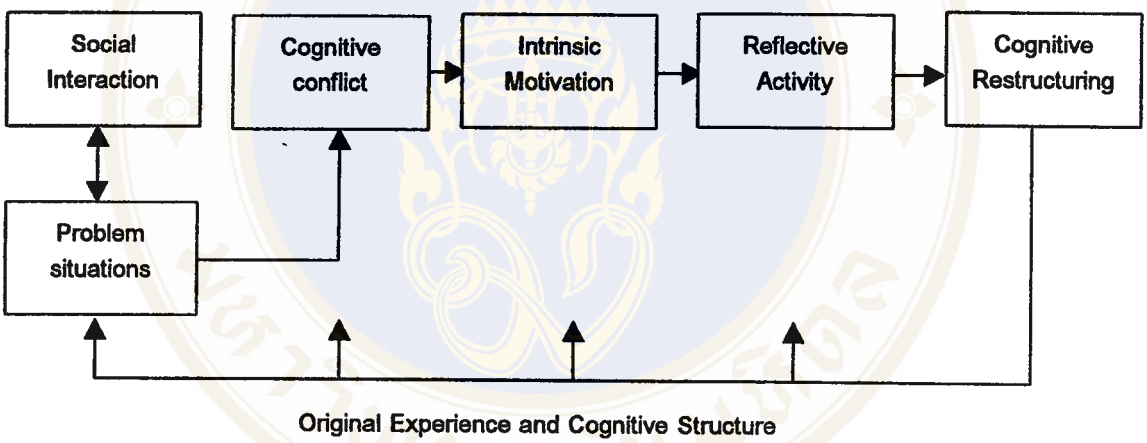


Figure 1 : The constructivism cycle by Constructivist theory

1. The social interaction brings the problem situations or the problem situations that can be fixed by social reaction.
2. The social reaction and problems situations are main cognitive conflict factors.
3. Cognitive conflict initiates the reflection activities.
4. The reflection is the core factor that stimulates for the new cognitive Structure creation.
5. The cycle comprise of 1 , 2 , 3 and 4 .

6. The above cycle always happens to the students' experience.

The Advantages from the Research

1. To construct new body of knowledge of sustainable development of energy by students in Mathayomsuksa 4.
2. To construct new and efficient learning process by constructing the body of knowledge of sustainable development of energy for students in Mathayomsuksa 4.
3. To be a guideline to improve the learning technique that being consistent to the psychological and learning technology that induces student create knowledge that make more efficient learning technique.
4. The students can apply the body of knowledge in sustainable development of energy to implement and publicize for the energy problem solving.
5. The learning process using the Constructivism is the good precedence to publicize and support the student-center teaching technique.
6. To support the government policy in developing education management emphasizing the student-center learning process and the learning that the instructor induces the student self-solving by using the process parallel with the result and supporting to the real implementation and problem-solving.

CHAPTER II

LITERATURE REVIEW

The researcher had studied and reviewed the past literatures to getting best result in Constructivism in sustainable development of energy as follow:

1. The Constructivist theory
    - 1.1 The Concepts in Constructivist theory
        - 1.1.1 Philosophy Concept
        - 1.1.2 Psychological Concept
    - 1.2 The learning concepts and assumptions in Constructivist theory
    - 1.3 Conclusion of the Constructivist theory
2. The Constructivism concept
    - 2.1 Participatory theory
    - 2.2 Storyline Approach
    - 2.3 AIC
    - 2.4 Mind mapping technique
    - 2.5 Conclusion of the learning innovation
3. The teenagers' development
4. The sustainable development of energy
5. The environmental education
6. The reference researches

1. The Consturctivism Theory

1.1 The Concepts in Consturctivism Theory

1.1.1 philosophy concept

The constructivism believes that the individual knowledge is the personal cognitive structure that retrieved from the personal intelligence attempt in managing their experience (Von Glastersfeld , 1991 : 13 – 20) resemble to the pragmatism concept issued by William James and John Dewey. (James, 1975 : Dewey 1929 as quoted in Phaichit Saduakkan's paper , 1996 : 15 – 16)

James said that knowledge is the individual capability in adjusting old experiences or believes with new experience by the proving process in appropriate cause and effect. That will be advantages for practice and process in leading the thought by reasonably proving the truth to thinking skills for other valuable experiences and to get rid of conflicts between old and new experiences. The pragnitism is not only count the experience for knowledge, but knowledge will construct form cognition.

Dewey segregate 2 kinds of experiences that non-cognitive experience and cognitive experience. Non-cognitive experience is derived from personal relation, as a regular habit even they are innocent while they reflect the non-cognitive experience will transform to cognitive experience.

The constructivism concept and thinking conflict eradication from pragmatism old and new experiences are so influence to Constructivist theory.

1.1.2 psychological concept

Jean Piaget believes that learning is an adoption to environment process that means to balancing the organ and environment. The equilibrium process comprises of 2 major mechanism those are organic absorption and structure adjustment. (Sutherland 1992; as quoted in Phaichit Saduakkan's paper, 1996: 20)

Organic absorption is the interpretation capability or environmental information gathering to existing cognitive structure or adjusting environment fit to cognitive structure. Structure adjustment is the capability in adjusting or enhancing cognitive structure that fit to environment. (Boonma Jarik 1981: Penpilai Ruthakananont,1996: Sutherland ,1992 as quoted in Phaichit Saduakkan's paper , 1996 : 20 - 21)

In equilibrium process, the organic absorption will start while the problem was solved by existing experience and structure adjustment will happen while the problem cannot be solved by existing experience. In case of someone face problem, the organic absorption is the interpretation capability or problem transformation to the format that they can manage by existing knowledge and experience. Structure adjustment is new methods or explanations searching capability that use for solving the problem. the equilibrium condition will take place.

Piaget, one of the constructivism pioneers, believes that students will adjust or enhance cognitive structure to equilibrium condition from their experiences and they will create constructivism process.

1.2 The Learning Concepts and Assumptions in Constructivist theory

The constructivist theory or constructivism is the theory of active knowing. The theory concept is person can learn from using activity with environment by several methods. They rather use their experiences, cognitive structure and motivation than gathering environment information or outsource teaching. (Driver and Bell, 1986; Nothings 1990; henderson 1992 : as quoted in Phaichit Saduakkan's paper , 1996 : 22) The cognitive conflicts that derives from person who face the unmanageable or unexplainable problem with existing cognitive structure will motivate the reflection and induce cognitive structuring that can manage the problem situations or conflicts. This can be tools to solve or explain other specific situations in the same framework and be basis for future structure. (Piaget 1965 ; Cobb Wood , And Yackel 1991 ; Confrey 1991 : as quoted in Phaichit Saduakkan's paper , 1996 : 22)

Underhill segregate the basic assumption of constructivism as follow :

1. Cognitive conflict and curiosity are the two major mechanisms which motivate learners to learn
2. Peer interaction is a major factor in producing cognitive conflict ;
3. Cognitive conflict induces reflective (metacognitive) activity ;
4. Reflection is the main factor with stimulates cognitive restructuring;
5. Item 1 , 2 , 3 and 4 are cyclical ;
6. The cycle always occurs within and is informed by the learner's experience; and

7. This cycle empowers learners , i.e. , puts them in control of their own learning.

The set of assumptions can be diagramed as in Figure 2.

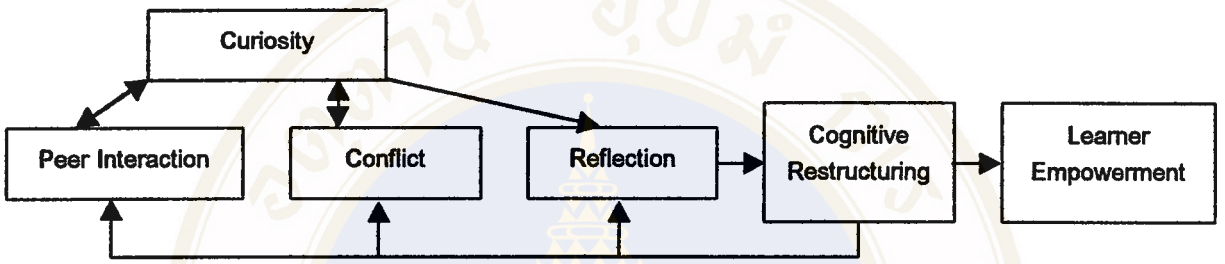


Figure 2 : The Constructivist Learning Set of Assumptions

There are specific definitions that explain the Constructivist theory as follow :

(1) cognitive structuring

The cognitive structure is the result of mental effort that is psychological process. If someone predicts right future situation by using existing experience, his cognitive structure will be more stable. If the answer is wrong , the learner will surprise , suspect and oppress. Piaget called this disequilibrium. When conflict of prediction and observation happen , the learners will have three options.

a) Not adjusting their cognitive structure and reject the information , this is classed as cognitive inertia. There is research evidence shows that it's hard to make individual cancellation or cognitive restructuring. (Champage , Klopfer & Anderson 1980 , quoted in Ministy of education , 1997 : 131) The learners are not interesting in touching new , but they will hold on their cognitive structure.

b) Adjust their cognitive structure in the way of their experiences and observations. This process will make meaningful learning process.

c) Not try to understand

Cognitive structure can be defined as follow :

The cognitive structure is the personal knowledge that created from their problem solving experiences and can be used to be and evidence for future situations.

(2) cognitive conflict and internal motivation

The Cognitive conflict is disequilibrium situation that confronts inconsistency with believes. The inconsistency information, causation, hesitation, indecision or non-absorption information or cognitive structure unsolved problems. (Piaget, 1965: Brainerd, 1978; Balacheff, 1991; Cobb, Wood and Yackel, 1991: 157 – 176)

There are 3 major Causes of internal motivation that can be describe as follow: (Biggs , and Telfer , 1987 ; as quoted in Phaichit Saduakkan , 1996 : 26 – 27)

1. The satisfaction in their capability demonstration and there is curiosity is the major mechanism.

2. Level of internal motivation inconsistency will take place when the cognitive structure that suit for environmental requirement inconsistent with appropriate their cognitive structure. In case of there is so much inconsistent , negative internal motivation , fear , frightening and avoidance , will occur. So the appropriate inconsistency will make positive motivation.

3. Conflict , More gap between new information and existing cognitive structure will induce the avoidance and less gap is not interesting. There are many

techniques that lead conflict to positive motivation such as making surprises , stumped options and conflicts with old experiences and make questions.

Teaching by making cognitive structure conflict is crucial in constructivist theory. Students face the problem that can be solved by cognitive structure at higher level than their possession but in the level they can solve themselves or by cooperation.

(3) reflection

The reflection is the circumspect believe or assumption consideration to seeking evidence to support or reject assumption. (Phaichit Saduakkan ,1996 :29–32)

The constructivism learning process is derived from person create and finish the knowledge through equilibrium process. The equilibrium mechanism will adjust themselves to match environment. The equilibrium process comprise of 2 processes.

1. The assimilation is the process that person interact with environment , absorb new experience and adjust to the existing cognitive structure.
2. The accommodation is the continuing process from absorption process. After absorption new experience to the old one , it will adjust new experience with the structure to finally induce cognitive restructuring.

The constructivism by Constructivist theory are cyclical as shown in the figure.

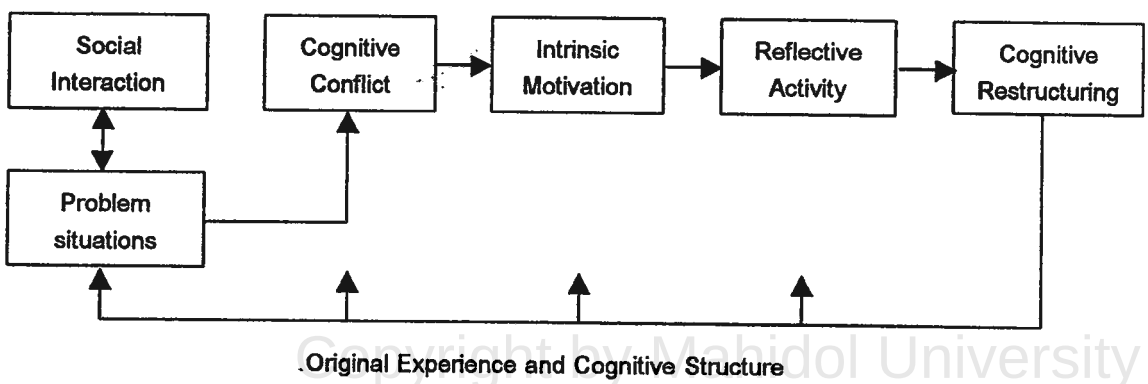


Figure 3 The constructivism cycle by Constructivist theory

1.3 Conclusion of the Constructivist theory

The constructivism support the learners' social interaction in the process to let learner can present their thought and accept others then reflect and finally select the accepted thought as a new body of knowledge. Besides the learners can construct new knowledge , the teachers have to prepare accessories and determine situation to make learners' cognitive conflicts and stimulate motivation that lead reflection activities and cognitive restructuring.

2. The Constructivism Concept

The constructivism is the methodology that has to practice in higher level. (Surawut Pattaisong , 1997 : 25)

Pimphun Taechakupt (Pimphun Taechakupt , 1997 , quoted in Panuwat Jiragranont , 1997 : 60) said that the constructivism is the theory or philosophy that emphasize self-learning activity. Learners face the situation that cannot solved or explained with existing cognitive structure , and create cognitive conflict and motivation will induce learners reflectively thought or action so they get cognitive restructuring that can manage situation. New cognition links to existing cognitive structure and create new meaningful learning model that being self-construction knowledge and teacher is not the creator.

The constructivism is new learning technology that has learning activity and let learners construct their body of knowledge. The researcher would like to present 4 innovations of constructivism as follows :

1. Participatory Learning
2. Storyline Approach
3. AIC

4. Mind mapping technique

2.1 Participatory Learning

The participatory learning is the active learning and student centered ownership that has 4 major concepts. (Sophon Julotok , 1998 : 13)

1. Learn by student existing experience ;
2. Create new continuous knowledge and enhance knowing network ;
3. Reactivate among students and between students and teachers;
4. Communicate with conversation and writing

Participatory learning composition

The participatory learning has 4 composition. There are experience , reflect and discussion , understanding and conceptualization and experiment application that can be explained by following diagram.

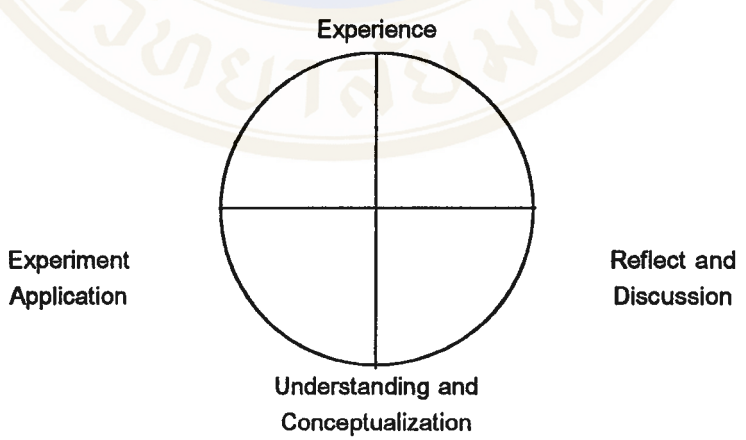


figure 4: the participatory diagram

1. Experience ; teacher help students to use their experience to develop body of knowledge

2. Reflect and Discussion ; teacher help students to present and exchange each other idea.
3. Understanding and conceptualization ; students understand and induce to conceptualization those student begin and get additon from teacher.
4. Experiment Application ; Students apply new knowledge with situations as a practice.

2.2 Storyline Approach

Storyline Approach is a teaching innovation discovered by Dr. Steve Bell and Sally Harkness , Scottish educationist. They started using this technique with primary school and developed so that can be used for every level teaching management . The story approach nowadays was famous in Europe and United State of America. (Autthapol Anuntavorasakul , 1999 : 1)

Storyline Approach is the teaching format that restore context and learning skills from several subjects and link the story and event that students create through activities , order the situations. Teacher will ask key questions to open issues and let the students think and action themselves and link the activities and the context together.

The Storyline Approach's major components are :

1. Episode / Setting the scene : identify time , place and environment
2. Character ; Parties involve in the above episode or scene.
3. A way of life : a way of life or a story of character
4. Event, incident or real problem to be solved ; Those 4 components can be shown as Figure 4. (Autthapol Anuntavorasakul , 1999 : 1)

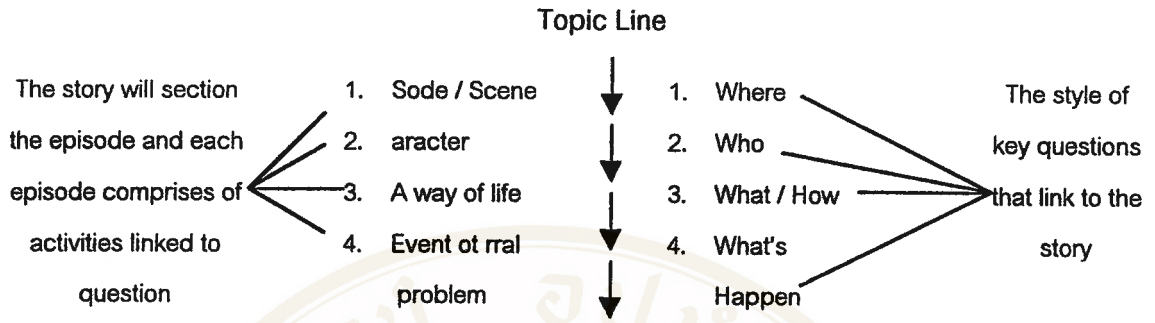


Figure 5 : Storyline Approach Diagram

The teacher important roles of storyline approach are prioritize the topic line that should be considered the continuity of the story within rough determination and key questions using to stimulate or open issues and learning atmosphere that let students participate , and eager to implement and give chances to students , colleague , parents and others involve in creatively evaluating while students are key person in creating story through the activities by using thinking , planning , implementing skills as well as imagination that the students construct the body of knowledge and discover themselves new body of knowledge.

2.3 AIC : Appreciation – Influence – Control

AIC is the brainstorming technique that used for workshop. This technique is derived from believes that person , group , community and society have creative power. If they can use their power in creative way , the society will easily prosperous. The AIC approach has three major steps. (Vorawit Aviruthvorakul and Monnipha Suksakdha , 1995 : 65 – 66)

Step 1 or Step A is Appreciation step. This step bring everyone accept and admire or present resistance or criticize. It would like to let everyone equitably

present by a picture or a word about situation in their opinions. This will help everyone use matter of fact , cause-effect and felling as well as express in several styles.

Step 2 or Step I is the influence step. This step use individual creativity to determine key method or strategy to get the shared vision or share ideal. This step will give everyone equal chances to express their idea about the strategies that will success shared vision and share ideal then classify strategies and consider group strategies.

Step 3 or Step C is Control step. This step will implement strategies by determine action plan in detail as what , why , target , method , time , who takes responsibility and cooperation , budgeting and source of fund and whether there is revenue from operation or not, if any, how much and other appropriate details.

Group member will select their responsibilities and cooperation in this step. They will help in creating action plan and making commitment to control the activities that will success the target and share ideal.

2.4 Mind Mapping Technique

Tony Buzan developed Mind Mapping technique in 1970. He described that human's brain has millions cell of nerves those link together with dendrite. Dendrite splits all around to gather information from other cells and axon is used to send information to other cells. Both dendrite and axon infinitively link together. Buzan called this function , radiant thinking , that are brain internal structure and process . (Buzan , 1997 : 26 – 57)

Mind mapping is similar to mirror that reflects radiant thinking to make understanding one's own thinking and make freedom of thought. The mind mapping character is the infinitely radiant writing. (Buzan , 1997 : 31) Mind mapping will be

constructed by both left and right sections of brain. The right brain section is relative to picture , symbol , imagin and the left brain section is rational and logical thinking. (Gelb, 1995 : 52 : Wycoff , 1991) The explainations of each step are described as follows :

1. Determine questions to the students: Whie teacher talks about durian, what the students think about?

2. Brainstroming the students to find out what students think about durian.

3. Write the main concept down the center and split the brance by characteristics.

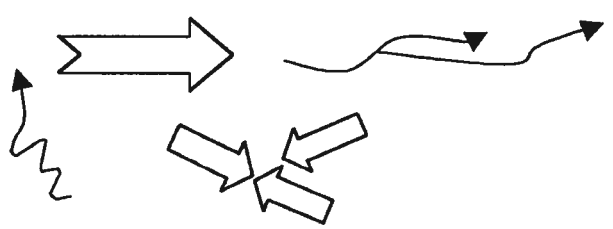
4. Draw line link each concept , main concept will nearer the center and less important concept will farer.

5. Draw appropriate line that every line must link to others.

6. Unit to each word such as a line is for a word that will facilitate linkage word to others.

7. Use color that can help to memorize.

- Use arrow to show the linkage of each concept



- Use symbol to show dimension link

- Use arithmetic show boundary of similar word

- Use 3-D to obviously show

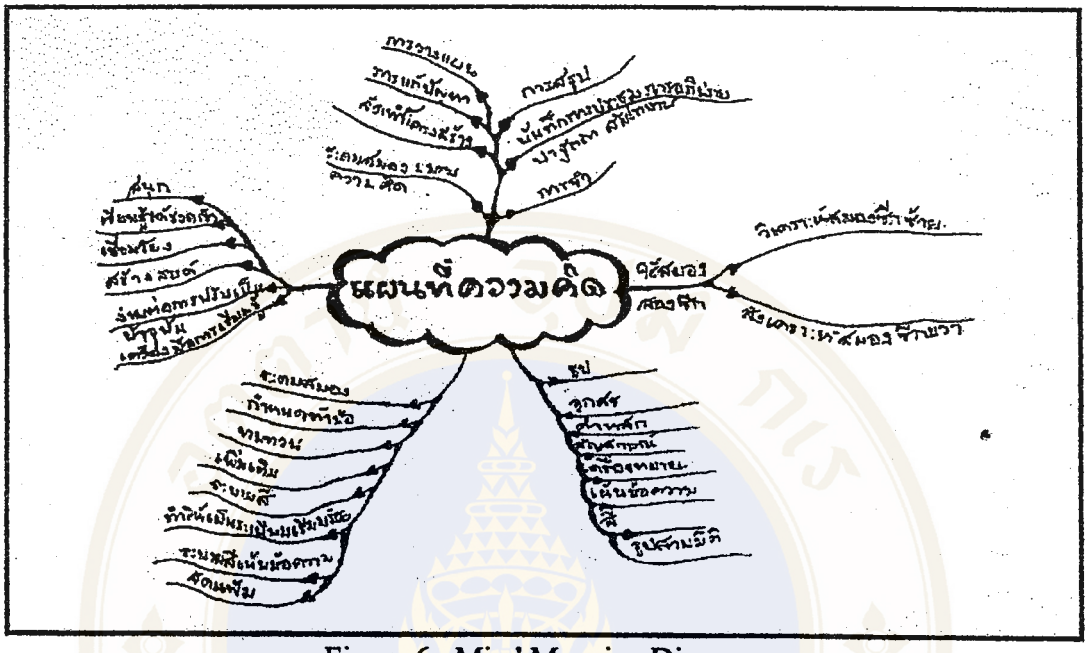


Figure 6 : Mind Mapping Diagram

2.5 Conclusion of the Learning Innovation

Those all of the 4 innovations of body of knowledge construction are technique that help students to create body of knowledge by using existing experience, social interaction, systematic thinking expression, creative empowered thinking.

3. The Teenagers Development

Because of the students, who construct the body of knowledge of sustainable development of energy, are studying in Mathayomsuksa 4 and called teenagers that means to grow to maturity or to grow to be adult. The psychologist said that this age is the critical period and there are many changes even body, emotion, social or intellectual.

The researcher thinks that the teenagers' development should be studied to be benefit for teaching process of body of knowledge construction of energy to be

appropriate with need, interesting and gathering students' satisfaction by studying emotional and intellectual development. (Anucha Champakdee , 1999 : 31 - 32)

Emotional development

Teenagers' emotion is aggressive and full of confidence. They always oppose to adults. Because of easily getting aggressive, they will easily be instigated or induced to try conclusion in both positive and negative way. The moment thought may cause wrong behave that mean their lives and future

We can classify the teenager emotion to 4 levels as shown:

1. Aggressive: temper , envy, abhor
2. Pressure: fear, anxious, sadness, hesitant. depress, disgust and sorrow
3. Joy : Love , like happy

These emotions will be advantage and disadvantage. It is always changed and hardly relates to others , so it should be studied some emotions.

1 Fear is the emotion that everyone has that will happen when someone feels that they are unsecured. The teenagers fear often are about the adjustment themselves to the environment such boys fear talking with girls , not being accepted in society , transforming their body. Those will not only make fear , but also make them irritating.

2. Anxious is resulted from fear and generated from thinking and predicting negative results whether it may be happen or not such as they anxious that they might not well done examination , so they are sleepless until they pass the examination. Besides they may anxious about family , society relationship and about body changes , etc.

3. Temper is an aggressive expression as envy and abhor that can be shown direct and indirect way such as shaking hand , foot , turning red , frequently breathing that may cause to hurt others or themselves , things or sometime they cry , bang foot , shouting
4. Love : The teenagers love can be classified to 5 items.
    1) Self-love means love and taking care themselves such as shape , beauty and clothes.
    2) Friend-love that teenagers often love and close to large group of same sex friends that have similarity of habit , taste and finally they will find out the closet friend to get some advise.
    3) Esteem-love that teenagers often love smart guy who is capable and adjust their personality to the precedent.
    4) Opposite sex-love that always interferes and occur teenagers love. They admire and adore in love and are well mentioned by the opposite sex that causes dominantly behave. The teenagers love is eager and fatuous that may affect their lives and future.
    5) Curiosity can be seen in teenagers. They desire to know about future or the mystery especially about the opposite sex such as seeking the information about sexuality and sexual organ.
5. Teenagers interesting is resulted from physical , emotional or social want that can be concluded as follow.
    1) Teenagers are interesting healthy such as nutrition , sleeping , clothes , relaxation , cleaning.

2) Teenagers are interesting sexuality and adapting to get on well with opposite sex.
3) They are interesting in career choosing
4) They are interesting in discovery and imagination such as scientific innovations , painting and composing articles.
5) They are interesting in good education habit : try to discover that how they can get good result , efficient work and can solve hard problem.
6) They are interesting in personal characteristics those can induce them success even for work or social.
7) They are interesting in philosophy that they hold as criteria , moral and ethics.
8) There are 2 dominant interesting : friends in opposite sex and career.

Intellectual development

Because of so much physical changes in teenagers , this will cause them more power , eager and capability in reasonable thinking , participation with others , self-consideration , observing other feelings and improving their personality to get social acceptance.

The teenager intelligence is rapidly developed and it will be highest prosperous while they are 16 years old and will be decline after 19 – 20.

The character of teenager intelligence development are;

1. Good memory but not use their memory because they want to express their idea especially social benefit. In this age , they will try to consider that which thing is better or should be and should happen in society.

2. Good concentration especially interesting items. They will concentrate to research and discover the truth without loosing and capable in concentration and suitable emotional control.
3. Prosperous, Broaden and thinking and seeking for new knowledge to improve their capability, understanding the beauty, melody. This prosper will improve step by step, not press in each age. The wise especially will better than the poor.
4. Imaginary, fancies and daydream. Their daydreams are about opposite sex, love and successful in their lives.
5. Strong confidence. They seriously settle their believes. It has to use the evidence to proof and convince them to believe. These are pro and con because if they believe in good thing that will induce them to the right way, others will cause damage.

Conclusion of teenager development

The Constructivism using all 4 innovation techniques; AIC, Storyline, Participatory or Mind Mapping, can be used to construct the body of knowledge for teenagers because these age is quite appropriate in despite, creativity, confidence, prosperous and broaden thinking and searching know-how for enhance their capability.

4. Sustainable Development of Energy

The Sustainable Development

Nowadays, Many Experts differently understand and definite "Sustainable development".

The Environment and Development World Council says that the "sustainable development is the development that response the needs of people without affection to next generation capability. In the other way, the sustainable development is the development process of natural resources and environment utilization without those effects and capability in natural resources and environment utilization of the people in next generation. (Sakda Supapongpichet, 1995 : 28 – 33)

Bunrod Bunsumred (1993 : 57) says that the "Sustainable development" is the responsive development of current people's want without resistance or obstruction to new generation want that they need to use , have or get in future.

The meanings of "Sustainable development" are different, but they have similar aim that is demanding to develop the quality of life, environment for future mankind and societies.

Relative Concepts of Sustainable Development

There are at least 3 concepts of sustainable development : (Suakda Supapongpichet,2535 : 15 – 17)

1. The humans want concept: The sustainable development concerns about the human wants those are the basic physical needs for living (foods, clothes, housing, working status, etc.)

2. The concept of limitation that the environment has at least 2 roles :

   2.1 The resources provider for the development process.

   2.2 The waste taker of the environmental development process.

The limitations of both role-plays are using the natural resources those effects to next generation capability in natural resources utilization because the

natural resource volume and utilization rate should not more than restoration rate of natural resources and natural balance.

3. The society impartial that generally the development is the economic improvement or adjustment. The sustainable development concept is using the natural resources in rate of the natural restoration rate but the sustention is not stable without society and cultural concerned development policy such as the equity of access opportunity , properly portfolio and benefit distribution

Winai Weerawattananont (1998 : 160 – 161) said about the concept and operations that call "Sustainable Development" that means the development that enduringly result to human and people by the concepts of

1. Man must live by using the natural resources and environment in this world only.
2. Humans, others living creatures and nature and made-of environment must favor to each other.
3. The development of environment and natural resource quality will be main force to urgently develop of the deteriorated environment and natural resource
4. The development of population and natural resources can increase in limited volume that the way of living must be improved with the concepts in item 1 – 3.

The Sustainable Development Policy

Winai Weerawattananont (1998 : 165 – 166) says that the development that enduring results is the development that not deteriorate quality of the environment and must seriously implement these :

1. The population control: Because the population inclement will cause widely use of natural resource that effects to the scarcity of natural resources and

cause environmental toxic that finally will be unbalanced the system. Canceling growth of the population will decrease the environment deterioration and deduct the utilization rate.

2. The environment restoration for the deteriorated environment and natural resource such as forests, water supplies, tumbled soil that will be protected for not more deterioration and must restore and develop the forests, excavate and find the water supplies, properly use the soil in each area.

3. The toxic protection and eradication: the toxic spread out into the air, water supplies and habitation must be eradicated by controlling the use of those toxic even in agricultural, industrial or residential area. There are sources to gather, manage and eradicate that toxic.

4. Plan for land and water supplies utilization: There must be properly allocated to the soil performance even for the purpose of agriculture, industry, residence or facility. It should plan for equity and proper to the seasoning and the main purpose and protect the spread of toxic or wastewater to the natural water supplies.

5. The natural resource utilization saving; the utilization of any natural resources such as water, electricity or other energy should be saving and worthy.

6. The proper technological development; The technology that used for agriculture, communication and transportation and residential must be effectively and not affect to the environment and must be developed in term of environmental restoration without environmental side effect.

7. The proper value and culture; The living related value and culture must be in proper and fit to the production rate.

8. War arms control; The weapon that used in war and destroying purpose must be controlled and limited in producing, applying, buying and selling to protect the threatening and invading, the advantages in utilization the resource and the environmental effects.

9. Education; The education in environment, natural resources, system, society, culture, technology or other knowledge must be suitably mixed for the quality of living, consciousness, living and nature comprehension and necessary skills.

We found that the sustainable development emphasize in developing concepts as mention above will not cause the deterioration of environment and will improve and endure the environment and natural resource. The education is importance for sustaining the development.

Energy

Energy is the working and status transforming or causing the material movement ability. Energy can not self-generated or vanished but it can transform shape. (Suthep Dusadeevanicha, 1996 : 2) The energy has 2 main groups those are potential and kinetic energy. Beside these, the energy can be segregated to many shapes such as thermal, electricity, mechanical, chemical, voice and electromagnetic energy. (Suthep Dusadeevanicha, 1996 : 11).

1. Thermal energy

The thermal energy has many sources such as geothermal energy, solar energy as well as the fuel combustion energy that is the important source that people use from the past.

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The thermal energy has many sources such as geothermal energy, solar energy as well as the fuel combustion energy that is the important source that people use from the past.

Table 1 : The thermal energy generated from types of fuel

Types of Fuels	Thermal Energy (Kcal/kg)	Types of Fuels	Thermal Energy (Kcal/kg)
Crude Oil	10,093	Lignite (Maemoh)	2,500
LPG	11,158	Wood	3,820
Gasoline	10,444	Charcoal	6,900
Kerosene	10,313	ash	2,600
Diesel	10,235	Alcohol	6,460
Fuel Oil	9,794	Calcium Carbide	4,840

(Source : National Energy Policy Office , 1987 : 28)

For energy selection, it must be concerned not only high heating-value but also other justified conditions such as fuel price, safety, production volume, supplied volume as well as the efficiency of the equipment that affiliated to each fuel.

Beside of fuel combustion, the thermal energy can derive from other sources.

1.1 Chemical reaction

Thermal energy from chemical reaction such as while calcium carbide combine with water, it will react to transform new matter that is smelt and flammable gas called Acetylene.

1.2 Nuclear reaction

The nuclear reaction energy is one of the alternative fuels that can substitute the natural fuel. There are 2 type of nuclear energy : 1. Fusion and 2. Fission (Pimphun Taechakupt and Payao Yindeesuk, 1997 : 30 – 34)

1.3 Other sources

The scientists try to find out other sources to substitute the declining petroleum. The scientists try to use the geothermal energy beside of flood and ebb.

2. chemical energy

A substance is comprised of atoms of elements that hold together with chemical bond. It must use energy called bond energy to integrate or disintegrate the bonds. The chemical bond is the energy-collecting source that conceals in each substance. (Suthep Dusadeevanicha, 1996 : 13)

In chemical reaction process it must use some energy to disintegrate the reactants chemical bonds and integrate the products chemical bonds because the energy in system must be constant. So the summation of potential energy of reactants must equal to the summation of energy of products. In case of the summation of potential energy of reactants is more than the summation of energy of products, the excess energy will be released. The reaction that releases the energy situation is called exergonic reaction. When the summation of potential energy of reactants is less than

the summation of energy of products, this reaction will gather some energy from outside and it is called endergonic reaction.

Living things must use energy that can derive from metabolism with biochemical reaction that called cell breathing. This biochemical reaction is the oxidation-reduction reaction that will release the energy to use for internal and external activity such as heart beating, thinking process, problem solving, laughing, singing, jumping that cause lively.

3. electricity energy

The electricity energy is the closet energy with our lives because we can rapidly and easily transform for using so the electricity is the key factor in economic and social development for all countries.

The sources of energy that we use for generating electricity are :

1. Crude oil was found in Gulf of Thailand, Fang District and Sirikit source at Kampangpetch. However Thailand have to import crude oil because there is not sufficient as demand consumption.

2. Natural Gas is the important source of energy of Thailand. there are exploration and production to be fuel for electricity generation and for cooking and for vehicles.

3. Lignite is found 72 sources in Thailand. The most of lignite is in northern and southern part of Thailand. Lignite is being fuel of electricity generation and industries. There will have lignite no longer if Thailand use lignite in rate as today.

4. Hydro Energy; Thailand construct dam to produce electricity from hydro energy such as Phumipol Dam at Tak province, Sirikit Dam at Uttaradit, Srinakarin Dam at Karnchanaburi province.

5. Geothermal is one source of natural resource that use for generating electricity.

6. Solar Cell is the semi-conductor electronic invention that can transform the sunlight directly to electrical energy. There are several types of solar cell, however the most applicable is made of silicon that are in circle re rectangular shape with 0.3 millimeters thickness. The solar cell consists of the layers of 2 types of silicon. The connection of the layers called "PN" connection. There are metal electric poles at the upper and lower sides. The upper pole is sieve appearance for the least sunlight block but let easiest pass for electron. The lower plate is metal covered and the upper plate is light-reflective reduction material.

While the sunlight radiate to the cell upper plate and thorough the connection, the silicon type N and P will cause the electric potential. The solar cell electrical connection will cause the electric current. This electric current is the direct current.

The generating electricity by using natural resources cause so many environmental impacts that the exploration and production of petroleum product as well as natural gas will gather some material such as mercury, cadmium, chromium that toxic for living creatures. The petroleum pipeline management also affects to the surrounding.

Lignite also causes problems to the environment. There is sulfur dioxide contaminate in the air and will be acid rain that danger to human, plant, animal, living and other construction. The lignite mine also cause water problems.

Without good technology and environmental management, the electricity generation causes environmental impact. Especially the energy sources are the natural resources that it will exhaust after use so we should find the alternative fuel that cause no effect to the environment Those are nuclear, solar and wind energy for example.

The Problems from Using Energy

The energy production and consuming those most of resources cause the impact to environmental and quality of life can be segregated as follows: (The department of environmental quality supports, 1995 : 46 – 48)

1. The environmental impact from energy generation

Electricity generation by using Lignite and fuel oil cause the air pollution with the sulfur dioxide that comes from combustion of fuel with sulfur content which toxic for people health.

Natural gas based electricity generation may cause waste water because of the cooling water that released into the sea that will higher the temperature and impact to the plant and animal nearby power plant.

The hydro plant impact land usage, forestation and animal management, because the dam often cover the area of valuable wood especially in tropical zone. The forest is the system that comprises of several biologics and is the valuable factor. Another major problem is immigration people out of the construction area and providing land to new people.

The oil and gas production process

The oil and gas exploration induces the environmental impact near the field such as mud, stone, soil including crude oil contaminate to the project area. The natural gas exploration and production cause the dredging between the process or may generate salt water from the exploration unit.

The last step of the process may impact especially the marine transportation. If any oil leak to the sea, it will have more effect than land use.

2. The Environmental Impact from Using Energy

2.1 energy used in transportation sector

The major energy used in this sector is gasoline and diesel. The impacts from oil that discovered are mercury from gasoline, carbon monoxide, nitrogen oxide, hydrocarbon and exhaust gas from uncompleted combustion especially in diesel engines and motorcycles.

2.2 energy used in industrial sector

Most of the environmental impacts from this sector come from fuel oil and lignite because both of them are high sulfur content.

2.3 luxurious and unconscious energy usage

The energy demand is still growth and people still luxurious use and unconscious that the energy can be exhausted so they don't have suitable environmental management resulting to the environmental impacts and reduce in natural resources. They try to find out alternative energy that has no environmental impact such as nuclear, solar and wind energy. There are approximately 480 nuclear power plants in the world for generating electricity (1994). Moreover, there are technologies in electricity generation that cause no effect to environmental impact such as solar cell which need more development for high volume generation. One of solutions of this problem is energy saving that no need high technology, timeless and less investment. Educating people to the target group is suitable method for developing countries as Thailand and this will result in social economic stability.

Conclusion of Sustainable Development of Energy

Energy can not be generated and disappear but can transform its status. Humans use this characteristic to transform natural resources to energy that supporting quality of life. There is more energy usage since more people and high technology facilitated their ways of living. The energy consumption behavior accelerates energy exhausting so that educating people in the sustainable development of energy is crucial.

5. *Environment Education*

Environmental education is the basis learning process about environment and social environment including relation and problems for improving the realization, vision, value and behaviors that supporting the environmental quality (Education Information Officer, Region 12, 1997 :11) which is similar to environmental education concepts of Lucko, Stapp, Schmieder and Laddawan.

Lucko (Bernard J. Lucko, 1982 : 8 , was quoted in paper of Winai Weerawattananont, 1989 : 3) believes that environmental education is the process for development in:

1. Knowledge about physical, social and cultural livings for creatures and environment.
2. The problems realization to find out problem solving.
3. Pursuing the responsibility behavior that will cause more quality of living.

Stapp (Stapp, 1981 :1) says that environmental education means the process that purpose to develop world population to aware entire environmental impact that including educating and motivating individual or group operating skills to protect and fix the environmental problems.

Schimieder (Schimieder, 1977 : 25) says that the environmental education is the knowledge educating and basis experience process about human, nature and natural resource which is new method in developing their responsibilities.

Laddawan Kanhasuwarn (1992, 4-5) says that the environmental education is the educating process to set value in environmental responsibility and educating people core concept for developing the skill, understand the relation between human and environment and practice deciding the proper expression about the environment contradicted issue.

It can be concluded that environmental education is the realizing process to change for proper behavior advantages in maintain environment quality.

The Environmental Education Purpose.

The Belgrade Meeting at Yugoslavia is set up to study and discuss about current and trend of environmental education in the world. The Belgrade Charter was set up from this meeting that its important is to set the purpose of environmental education and set up the guideline of education as follows: (UNESCO, 1976 : 2 – 3)

1. Awareness; to aware people and society and have media that sensitive for entire problems
2. Knowledge; to comprehend people and society the basis environment and the relative impact and understand human responsibility for environment
3. Attitude; to set up people and society value and care for environment and inspire them to involve and seriously protect and improve environmental quality.
4. Skills; to educate knowledge people and society about fixing the environment impact.

5. Evaluating Ability; To help people and society evaluate environmental operation as well as the environmental projects with consideration in component including politic, economic, social, art and education.
6. Participation: to help people be responsible for rapidly fix environmental impact for proper implementation.

The environmental education objective induce the formal and non-formal education management by infiltrating the environmental education context in subject of science and social education and add up to the whole subjects and non-formal education.

Environmental Education Teaching Technique

Winai and Bancheun (Winai Weerawattananont and BanCheun Sipunphong 1996 : 111 – 113) says that it should let learners to learn directly from nature : visual education, experiment that can provide learner see the truth and let the students operate and discover themselves, working group to search information, play role. These methods can be used for changing attitude. Teacher has important role in teaching for successful objective. Laddawan conclude the teacher role as :

1. Awareness about environment and natural resources as well as everyone role that should respect to the environment.
2. Educating the environment and human life impact
3. Practicing skills such as observation, assumptions, collecting information and recording.
4. Attitude Improvement and set up value to the environment

Environmental Education Conclusion

The environmental education success is the success of environmental problem solving that will result to the formal and non-formal education to aware people in properly change to environment.

6. The Related Research

6.1 The Related Research That Study About Environmental Education

Suwanna Arunothaipipat (1999 : d) use "Green House Effect" Science teaching document of Mathayomsuksa 1 and get the result that

1. The teaching document is efficient as 89.50/89.09 that passes the specified standard at the level 90/90.

2. The efficiency result comparison after class is higher than pre-class level.

Suchada Chaikhajornphun (1998 : Abstract) studied the student center learning process in environmental science "Ecosystem" of Mathayomsuksa 4 and found that the students of this process got higher effective scale than before with the 0.05 significant level.

Jarunee Subsunk (2000 , a) studied the "soil" teaching module of Mathayomsuksa 2 and found that

1. The study efficiency is at level 96.12/94.66 that higher than the specified level of 90/90.

2. The study efficiency comparison between after and before class is significantly difference at confidence 0.05.

Nuttha Sucharittham (1996 : abstract) studied the learning efficiency of science and creativity in science with subject of "Ecosystem" of Mathayomsuksa 1 with using the science problem solving practice. The research resulted that this practice got the difference level at 0.01 confidence.

6.2 The Related Studies In Constructivism Technique

In Thailand, there were the Constructivism technique formal recent studies in Mathematics, but there was no formal study in the environmental education.

Cook (Cook, 1995 : 3124-A) studied the Constructivist Pedagogy technique with Elementary algebra of Mathematics and found that the Constructivism technique resulted in students knowledge and the context resulted in instructor teaching.

Alsup (Alsup, 1996 : 3038-A) remarked the study result that problem solving constructivism techniques of Mathematician in Fraction, Decimal digit and Percent of practice teacher that can significantly reduce the anxious and increase confidence.

Piazza (Piazza, 1995 : 3403 – A) did the quality surveys research the constructivism teaching technique and resulted that the constructivist theory help students in body of knowledge construction and the teacher development their teaching technique themselves.

Wade (Wade, 1995 : 3411 – A) researched the Mathematics teaching technique by problem solving and learning efficiency, self confidence, Elementary level 5 Mathematics attitude with 17 samples within 6 weeks that 3 and a half hour daily. The researcher used t-test statistics method to compare learning efficiency and this was the qualitative research method for attitude and confidence test by observation and interviews. This significantly resulted in incremental efficiency with the level of confidence less than 0.05 and the second posttest and got the same result.

Moreover the poor score students got higher efficiency at 0.05 level of confidence. The research shown that attitude and self-confidence in Mathematics increased.

Bullock (Bullock, 1996 : 611 – A) studied to evaluate the effective constructivism teaching technique of Mathematics elementary teacher in students attitude in Mathematics and found that the students who followed the constructivist theory had the positive attitude in Mathematics.

Paichit Saduakkarn (1995, abstract) studied the Mathematics teaching technique that effected to the learning efficiency in Mathematics and knowledge transfer ability and found that in the medium score students, the students who were taught with this technique got higher learning efficiency that normal students. The students who were taught with this technique got higher knowledge transfer ability than normal students in high, medium and low score students,

Wichot Pongsiri (1997 : 68) learned about learning efficiency and attitude in Mathematics of Mathayomsuksa 1 students who was taught by the constructivism technique using the problem solving method got higher efficiency level at the 0.05 level of confidence and positive attitude level at the 0.01 level of confidence.

Jaruwan Youngruksa (1999 : abstract) studied the learning efficiency and endure in mathematics of Mathayomsuksa 1 who was taught by the constructivism technique can improve their attitude and learning efficiency so researcher managed the learning activities by using the constructivist theory by construct the body of knowledge in sustainable development of energy which will develop future environmental education.

The educational innovation that used in environmental education results in good efficiency and positive environmental attitude. So the constructivism technique

that well apply with the Mathematics should well reflect to the environmental education.

The key success of problem solving in environmental impact is using the environmental education to create learners' knowledge by changing behavior to value and economically utilize the energy. This will resulted from self-constructed body of knowledge with the proper educational innovation to their age and this will finally induce to the sustainable development of energy.

CHAPTER III

METHODOLOGY

The body of knowledge construction in sustainable development of energy research is the experimental research, which proceed these steps:

1. The sample
2. The research process
3. Research instruments
4. The instrument efficiency
5. Data collection from experiment
6. Data compilation and analysis

Sample

The 16 students would be selected as sample from Mathayomsuksa 4 at Santirath Wittayalai School, Bangkok.

The Research Process

1. Study the constructivist theory from the research document to design the body of knowledge construction in sustainable development of energy by using 3 steps, as fellows :

   1) Cognitive conflict construction
   2) of Reflection
   3) Cognitive restructuring

2 . Study the education innovation to be a technique for creativity for body of knowledge followed the constructivist theory by using these techniques.

1) Apply the Participatory Learning technique for cognitive conflict construction and reflective step

2) Apply the AIC technique for reflective step

3) Apply the Storyline Approach techniques activities for cognition conflict construction

4) Apply Mind Mapping for cognitive restructuring conclusion.

3. Determine the research objective in sustainable development of energy from studying the environmental education curricular and other studies.

The objectives of the sustainable development of energy

1) To comprehend the sustainable development of energy and the problems resulted from energy utilization.

2) To solve the energy problem as well as decide and implement the sustaining utilization for housing, school, and community in local and country.

3) To aware the energy importance and cooperate in sustainable energy conservation.

4. To study the research context from the environmental sciences, physical science and other textbook. The researcher segregates the context to four parts.

1) The importance of energy :

1.1) The energy characteristic

1.2) The relation of energy in various forms

1.3) The important of energy

2) The energy problem :

2.1) The problem situation about the fuel and energy

2.2) The environmental impacts from energy generation

2.3) The environmental impacts from energy utilization

3) The sustainable development of energy :

3.1) The meaning of sustainable development of energy

3.2) The concept of sustainable development of energy

4) The method of sustainable development of energy :

4.1) The energy conservation guideline

4.2) The implementation for sustainable development of energy

5. The Concepts

1) The energy is crucial for living. Nowadays the entire working status needs the energy.

2) The energy problem comes from the energy generation that impact to environment and worthless energy utilization.

3) The development that response to the current energy demand by carefully using the exhausted energy and seeking for alternative sources to not impact the energy demand of the next generation that is the sustainable development of energy.

4) The energy conservation is the method of sustainable development of energy by using science and technology, energy management and educating people to change their behavior.

6. To study the context of sustainable development of energy from energy documents, energy conservation and other documents for setting the standard of body of knowledge construction as follows:

1) The energy importance. The standard is energy can be transform from one stage to others so the energy is important for all over living.

2) The energy problem. The standard is the energy problems can be defined:

2.1 The worthless utilization cause disadvantage in utilization

2.2) The energy generation impact to the environment.

3) The sustainable development of energy; The standard is economically utilization beginning with ourselves parallel with substituted energy that will forever remains.

4) The sustainable development of energy method comprises of 3 areas.

4.1) Educating for behavior adjustment to receive the value of energy and economically utilization

4.2) The sciences and technology increase the efficiency for energy saving.

4.3) The energy utilization plan

7. To plan the teaching in sustainable development of energy details:

1) Subject

2) Concept

3) Objective

4) Context

5) Learning Activity

6) Education Media

7) Measurement and Evaluation

8) To step for teaching. The teaching step is the important tangible part of the learning activities that leading to the objective of the frame theory activities. These teaching steps are determined by using the frame of constructivist theory and innovations consistency to this theory for construction the body of knowledge. The determine teaching steps are:

1) Step of Cognitive conflict

The cognitive conflict step uses the Storyline Approach or Partipatory leaning technique for the learning activities.

1.1) Storyline Approach technique will separate each 3 students in groups and let every groups draw the picture by using their imaginary followed the cards specific by each steps

Step 1 Draw the scenery from card 1

Step 2 Draw the actors from card 2

Step 3 Draw the living style from card 3

Step 4 Draw special event from card 4

1.2) Participatory Learning: The teacher will show the problem situation by demonstrate the picture and play the videotape or the best choice that each students select the let the students answer the question from the work order form.

2) Step of Reflection

The reflection step uses the AIC or Partipatory leaning technique for the learning activities.

2.1) The groups conclude their ideas to be a single idea.

2.2) The group's representatives present the idea to class.

3) Step of Cognitive Restructuring

The cognitive restructuring step uses the Mind mapping technique for the learning activities.

3.1) Students in each group discuss about the important of the things teachers asked for.

3.2) Students in each group brainstorm to find out the important and conclude the concept of those things.

3.3) Write down the concept at the center and drag branches as minor concepts.

3.4) Draw the linkage of those concepts. The bigger concept will near the center. The branch concepts will be further. They should use word as unite such as 1-line 1-word, and use color to help their remembrance and generate creativity.

9. To ask for advises from the 4 expertise of the environment, education, environmental education and teacher to evaluate and adjust the context and activities and then present to the thesis advisees. After the advisee consideration, the researcher will improve until the advisees satisfy the thesis.

Research Instruments

There are 12 periods are described in teaching plan of sustainable development of energy by constructivist theory that comprises 4 plans.

Table 2 : Teaching plan of sustainable development of energy

Subject	Teaching Technique	Number of Periods	The Contents
1. Importance of energy	1. Step of cognitive conflict uses Storyline Approach 2. Step of reflection uses Participatory Learning and AIC 3. Step of cognitive restructuring uses Mind Mapping	3	1. The energy qualification 2. The relation of each form. 3. The importance of energy for living

2. The energy problems	1. Step of cognitive conflict uses Participatory Learning 2. Step of reflection uses Participatory Learning and AIC 3. Step of cognitive restructuring uses Mind Mapping	3	1. The problem of fuel and energy sources 2. The environmental problems from energy generation 3. The environmental problems from energy utilization
3. The sustainable development of energy	1. Step of cognitive conflict uses Participatory Learning 2. Step of reflection uses Participatory Learning and AIC 3. Step of cognitive restructuring uses Mind Mapping	3	1. The meaning of sustainable development of energy 2. The concept of sustainable development of energy

4. The method of sustainable development of energy	1. Step of cognitive conflict uses Storyline Approach 2. Step of reflection uses Participatory Learning and AIC 3. Step of cognitive restructuring uses Mind Mapping	3	1. The means of energy conservation 2. The practice for sustainable development of energy

The Instrument Efficiency

The teaching planning would submit to 4 qualified advisers that comprised of 1 student, 1 environmental education expertise, 1 environmental expertise and 1 instructor to evaluate with the evaluate form. This evaluation form consists of 15 evaluation items. There are 5 scales for each item.

4.50 – 5.00	Mean	Strongly agree
3.50 – 4.49	Mean	Agree
2.50 – 3.49	Mean	Somewhat agree
1.50 – 2.49	Mean	Disagree
1.00 – 1.49	Mean	Strongly agree

This form evaluate the 4 educational plan about :

1. The sustainable development
2. The importance of energy
3. The energy problems
4. The sustainable development of energy

The result of evaluation show in table 3

Table 3 : The result of evaluation the educational plan efficiency in sustainable development of energy

Evaluation Items	$\bar{X}$	S.D.
1. The scale that the objective is related the context	4.50	0.050
2. The scale that the context is properly allocated	4.50	0.050
3. The scale that the context and activities in educational plan for sustainable development are assigned	4.23	0.829
4. The scale that the context and activities in educational plan for important of energy are assigned	4.23	0.829
5. The scale that the context and activities in educational plan for energy problem are assigned	4.23	0.829
6. The scale that the context and activities in educational plan for sustainable development of energy are assigned	4.00	0.707
7. The scale of activities is consistent to the constructivism theory	4.23	0.829
8. The scale of activities of the cognitive conflicts construction are properly used	4.23	0.829
9. The scale of construction activities of the cognitive conflicts and reflection caused the cognitive restructuring (Constructivist)	4.23	0.829
10. The scale of educational activities result to the solutions for environmental impact in energy	4.23	0.829
	4.50	0.050

11. The scale of educational activities consist to the students center concept	4.23	0.829
12. The scale of educational media support the body of knowledge construction	3.75	1.299
13. The scale of evaluation consists to the objectives	4.23	0.829
14. The scale of educational plan support to the body of knowledge construction	4.23	0.829
15. The scale of language appropriate		
The total result	**4.25**	**0.829**

The table 3, the expertise evaluation shows that the educational plan is efficient in excellence totally result ($\bar{X}$ = 4.25 S.D. = 0.829). The average of the result is between 3.75 – 4.50 and the average of standard deviation is between 0.05 – 1.299. The highest score in the excellence scale ($\bar{X}$ = 4.5) is the scale that the objective is related the context, the scale that the context is properly allocated and the scale of educational activities consist to the students center concept. The expertise evaluate the scale of educational media support the body of knowledge construction in good scale ($\bar{X}$ = 3.75), which is the lowest score.

Expertise presents more recommendations that the educational plan is excellence creative and it will be better if there are some improvement. Those recommendations can be described as follows:

1. The objective is related the context and activities, which can make the students getting knowledge as the specified objective.

2. The sustainable development that uses the forest problems that is far makes less awareness than something is near such as water. The activities of discussion about the advantage of forest will result in the importance in students' views.

3. The inside dome activities without communication outside and then continue the part 2 activities that let the students plan the energy utilization if the oil expired are the continuing activities and create the importance and awareness in students' view.

4. The actual and moderate problems can make students better aware and express, criticize their idea.

5. The sustainable development of energy should have more activities after study others' view. There should be more activities that students can create clearer point of view.

6. The activities and the continuity of the steps consist to the concept of theory.

7. The step of cognitive conflict without imagination the first step is excellence. The framework of imagination does not limit the students' ways of thinking.

8. The cognitive restructuring by using Mind Mapping technique is excellence and tangibly reflects the truth that can let the teacher clearly understand the students' opinion.

9. The learning activities result to the excellence problem solving because this will make students create ideas, compare the ideas for seeking the problem solving and then construct the body of knowledge.

10. The situation determination that make the students think about the sustainable development of energy is whether gathering all the concepts and how to present perfect information to the students.

11. The evaluation form should be adjusted for consistency of the evaluation.

12. There is not right auditory system for built constuctivism.

13. Those are excellence creativity and they will be better if there are some adjustment especially LCA.

The researcher has adjusted the thesis as the expertise recommendation and present to the thesis advisees, which recommend the improvement of the step of issuing problems for cognitive conflict construction and additional guideline for the sustainable development of energy. The researcher has improved as the recommendations so all advisees satisfy the whole educational plan like this:

1) The important of energy
2) The problems of energy
3) The sustainable development of energy
4) The method of sustainable development of energy

The Data Collection from the Experiment

There are parallel activities of learning activities and data collection into three steps.

1. Making relation with students before teaching in the first two weeks.(November 16, 2000 – December 30, 2000)

2. Processing the teaching activities on Thursday, one day a week , three periods each day since week 3 through week 6 (December 6, 2000 – January, 4 2001)

3. Daily collecting data since the first week through the sixth week (November 16, 2000 – January 4, 2001) The data collection methods were observation, interview and studying from working order and learner's critic then summarized to construct the body of knowledge in sustainable development of energy.

1) Interview: The objective of interview is to find out thinking, felling, intention or behavior in the past that the researcher cannot observe or the behavior that the researcher cannot directly observe. We cannot observe the imagination and human's mean so that we must ask and talking with people. (Napaporn Havanont , 1997 as quoted in Jiraphun Tritipjarus, 1999 : 95). There are 6 types of interview questions.

(1) Background Questions

(2) Knowledge Questions to find out the truth that difference from opinion, attitude and believes

(3) Experience or Behavior Questions

(4) Opinion or Value Questions about various issues

(5) Feeling Questions about things or the experience mentally mood

(6) Sensory Questions

The research is the interviewer by using tape recorder and note, then completely write detailed explanation and decode the recorder for categorizing the data for further analysis.

2) Discussion:This focus group discussion is the data gathering method that integrate the sample in a small group and ask them questions for discussion (Uthumporn Jamornmarn, 1990 :44) for example asking about the current energy utilization that was happened in classroom.

The data gathering from discussion is observation, recording and studying the work order then categorized the results and systematically analyzed.

Data Compilation and Analysis

The researcher daily compiled and analyzed data after finishing class, interview and discussion. The researcher decoded the recorder and wrote details of information after read, comprehended, analyzed and categorized the body of knowledge.

CHAPTER IV

RESULTS OF STUDY

The researcher would like to present the result of the body of knowledge construction in sustainable development of energy into 3 steps of the experiments.

1. Relation with the target group
2. Implementing teaching activity
3. The body of knowledge in sustainable development of energy
4. The learning activities problems

1. Resulted from Relationing with the Target Group

The sample of this research is the group of 16 students of Mathayomsuksa 4/2 at Santirath Wittayalai School that comprises of 2 boys and 14 girls. The result of making relation with the target group help the research know information and their background as follow:

1. Miss Premika or Oh. She is merry, cheerful, annoying friends. Her hobbies are listening radio, reading cartoons and being alone. She doesn't like loud noise. Working with computers or being doctor is her dream but she think it is difficult because she has not get good grade.

2. Pipob, or Pob, comes from Singhaburi after finished junior high school to enter Santirath Wittayalai School. Pipob is bashful and kind. However, he can express good idea. Pipob told that he lives in Bangkok alone. Sometime he feel lonely. He has only a small radio and a fan . He is a gentleman

3. Miss Rungtiwa or Muay is quite proficient and was ranked to the third of class and is a musician of school military band. She proud and impress the band union.

4. Miss Laddawan or Mee is cheerful student and often ask questions. She loves pet. Once she helped dog moved its puppies from flooding trap.

5. Miss Kanokpron or Kluay, the second ranked in good record, a talkative girl, however she paid good attention in class. She mentioned that her family was perfect, loves and cares each other and always plays activities together such as singing, shopping, etc.

6. Miss Kanokporn or Tu is the good responsible class leader. Her father is a military man has only one child. She is cheerful, easily angry but also easily recovered too. She wants to get good job that she take care her parents and herself.

7. Miss Huttaya or Bee is quiet but looks merry. She impressed her junior high school teacher that supported her willpower and insinuatingly being everything.

8. Miss Chutima or Pum was finished junior high school from Prajuabkerekhun. Her parents have a pineapple farm. She stays with her relatives. She is less talk, smile and shy but her writing is a good ideas. She once misunderstood with her mother and made her mother peevish. And thought that she love her father than her mother but she knew that she loves her mother a lot after she moved to Bangkok

9. Miss lookpla or Pla, Chutima's close friend comes from Prajuabkerekhun She is quiet, bashful. She can present good idea with writing paper

but she does not like to express. At lunchtime, she and Chutima often do homework without meal.

10. Mr Anun or King. He proud with his position of school cheer leader. Almost his close friends are girls.

11. Miss Mayuree or Ma is interesting in science and environmental. She used to join the Mahidol University of environmental youth activity. Besides, she is also interesting in Buddha religion.

12. Miss Krongjit or Wahn get on well with other people and be consultant of friend. She is closed to Premika because they are studied in the same class since junior high school.

13. Miss Sirinthip or Rin is Japanese buff even singers or Japanese drawings. She can sing Japanese songs. She did not have lunch because she wanted to be diet. Once she pretend to be sorry because a Japanese super star died to make her body fit. Some students who crazy Japanese thinks similar to her.

14. Miss Jiraporn or Ae is talkative, courageous, and creative. Her hobbies are listening music, writing letter and reading cartoons. She told that she used to have perfect family. now she is lonely because her mother died.

15. Miss Thitirath or Am is cheerful, merry and smiley. She closes to Kanokporn. She likes reading and listening music. She would like to have trusty advisor for consulting her problems.

16. Miss Sayamol or Oat is vigorous, courageous, good in discussion. Her opinion seems an adult and she is a consultant of friends. Her family has so many problems that occurred by adult. She kept her weak behind her strength because she cried while talked about her family.

2. Resulted from Implementing Teaching Activity

The teaching activity support behavior and discussion development before and after the activity. The researcher introduces the 4 main teaching plans.

Plan 1: The importance of energy

The group behavior shows that they will to do the activities especially the group of Chutima, Lookpla and Huttaya those in good reactions. The picture of Pipob, Sayamon and Kanokporn group is the most beautiful. Groups opinions the question that could a scientist alive if there is he stuck in a dome are:

Group 1: There are Kanokporn, Jiraporn and Thitirath. They expressed group opinion about the cognitive conflicts and reflection that the scientist can alive in the dome because of food, clothes and medicine. The solar cell is the energy that help creatures alive.

The foresight activity was processed by question what will happen if there is no oil in future, this group thought that

1. Cars, Trains, Planes and Ship cannot transport.
2. The transportation slowly will process.
3. The agriculture cannot develop.
4. The industry will not prosper.
5. There are criminal situations.
6. There are more jobless people.
7. The country stops the development.
8. There is no electricity.

9. There is more garbage (metal work).

The cognitive restructuring conclusion of the importance of energy :

They show that the major energy is solar energy that plants used for synthesize. That will be food for human and the oxygen is the byproduct. Human living entirely involves sun light for example warmness, seeing, food preservation or energy transformation for facilitating.

Group 2: There are Chutima, Jiraporn and Thitirath. They expressed group opinion about the cognitive conflicts and reflection that the scientist can alive in the dome because there is food that comes from the experiment and there are animal and vegetable already in dome. The clothes come from animal skins and plants. The medicine comes from plants and the most important there is water supplies to consume. All of them can alive because there is solar energy.

The foresight activity was processed by question what will happen if there is no oil in future, this group thought that

1. The bicycles will be used to substitute cars.
2. Lamp substitutes the electricity.
3. The transportation must proceed by argosy.
4. The accessories come from plant's product.
5. The industries must reduce its sizes and more labor will be used.
6. The solar energy will be used for work.
7. The animals will be used as vehicle.
8. House will be made of wood.
9. Labor must work hard because there is no machinery.

10. The country stops the development.

The cognitive restructuring conclusion of the importance of energy :

They show that the major energy pro and con. The energy advantages for country development. The especially economic development has to use lots of energy. On the contrary, the energy can damage air, human live and health and natural resources

Group 3: There are Roongtiwa, Laddawan Mayuree and Krongjit. They expressed group opinion about the cognitive conflicts and reflection that the scientist can alive in the dome because there are necessities of life that plants synthesize by using solar energy. Animals eat plants and Human food comes from plants and animals. Those are dependency without any facilities.

The foresight activity was processed by question what will happen if there is no oil in future, this group thought that

1. The bicycles will be more usage.
2. There is more bicycle shop.
3. Cars will be only remnants of metal.
4. The planes will be crash or there is no plane.
5. There is no gas station.
6. There are more jobless people.
7. The transportation will freely flow.
8. It will be good situation about pollution.
9. Trains cannot be moved.
10. There are fewer industries or there is no one.

The cognitive restructuring conclusion of the importance of energy :

They show that the solar energy is the most important energy that provides warmness. The plant synthesis is the source of food and oxygen that creatures can live. Moreover solar energy can transform to electricity, mechanical and voice energy.

Group 4: There are Sayamon, Pipob and Kanokkorn. They expressed group opinion about the cognitive conflicts and reflection that the scientist can alive in the dome because there are necessities of life for example plants, animal, water and sunlight as a cyclic that if something is lack there is another substitute until the system is stable for long run. Moreover the scientist has enough knowledge to discover the process.

The foresight activity was processed by question what will happen if there is no oil in future, this group thought that

1. There is no electricity.
2. There is no treated water supply.
3. Cars can not be moved.
4. There may be thieves.
5. There will rapes.
6. There is more difficulty in transportation.
7. The factories will be closed.
8. There are more jobless people.
9. It is far to reach medicine.
10. It cannot be seen at night.

The cognitive restructuring conclusion of the importance of energy :

They show that the solar energy is the major and most important energy that provide light and warmness those are key factors for synthesis which is the source of food. Moreover solar energy can transform to electricity which can transform to other energy.

Group 5: There are Premica, Anun and Sirinthip. They expressed group opinion about the cognitive conflicts and reflection that the scientist can alive in the dome because there are necessities of life and scientist can transform the solar energy to other forms which is the most important.

The foresight activity was processed by question what will happen if there is no oil in future, this group thought that

1. The factories will be closed.
2. Cars cannot be moved.
3. Planes cannot fly.
4. The gas stations will be closed.
5. There are more jobless people.
6. There is no electricity.
7. The parcel post will slowly transport.
8. Country development will more slowly.
9. There will be weak in physical because it took long distance for work.
10. There will be remnants of metal because cars are not used.

The cognitive restructuring conclusion of the importance of energy :

They show that the energy is the major factor that provides us live. Energy comes from transformation of solar or petroleum energy. Energy facilitates and makes more convenience for lives. The solar energy is the most important energy. The advantages of solar energy are it provides

1. Plant synthesis
2. Thermal energy
3. Light to earth
4. Growth of plants
5. Vitamin A
6. Warmness to lives
7. Transformation to other energy
8. Food preservation without electricity
9. Destroy diseases and microbe
10. Transformation to electricity for daily usage.
11. Vehicle movement without fuel necessity.
12. Complete ecosystem and provides producer continuous work.

Plan 2: The energy problems

All groups have good reaction. The results of the activities can be described as follows:

Group 1: There are Laddawan, Mayuree and Sirinthip. They expressed their opinion about the cognitive conflicts and reflection about the leakage oil tank as follows:

Laddawan said that she thought about deteriorated marine environment while the tank was leaked. The natural resources will damage and waste. When oil spilled out to land or sea or evaporate, it will damage to human. It cannot plant. The air will be polluted and the fishry will difficulty. The natural resources rapidly are exhausted. The disadvantages are

1. Lose natural resources
2. Air environment pollution
3. Water environment pollution
4. Land environment pollution

The tank oil is actually used and exhausted but the perforation makes it useless. This is similar to the luxurious. The energy problems of this issue are the energy will be rapidly exhausted if there is careless and luxurious.

Mayuree thought about the sea, marine natural resource and people because the marine animal will die and oxygen cannot infiltrate to the water while oil spill out and covered the sea surface. The people surrounding are in danger. The economic will go down and there is no product to export and people are bad health.

The oil actually is used and can be exhausted but the perforation is the unnecessary usage. This is similar to "passthrough work". The usage without caring the effect will cause energy problem for example one-sided paper utilization, driving alone are waste.

Sirinthip thought about the river. What will happen when the oil spread out the river. The tank leak will affect to environment impacts. One of the most possible of hose impacts is the rotten river.

Sirinthip thought about the river. What will happen when the oil spread out the river. The tank leak will affect to environment impacts. One of the most possible of hose impacts is the rotten river.

The oil actually is used and can be exhausted but it will be more rapidly exhausted if we improperly use. The perforation is similar to luxuriously and careless usage.

The energy problem activity used the Thai-Malaysia natural gas pipeline to be an example.

Laddawan said that the people resist this project because they afraid that they will damage from the pipeline explosion. She believed that substitute energy is important because country will decrease development if there is no energy. Mayuree and Sirinthip agreed with her opinion.

The conclusion of cognitive restructuring of the energy problems: This group mentioned that the most important problem is natural resource damage that will effect to other problems. The energy problem is the useless utilization, which comes from human behavior this will deteriorate economy and delay development of country.

Group 2: There are Huttaya, Chuttima and Lookpla. They expressed their opinion about the cognitive conflicts and reflection about the leakage oil tank as follows:

Chutima said that she thought about environmental impacts and loosing energy without benefit. This causes by human luxury. The tank oil leakage is similar to the "unawareness of the facts in oil usage" or careless and luxurious.

Huttaya thought about the damage of marine environment. For example, if the oil spilled out into river then animals will died. The environment will be damaged. The oil tank leakage is similar to the luxurious utilization behavior without valuation. She concluded that the future problems of energy are the energy will be exhausted and this will damage environment.

The energy problem activity used the Thai-Malaysia natural gas pipeline to be an example.

Chutima said that the people do not care the energy problems but afraid their disadvantages. The energy generation cause much environmental impact. Her opinion consisted to Huttaya's that is the energy generation and utilization always cause the enviromental impact such as dam construction for power generation is also damage the environment.

The conclusion of cognitive restructuring of the energy problems: This group separated 2 types of problems.

1. Power generation will cause the environmental impact for example the dam construction for generating electricity or the Thai-Malaysia natural gas pipeline project.

2. The worthless or careless in energy utilization will damage to the environment.

Human wants deteriorate human spirits that love convenience and careless the sources of that convenience and this will cause the competition in society and uninteresting in merit.

Group 3: There are Kanokporn, Jiraporn and Pipob. They expressed their opinion about the cognitive conflicts and reflection about the leakage oil tank as follows:

Kanokporn thought about the waste of energy because the leakage of the utility means the exhaust and this event is similar to invaluable of energy.

Pipob said that he thought about human using energy. The hole is similar to energy usage that more energy we have, more usage will occur. The bigger hole means more usage. This needs someone to plug the hole or less use of energy. The luxurious and invaluable usage is worth nothing.

Jiraporn thought about earth. The useless oil leakage seems to be careless behavior and devalue the energy benefit.

The energy problem activity used the Thai-Malaysia natural gas pipeline to be an example.

Chutima said that the resistant damage country in acquiring substitute energy because they did not know the truth or the right objectives. Beside this, she thought that energy generation cause less problems than utilization if people invaluably use energy.

Pipob thought that the contradictory causes the disadvantages. He agreed to Jiraporn's opinion that the problems come from utilization more than generation.

The conclusion of cognitive restructuring of the energy problems: Human causes energy problems because of their invaluable and careless usage. They do not only use and also do not find out the alternative energy. They are unconscious in energy utilization and do not consider about the expiration.

Group 4: There are Sayamon, Kanokporn and Thitirath. They expressed their opinion about the cognitive conflicts and reflection about the leakage oil tank as follows:

Kanokporn thought about the waste of energy. This event is similar to invaluable and luxurious usage of energy. Her opinion is consistency with Thitirath's and Sayamon's opinion That the energy can be exhausted and human hurried the expiration because of luxurious and invaluable usage and they do not think that petroleum uses time for ages.

The energy problem activity used the Thai-Malaysia natural gas pipeline to be an example.

Kanokporn believed that this problem occurs because people do not understand the necessity of energy usage and they only think about environmental impact and careless about the benefits. The government should clearly explain that who will get the benefit from this project and how it can support in country development. Sayamon agreed with this opinion that two groups of people cannot understand each other unless they talk about the same thing. Thitirath thought that it might have someone influence this problem. He said that the substituted energy is very important. Without further energy, we hardly continue our lives.

The conclusion of cognitive restructuring of the energy problems: They mentioned that the problem comes from invaluable and unconscious usage. They do not take care the utilization behavior that seems to be the leakage of oil tank and they do not try to seek the substitute energy.

Group 5: There are Prenika, Anun, Krongjit and Rungthiwa. They expressed their opinion about the cognitive conflicts and reflection about the leakage oil tank as follows:

Premika thought about the explosion and the effect to nature. People might die if the oil spilled out because Thai people always scattered things such as cigarette ashes. When someone scattered cigarette ashes it will be exploded and everyone would die.

The oil actually is used and can be exhausted but the perforation hurries up the expiration. This event is similar to non-saving utilization. That will cause non-useful utilization and effect to the environment.

Anun thought that the wasteful usage that if the tank was leaked the oil will be exhausted. This event is similar to wasteful utilization. We will lake of petroleum or energy if we do not save it. This event seems to be non-saving utilization. This will cause problems such as the factories might be closed.

Rungthiwa said that she thought about the explosion, wastewater and dead marine animals. If there are any explosion material nearby the oil, it will explode. The marine animal will die if the oil spilled out into the sea. This will damage the environment. The oil is actually used and can be exhausted but the perforation hurries up the expiration.

Krongjit agreed to all group members and thought that the main problems of energy are environmental destruction and invaluable usage.

The energy problem activity used the Thai-Malaysia natural gas pipeline to be an example.

Premika said that the resistor afraid that the nature will be destroyed and this will impact to the environment. The problem is we cannot generate energy because of the resistant. This opinion was agreed with Anun's, Roongtiwa's and Krongjit's opinions.

The conclusion of cognitive restructuring of the energy problems: They mentioned that besides invaluable usage that causes the environmental impacts. This event will effect to public health and deteriorate human spirits.

Plan 3: The sustainable development of energy

Group 1: There are Pipob, Sayamon, Kanokporn and Sirinthip. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

Pipob's opinion is the power generation should come from solar energy, garbage and water because the sunlight will never expire. Earth comprise water three on four parts it could help for electricity generation. The garbage energy will eradicate its problems. The energy from oil, natural gas, coal will be expired so we should worth utilize them and saving for long life.

From the views activity of three men, Pipob choose to be Nop because he knew that the energy will be expired and find out problem solving that will have new substitute energy. Then he changed to be Nu because he always considers about energy usage. However Nu should find out the problem solving because the energy will be expired in oneday.

He definite the sustainable development of energy that the operation that endure the energy, help human have long life energy but they must save.

Sayamon Thought that the proper energy for power generation is sun light because of it is the suitable with the country environment, endurable and has no environmental impact. He thought that the exhausted energy effect to the sustainable development because there is limited amount.

From the views activity of three men, she chose to be Nu because he thought about truth and not sided himself. He thought about future and tried to solve problems. She thought that this is great idea, which is valuable usage today for using long run in future. He did this for himself, his family and everyone in the world.

Kanokporn Thought that the proper energy for power generation is sun light because of it is no waste the energy that decreased everyday. Some sources of energy were limited and depleted. We should save it, seek for the substitution and worthy utilized.

From the views activity of three men, she chose to be Nu because he knew how to use, save and understand its value and think of others.

She definite the sustainable development of energy that the energy can be depleted so we must use less and not luxurious, prepare ourselves for the problem then try to fix the source of problem and especially discover substitute energy.

Sirinthip thought that the proper energy for power generation is water because there are many sources water supplies in the world. The energy from oil, coal can be depleted. The nuclear cause the environmental impact. There is limited exhausted energy not enough for development. If we have sustainable energy, we can forever use for development.

From the views activity of three men, she chose to be Nu because he could see the tiny problems and can pursue everyone to save energy. Nop is suitable for current

and future situation because his knowledge can be benefit in energy saving and development.

The sustainable development of energy is the plan for daily energy utilization in order to have energy in the long run.

The conclusion of cognitive restructuring of the sustainable development of energy: This group mentioned that man must know how to save and use the substitute as necessary. We must carefully use the energy and discover the natural products for substitution for example use basket to carry fruits despite plastic bag, resist the activities that impact the environment or stop destroying the existing natural resource.

Group 2: There are Kanokporn, Thitirath and Jiraporn. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

Kanokporn thought that the power generation should come from solar energy because it can be forever use and cause less impact to the environment. Some sources of energy were limited that effect to the sustainable development.

From the views activity of three men, Pipob choose to be Nu because he could see the effects and problems that will occur and he decided to work.

She definite the sustainable development of energy that value the things we use and think for the effects that may happen.

Thitirath chose solar energy for generating electricity because it can easily be transform and forever use. There are some impacts occur from sources of exhausted energy. We should energetic in using the energy and adjust for the right situation.

From the views activity of three men, he chose to be Nu because his opinion is right that using adequate energy and can maintain for next generation. He definite the sustainable development of energy that the energy is used for much development. Earth may be in bad situations so we must justifiably use energy.

Jiraporn chose solar energy for generating electricity because its endure and cause no environmental impact.

From the views activity of three men, she chose to be Nu because he think for the future that was effected from what we did today. People nowadays are selfish. The people that benefits to next generation consists of Nu and Nop: Nu is careful in working and consideration, Nop is modern and wants earth to development in positive way.

The conclusion of cognitive restructuring of the sustainable development of energy: This group mentioned that the careful utilization of energy and should consult each other in order to find out the substitute energy.

Group 3: There are Huttaya, Lookpla and Chutima. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

Huttaya chose the solar energy for generating the electricity because it can be used for many purposes easily found and cause no impact to the environment.

Some sources of energy were limited that should discover the substitution.

From the views activity of three men, she chose to be Nop because he thought about how to forever the energy. The sustainable development is how to enduring use energy. The most important is Nop could solve the problem while he knew that there is not enough energy in future and find out the substitution.

Lookpla chose generating electricity from water energy because it has cyclic and is no depletion. It is the natural energy and has low production cost.

Some sources of energy were limited and depleted and some are forever. The sustainable development should implement these steps:

1. Energy utilization plan
2. Endurable energy usage in order to substitute parts of the exhausted energy.

From the views activity of three men, she chose to be Nop because he look forward to the problems, analyze and fond out the problem solving as well as the substitution. The sustainable development of energy comes from to save the energy, to plan for utilization and to discover the substitution energy.

Chutima chose solar energy for generating electricity because it comes from nature but its disadvantage is it comes only daytime. Some sources of energy were limited and depleted so that we cannot plan forever use.

From the views activity of three men, she chose to be Nop because he tried to find out the problem solving.

The conclusion of cognitive restructuring of the sustainable development of energy: This group mentioned about the energy utilization in development and prosperous future. However we have to plan how to use those energy for enduring.

Group 4: There are Premika, Anun and Roongtiwa. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

Premika chose the garbage energy for generating the electricity because it has in large volume and impacts to environment. The solar energy is endurable and causes no impact to the environment.

Some sources of energy were limited and some are forever those can effect the sustainable development. If we chose the exhausted energy without the substitution, it will be in trouble. Otherwise, if we have both of them, it can make me comfort for the long run.

From the views activity of three men, she chose to be Nu. If everyone thinks as he does, the energy can exist forever. Nu is a smart user that he emphasizes and nurtures the natural resource. His thought effects the current and future situation because he is careful about how to use energy and plan for the utilization.

The sustainable development of energy is the economically and worthy utilization of energy and there will be adequate energy for using in the long run.

Anun chose generating electricity from solar energy because it can transform to electricity and other energy as well as the garbage energy is also decrease the volume of garbage.

Some sources of energy were limited and depleted and some are forever so we should suitably use the energy. The exhausted energy can be depleted if we luxuriously use and we should develop the endure energy.

From the views activity of three men, he chose to be Nu because he carefully consider which we should do next. This cautions us to think a lot in order to have energy for the future that reflects to the sustainable development of energy.

Roongtiwa chose garbage energy for generating electricity because now there is large volume of garbage. This will generating electricity and also deducts the garbage problem.

Some sources of energy were limited and depleted so that we should find the endurable energy in order to substitute the exhausted energy.

From the views activity of three men, she chose to be Nu because he worried about the future, other people and carefully conduct his life. He did not solve lots problems, but he carefully used so as to next generation. This is beneficial for the majority.

The conclusion of cognitive restructuring of the sustainable development of energy: This group mentioned about the economical energy utilization in order that there will be further energy.

Group 5: There are Mayuree, Laddawan and Krongjit. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

Mayuree chose the solar energy for generating the electricity because of its endure and has no environmental impacts.

From the views activity of three men, she chose to be Nu therefore he thought about the effects and knew how to worthily use energy for living.

The sustainable development of energy means worthily use of and causes no environmental impact.

Laddawan chose generating electricity from solar energy and ethanol, which derived from plants because the solar energy is the large source of energy, and the ethanol causes no environmental impact.

From the views activity of three men, she chose to be Nu because he thought about the future effects, had the right way of living, did nothing to impact the future.

The sustainable development of energy comes from economically usage of energy that must be beneficial, endurable and worthy.

Krongjit chose garbage and plant's ethanol energy for generating electricity. Human habit is careless so that we will have energy to use forever and this will deduct the environmental problems.

She agreed with Mayuree's and Laddawan's opinion about 3 men views.

The conclusion of cognitive restructuring of the sustainable development of energy: This group mentioned about endures energy utilization and the affection of the environment that the utilization should be worthy and the major substitution energy are solar and ethanol.

Plan 4: The method of sustainable development of energy

Group 1: There are Roongtiwa, Pipob and Mayuree. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

This group well drew their imagination. Their picture showed the methods on behalf of managing energy problems such as population control, vehicle design that use less fuel but maintain the efficiency, 1- day supporting activities to stop energy usage in order to issue the importance of energy and change consumption behavior

The cognitive restructuring conclusion of the method of sustainable development of energy: This group presented the guideline of sustainable development of energy as follows:

1. Develop the accessories so as to economically fuel consume.
2. Systematically allocate the fuel usage.
3. Control the factory so that can efficiently use energy.
4. Distribute and educate the children about energy in order that they can daily use and transfer to adults.
5. Experiment for discovering the substitute sources of energy
6. Flight and advertise the economic energy usage.
7. Use bicycles instead of cars to reach close places
8. Plan for suitable usage of energy so as to get the most benefit.
9. Assemble large but less-consumption passenger cars and pursed car- pool.
10. Plan for population control so that it will less consumption
11. Stop using energy one day in order to issue the importance of energy as an axiom that "there is no tear until die".

Group 2: There are Thitirath, Kanokporn and Jiraporn. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

This group well drew their imagination. Their picture showed the ways of living that there are electricity generations from solar cell and the vehicles were designed to less consume fuel as well as using the solar energy.

The cognitive restructuring conclusion of the method of sustainable development of energy: This group presented the guideline of sustainable development of energy in term of energy saving or conservation as follows:

1. Study the geometry of country in order to seek new sources of energy
2. Survey the remaining energy
3. Discover other sources of energy such as garbage, natural gas, ethanol.
4. Study the energy demand
5. Survey the growth of population
6. Draft plans from the information
7. Ask scientist to invent new energy gathering machinery
8. Construct the solar cell plate
9. Generate energy from the survey information
10. Invent the useful equipment or energy involved tools
11. Discover from nature (that will not exhausted) such as transforming sunlight to any kinds of energy
12. Invent and find out new sources of energy in place of loosing energy
13. Discover the methods that transform useless things to be energy
14. Invent the accessories that consumes less energy
15. Disclose the inventions in exhibition
16. Educate students about the advantages and disadvantage of energy
17. Disclose the knowledge about energy to public
18. Disclose the economic and suitable usage of energy
19. Establish the energy conservation associate
20. Perform as precedent in energy usage.

Group 3: There are Sayamon, Huttaya and Kanokporn. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

This group thought about saving the energy that implemented by educating about the energy, energy savings, exhibit and guide the energy usage and find the substitute energy.

The cognitive restructuring conclusion of the method of sustainable development of energy:

1. Education

1.1 Educate people abut energy, advantages and disadvantages form energy usage

1.2 Arrange youth camp in order to widely distribute knowledge

1.3 Arrange the competition subject to energy such as compositions, drawings, discussion, demonstration

1.4 Arrange energy exhibitions

1.5 Guide the way of suitable usage of energy

1.6 Establish the energy usage to children and public

1.7 Arrange contest subject to energy conservation in order to force eager

2. Science and technology

Invent the energy restoration tools and find out the source of energy generation.

3. Plan for energy usage

Step 1: Manage the national utilities and resources as regards number of members in a house, how much electricity and water should be used. The government should regulate how much water should supply to each house within a week without adaptation.

Step 2: Issue law for vehicle such as one car must have at least 3 passengers, or right for car buying such as a house that has four members cannot belong more than two cars.

Step 3: Control the growth of population to suit for the country resources by determine that a couple cannot have more than three children and this depends on housing income such as

- The housing income is between 0 – 8,000 baht a month can have 1 child.
- The housing income is between 8,000 – 12,000 baht a month can have 2 children.
- The housing income is more than 12,000 baht a month can have at most 3 children.

Step 4: Arrange the day of natural resource such as forest restoration for a while as appropriate.

Group 4: There are Sirinthip, Krongjit and Premika. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

The method of sustainable development of energy is in term of energy conservation that started the cooperation, united for cooperation in changing the behavior that waste the resource, education, technology.

The cognitive restructuring conclusion of the method of sustainable development of energy:

1. Invent the equipment that consume less natural resources but produce more productivity
2. Invent to recycled the useless material
3. Invent the equipment that consume less energy but produce more benefit
4. Invent the tools that use natural energy instead of general energy
5. Educate children about advantages and important of world resource
6. Educate about worthy usage of energy
7. Educate to discover substitute energy instead of exhausted energy
8. Plan the procedure for comprehensive education about world resource
9. Plan for recycle the useless resources
10. Determine the way of worthy energy usage
11. Plan for cyclically use the resource

Group 5: There are Lookpla, Chutima and Laddawan. They expressed the cognitive conflicts and reflection in form of their opinion as follows:

This group has guideline of sustainable development of energy is to start at family level that the usage of energy must be worthy and practice as precedent. We must always think about advantages and disadvantages of energy usage. The

innovation for facilitating ways of living, which is energy saving. The energy usage guideline must be educated to public and there must be population control plan.

The cognitive restructuring conclusion of the method of sustainable development of energy:

1. Plan for the problems from electricity consumption and emphasized to the family level. It should be educate the family how to save energy and spread out to community. The example of conservative energy utilization are

1.1 Use economic-label appliances

1.2 Don't simultaneously use those appliances

1.3 Read and follow the instructions

1.4 There should be easily air-flow, lighten and plant around house in order to not using air-condition

1.5 Choose the proper appliance to the family size

2. Disclose the scientific concept about energy problems public through media so they realize the problems and future usage.

3. Educate the people about the problems and guide the problem-solving including establish the conscious in valuable energy usage.

3. The Body of Knowledge in Sustainable Development of Energy

The researcher assembles the body of knowledge that students construct during process the activities into 4 issues.

1. The importance of energy
2. The energy problems
3. The sustainable development of energy
4. The method of sustainable development of energy

1. The body of knowledge of the importance of energy

The body of knowledge, which the researcher expected, is that energy can transform to other shape and the energy is important to human life that the sample can construct the body of knowledge as:

Energy is generated by nature that man can manage the transformation in order to facilitate for living. Entire energy has relation in transformation that is important. There are conclusion of important, properties, advantages and disadvantages.

1) The important energy is solar energy that can be used for plant synthesis and result to be food and the oxygen is its byproduct. Sunlight involves the ways of living because it provides warmness, seeing, food preservation. Its energy can transform into other form so that food, clothes and anything that facilitate ways of living.

2) The energy parallels advantages and disadvantages. The advantages of energy is used for country development especially the economic development has to used large amount of energy. Moreover, energy facilitates and involves ways of living since food, transportation, communication, but the energy utilization reflect to the environmental impact such as air pollution, noise, etc. that damage the creatures, physical health and sources of natural resource.

3) Energy can transform into other forms. The important source of energy is sunlight that can transform into electricity that lightens, facilitates using for cooking, air conditioner, and other appliances. Beside this electricity is beneficial in industrial sector. It can transform to mechanical energy that causes the movement, transportation and voice energy.

This world is the large ecosystem that comprises of plant, animal and human those are related and connected by energy.

2. The body of knowledge of the energy problems

The body of knowledge, which the researcher expected, is the major energy problems are:

1) The worthless utilization of energy those waste the energy

2) The energy generation problems that impact the environment

The samples well construct body of knowledge and better than expected and it can be describe as follows:

Energy is crucial. Invaluable energy usage will cause problems, which come from unconsciously utilized as the leakage that loose the benefit although some sources of energy are exhausted. Human behavior, which compares to the hole, hurries the depletion. The energy usage problems destroy the environment that influences to ways of living, career. The energy problems can segregate to:

1) Energy problems form utilization resulted from worthless utilization. The daily energy utilization effect to the environment such as the air pollution from fuel combustion though from cars, vehicles and industries. The careless energy usage will cause the environmental impacts such as oil leakage into the sea will damage the animals because oxygen cannot infiltrate to the water then the animals will die. This cause the economic, export and then impact to human livings

Careless energy usage cause waste utilization. The oil and gas leakage can be fired or cause accident as was happened in the past.

Human behavior cause the worthless utilization because things we use today entirely has to use energy for production. Careless energy utilization such as one-sided paper usage, driving alone, lighting or water leaving, etc.

Some sources of energy are limited. Every country must use but some countries have oil so those countries integrate and rise up the price. This effect to the country balances especially the country that has economic problems like Thailand. The cost of living will rise up. Those are the problems that all come from energy usage.

2) The energy generation problems come from the energy substitution, which may cause environmental impact and the public resistance and rebellion. The example of this issue is the rebellion of the Thai-Malaysia natural gas pipeline, which there was contradiction form two groups of people or the resistance of dam construction for generating electricity those has to cut down the forest which is the wild animals ecosystem.

While man generates energy, the environment will be destroyed so that there is resistance of the native people. In case of Thai-Malaysia gas pipeline, the resistor thought that this project would destroy their environment and Thailand is not suitable situation for gas pipeline and gas separation plant construction regardless the advantages. The advantages of this project are it will provide us substitute energy and the energy will lead the technology. So the energy depletion will cause country slowly develop.

The problem of energy generation is important especially in outsourcing substitute energy as well as the environmental impacts that come from those generation.

3) The deterioration of human spirits dues to the convenience and result in competition and invaluable merit.

3. The body of knowledge of the sustainable development of energy

The researcher expected that the sustainable development of energy is though economic and valuable energy utilization and to discover new sources of energy. The samples constructed the body of knowledge as expected.

The sustainable development of energy is the event that there is energy can be used forever by planning the energy utilization because it can be exhausted. People must save the energy, carefully utilize and prepare for the problems by outsourcing substitute energy.

The sustainable energy of energy would have cooperation and everyone must carefully use it and think about the effects because the energy is important for living and country development at the same time it also impact the environment.

The important sources of energy is the sunlight and garbage which has no impact to the environment and reduce the garbage problems

There are two sources of energy. The exhausted energy and endure energy. Both of them affect the sustainable development of energy. The energy utilization of that exhausted energy should be planned for long run. Everyone should discover substitute energy and develop the endure energy. The sustainable development processes are:

- Plan the energy utilization
- Develop or outsource the endure substitute energy

There are two concepts of sustainable development of energy

1. The economic and valuable energy usage by uses only the necessity.
2. Outsourcing substitute energy with science and technology. The current and future energy is the solar energy.

4. The body of knowledge of the method in sustaining development of energy

The expected body of knowledge is energy conservation that comprises of three processes.

1) Educating to public in order to valuable and worthy usage
2) Increasing efficiency by using science and technology for conserve the energy
3) Planning for worthy usage of energy

The samples construct the body of knowledge better than expected.

The guideline of sustainable development of energy is to discover methods to conserve the energy. These are three ways for energy conservation.

1) Educating so as change the behavior of energy usage

(1) Disclose and educate children about energy in order to can use daily and transfer to adults.

(2) Invent and advertise advantages to public about how to economically use energy

(3) Establish the associate or project in energy conservation in order to be precedent of the right energy user

(4) Arrange youth camp so as to widely publicize the knowledge

(5) Arrange the competition in subject of energy such as slogan, composition, drawing, discussion, exhibition

(6) Arrange the energy conservation contest

(7) Educate the worthy usage of the world energy

(8) Educate the children about the problems, problem solving and establish consciousness

2) Using science and technology for increasing efficiency in order to saving energy

(1) Construct the vehicles that can load large number of passengers though using less energy

(2) Develop tools so as to use less energy while produce more productive

(3) Develop the endure natural resource to be substitute energy such as solar and garbage energy

3) Planning for long run energy. Those plans are the energy usage plan, living plan, and utilization plan as well as behavior adjustment in order to reduce loosing energy.

(1) Plan for the most right, saving and beneficial usage

(2) Manage and control factories the energy consumption efficiency

(3) Systematically allocate energy usage

(4) Issue law in efficient energy usage control

(5) Plan the comprehensive lesson about the world natural resource for public

4) Controlling the growth of population because more population will be more energy consumption.

4. The Learning Activities Problems

This educational plan was only approved by the expertise without former implementation due to the limited time for thesis completion. The researcher tried to improve the education plan. Though there is no result from this plan, the researcher has basically tested this plan so that find out some problems such as too large paper in drawing for imagine and mind mapping activities will take too much time than the assignment. If there are tests for primary educational plan will provide the students potential that researcher can improve for suitable educational plan. So the primary test for educational can raise the efficiency of education in constructivism.

CHAPTER V

DISCUSSIONS

The purpose of this experiment is to study the result of body of knowledge construction in sustainable development of energy. The result is correspondent to the specified assumption, which is the students learned by using constructivist theory, and they can construct the body of knowledge in sustainable development of energy. That might cause by:

1. The arranged education activities followed the constructivist theory are the activities that support to learners' social interaction, which proceeded by working group. They can discuss, reflect and choose the idea that was accepted.

2. The body of knowledge construction uses the factor, which the instructor prepared situation, problems, questions, that is consistent to the Biggs' discovery (Biggs, 1968 :217) that the learners can discover new knowledge if the instructor provides them the equipment and situation that the learners will create the cognitive conflict that induce motivation and reflection. Then they finally can restructure new cognition.

Despite they can construct the body of knowledge in sustainable development of energy, they can better construct the body of knowledge than expectation. This may be resulted from

1. Someone has cognitive structure about environmental education more than others because they had joined the environmental camp or personally interested, which is the internal motivation and induces to have more complex in cognitive structure resulted to higher quality of body of knowledge than standard.

2. Some of samples well interact with others. Some are sprout to discuss without fearing to fault or unaccepted so this group will better construct body of knowledge than others.

3. The samples' willing is including the background of responsive and serious students who are older than ages or have more experience than others are. These can construct more the body of knowledge than their specified.

The difference of samples' background communication, social interaction, sprout in expression, older matters, responsibility and experience have no effect to the expected body of knowledge construction but those effect to the higher cognitive restructuring than specified.

The body of knowledge construction in this study is the descriptive knowledge in self-consider and practical level. Some parts of the concept are the in social point of view. If there are implementations, it will be advantage for the energy conservation. The body of knowledge will mainly comprise from existing experience that stimulated by educational media. The body of knowledge that they construct will value for changing worthless energy utilization behavior from themselves. This research is not target to the understanding new theory of the sustainable development that the cognitive conflict gap between the new information and existing experience is too wide that induced to the avoidance of comprehensive and no cognitive restructuring.

This thesis only objects to construct the descriptive constructivism though there are several types of constructivism such as the experimental constructivism. The reason is this thesis object to change the target group's concept for the sustainable development of energy concept that is the main purpose of the environmental

education. The descriptive constructivism will show the way of thinking of the target group that will result to future behavior. The constructivism of sustainable development of energy can use the experimental constructivism that processes the activities with the science know-how. This will reflect more tangible study result and good for further energy conservation activities.

The new theory creativity step in constructivism of sustainable development must choose the samples that has deeper experience such as qualification, maturity and more complex of existing experience. There are not many persons that have all those characters more than the samples of this thesis. So only the expertise can contributes themselves to the events and used to the experience can access of new theory in sustainable development. Other causes of the problems of new theory or constructivism may be the media that less or unclearly introduce know-how to public, which are the important parts of basic knowledge construction and existing cognitive structure.

The learning activities in sustainable development of energy can be founded that the target group can reflect their opinions that represent to their performance that the guideline for sustainable development of energy has to control the number of population because of more population will increase the energy consumption. The constructivism that the target group construct is better than objectives because the basic knowledge or the familiar. Beside the population control, it should have development control because the development will consume more energy. This target group cannot access to this problem may be resulted from the situation preparation or educational media or other framework is not adequate for those knowledge.

The constructivism is comprise of existing experience with problem situation that make self cognitive conflict and interpersonal cognitive conflict after interaction and reflection then create new knowledge. It's quite good if there is some support for further self-study. If this constructivist is right, it can make them secure their cognitive structure or if this constructivist is wrong, it will make them reflect and finally lead to modify their cognitive structure.

This research can be found that the target group behavior is consistency to the constructivist. Their behavior during the research shown that they pay important to energy such as there are some warning to others about eating all of food because it have to use energy for cooking. If they keep this behavior it will result to further energy conservation. This is the good step of beginning. So, it should be study whether and how long the behavior after they construct the body of knowledge is consistency to their constructivism.

The result of the study shows that the target group can construct the constructivism as specify in context. The researcher hopes that the target group construct without specific opinion and moral. However, the researcher found that their opinion and moral are quite good and consistent to the context of the body of knowledge.

CHAPTER VI

SUMMARIES AND RECOMMENDATIONS

This research is to study the body of knowledge construction in sustainable development of energy with the constructivist theory by Mathayomsuksa 4 students.

The Research Objectives

To Experiment the learning process by applying the Constructivist Theory in sustainable development of enerty.

The Assumptions of Research

The students who study the Constructivist concept can construct the body of knowledge of sustainable development of energy.

The Research Instruments

The research instruments are four educational plans of sustainable development of energy by constructivist theory, which totally use twelve periods.

1. The importance of energy uses 3 periods;
2. The energy problems uses 3 periods;
3. The sustainable development of energy uses 3 periods;
4. The method of sustainable development of energy uses3 periods

The Research Methodology

1. Making relation with students before teaching in the first two weeks.
2. Processing the teaching activities on Thursday, one day a week , three periods each day since week 3 through week 6
3. Daily collecting data since the first week through the sixth week

The Data Collection

The data collection methods were observation, interview and studying from working order and learner's critic then summarized to construct the body of knowledge in sustainable development of energy

The Results of Study Conclusion

The result of the experiment in order to study body of knowledge construction in sustainable development of energy with constructivist theory by collecting the qualitative information is found that the constructivist theory can help students in constructing the body of knowledge in sustainable development of energy as expected.

The sample well constructed the body of knowledge because there are some parts better than the expectation.

1. The body of knowledge of the importance of energy

The expected body of knowledge is energy can transform into other form so the energy is importance for living

2. The body of knowledge of the energy problems

2.1 The expected body of knowledge is the major problems of energy are

1) The worthless utilization of energy those waste the energy

2) The energy generation problems that impact the environment

2.2 The body of knowledge that the samples construct is the careless utilization induces extreme accident and damages the environment. This body of

knowledge is better than the expectation that the energy deteriorate human mental because it facilitates human and cause of the competition.

3. The body of knowledge of the sustainable development of energy

The expected body of knowledge is the economical and valuable energy utilization and to develop the substitute energy.

4. The body of knowledge of the method in sustaining development of energy

4.1 The specified body of knowledge is the method in sustainable development of energy that is energy conservation that comprises of three processes.

1) Educating to public in order to valuable and worthy usage
2) Increasing efficiency by using science and technology for conserve the energy
3) Planning for worthy usage of energy

4.2 The samples construct the body of knowledge better than expected that it will be happen while controlling the growth of population is effective.

It can be concluded that the samples can construct the body of know as expectation and some parts are over the expectation. Moreover the researcher found the target group behavior that is consistent to the context of their body of knowledge. This can be shown that the opinions and moral are support to the sustainable development of energy, which lead to environmental impact problem solving.

Recommendations

1. It can be found that if the samples well interact with social, courage in expression, responsiveness and have more experience can better construct the body of knowledge by using constructivist theory. So the instructors and who has responsibility in education should support the learners to express, to develop communication and social skill, to responsive and to reinforce the experience in order to construct the body of knowledge for solving environmental problems.

2. It should be supported and sponsored the instructors to manage the education plan by using constructivist theory to other subjects so as to be beneficial for educational development especially in science, environmental science, biology, chemistry and physics those are hardly understand. Some subjects are intangible such as the internal creature energy in the subject of biology of Mathayomsuksa 5. The instructors should have additional educational media for example CAI and should prepare problems, which have more branches and the learners can also construct the body of knowledge.

3. All innovation techniques that consist of AIC, Participatory Learning, Storyline and Mind Mapping can well support the construcitivism. So it should be used for other subjects of education.

4. It should be further study after the target group construct the body of knowledge of sustainable development of energy whether this constructivism can really change their behavior.

5. It have to use the existing experience and interpersonal in construction the constructivism of sustainable development of energy in order to

secure the cognitive restructure and create nice constructivism. So it should be supported the study and sources of knowledge.

6. The learning activities in guideline of sustainable development of energy show that the target group reflect their performance whereas the prepared factor is problem situations and the educational media is not favor for construct the higher specification body of knowledge. The target group found that the guideline for sustainable development of energy is population control. However they cannot access the development control as a guideline for sustainable development of energy because more development will increase energy consumption. This is important and interesting concept. If the teacher prepare more suitable situation and media as well as not too much limitation or widen of frame work, the researcher assures that this target group can constructivist this topic.

7. This educational plans were only approved and evaluated by the expertise without primary former implementation so it cannot be found the level of target group performance that cause the higher expectation constructivism. If there are tests for primary educational and improve for suitable educational plan, it will raise the efficiency of education in constructivism.

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APPENDIX

- Educational Plan
- Teaching Evaluation Form
- Example Figures of Activities
- Example Drawing leading by Imagination and Mind Mapping
- Name of Expert

EDUCATIONAL PLAN 1

Subject The Important of Energy.

Concept The energy is crucial for human. all current living and working situation must rely on energy.

The Learning Objective

1. The students can describe meaning and characteristic of the energy.
2. The students can explain the relation between forms of energy.
3. The students can explain the important of energy to life.

Context

1. The characteristic of Energy.
2. The relation between forms of energy.
3. The important of energy to life.

The Learning Activities

Part1 ***The activity for construct the meaning, characteristic of energy and its relation.***

1. Step of cognitive conflict

Separate 3 students for each group. Let the groups draw a picture from their imagines that come from the card specification, which teacher gives by these steps.

Step 1 Lets the students draw scene from card1.

1. Scene is the glass dome that human create for experiment. There is a big water supply that experiment to cultivate plants and domesticate animals without outside dome interferes. There is only sunlight through the glass because the energy is limited and nearly exhaust.

Step 2 Draw the actors from card 2.

2. The actors are the scientists that experiment about energy such as using the thermal energy to cook and using solar energy for producing clothes, etc. The scientists live in the dome with other living creatures that they create.

Step 3 Draw the living style from card 3.

3. Determine living style: The scientist will live inside the dome around 1 month with the experiment that they will not bring food or others from outside. They can only live with the factor inside dome.

Step 4 Draw special event from card 4.

4. The special event: The scientist goes into dome in one day. While he goes outside, the mechanical control does not work so he is stuck inside forever. How can they survive?

2. Step of reflection

2.1 The students conclude the group opinion that how can the scientist survive while they live in the dome.

2.2 The representatives of each group present the idea about how can the scientist survive while they live in the dome to the class.

2.3 Let the students answer the questions in card 1.

3. Step of cognitive restructuring

The students of each group present the meaning, character and relation of energy form from card 1 to class.

Part2 ***The activity to construct the importance of energy.***

1. Step of cognitive conflict

Let the students do the scenario activities for next 32 years while the crude oil will be expired. Each student writes what can happen for 10 items.

2. Step of reflective

2.1 Separate every 3 students to a group to conclude and write down 10 ideas the events that can happen while the crude will be expired in next 32 years and draw a picture by their imagination.

2.2 Presentation by the representatives of each group about the probable event with their drawing.

3 STEP OF COGNITIVE RESTRUCTURING

Let the students restructure the cognitive by doing these activities.

3.1 Let the students show ideas about the important of energy.

3.2 Let the students brainstorm to find out the important of energy for human living and conclude to be a concept.

3.3 Write down the concept of the important of energy at the center and draw branches.

3.4 Draw the linkage of those concepts. The bigger concept will near the center. The branch concepts will be further. They should use word as unite such as 1-line 1-word, and use color to help their remembrance and generate creativity.

The Education Media

1. Drawing paper
2. Crayon
3. Form 1
4. Card 1, 2, 3 and 4

The Performance Evaluation

1. During Classes

1.1 Observe the participation in drawing the imagination about the meaning, characteristics and relation of energy forms.

1.2 Observe the participation in doing the scenario activities and present the ideas by observe the situation of next 32 years

2. After Class

Observe and interview more about the important of energy.

FORM 1

1. Do you believe that the scientists can use the solar energy for cooking, why?

2. Do you believe that the scientists can use the solar energy for producing clothing, why?

3. What is the importance of water?

4. What is the importance of the sunlight?

5. What is the importance of plants?

6. What is the importance of animals and human?

7. What is the energy relation between water, plants and sunlight?

8. What is the energy relation between water, plants, sunlight, animals and sunlight?

9. What is the energy?

10. What is the relation between each form of energy?

WORK ORDER CARD

CARD1

1. Scene is the glass dome that human create for experiment. There is a big water supply that experiment to cultivate plants and domesticate animals without outside dome interferes. There is only sunlight through the glass because the energy is limited and nearly exhaust.

CARD2

2. The actors are the scientists that experiment about energy such as using the thermal energy to cook and using solar energy for producing clothes, etc. The scientists live in the dome with other living creatures that they create.

CARD3

3. Determine living style: The scientist will live inside the dome around 1 month with the experiment that they will not bring food or others from outside. They can only live with the factor inside dome.

CARD4

4. The special event: The scientist goes into dome in one day. While he goes outside, the mechanical control does not work so he is stuck inside forever. How can they survive?

EDUCATIONAL PLAN 2

Subject THE ENERGY PROBLEM : 3 periods

Concept The energy problem means that the environmental effect and the utilization of energy that comes from energy generation.

The Learning Objective

1. The students can explain the environmental impact from energy generation.
2. The students can analyze the environmental impact from energy utilization.
3. The students can analyze the fuel and energy problem situation.

Context

1. The fuel and energy problem situation.
2. The environmental impact from energy generation.
3. The environmental impact from energy utilization.

The Learning Activities

1. Step of cognitive conflict

1.1 Teacher shows the picture of leakage oil tank and let the students write their opinions and answer the question.

1.2 Teacher plays the videotape of the rebellion at Songkhla about the Thai- Malaysia Pipeline and let the students answer the questions in Card2 that what are the key reasons of this event.

2 Step of reflection

2.1 Separate 3 students for each group. Let the groups conclude their ideas about the energy relation to the picture of oil leakage tank and the rebellion of Thai-Malaysia pipeline.

2.2 Let the group's representative present their opinion what is the relation of energy to the oil leakage tank and the Thai-Malay pipeline rebellion.

3 Step of cognitive restructuring

Let the students construct mind mapping by these following steps.

3.1 Let each group discuss about what are the energy problems in their opinion.

3.2 Let each groups brainstorm to find out and conclude the concept of the energy problems.

3.3 Write down the concept at the center and drag branches as minor concepts.

3.4 Draw the linkage of those concepts. The bigger concept will near the center. The branch concepts will be further. They should use word as unite such as 1-line 1-word, and use color to help their remembrance and generate creativity.

The Education Media

1. The picture of the Thai-Malaysia pipeline rebellion
2. The picture of the oil leakage tank
3. Form 1, 2
2. Videotape of the Thai-Malaysia pipeline rebellion news

The Performance Evaluation

1. During Classes

1.1 Observe the participation in drawing the imagination about the relation of the oil leakage tank picture to the energy.

1.2 Observe the participation in drawing the imagination about the relation of the picture of the Thai-Malaysia pipeline rebellion at Songkhla to the energy.

2. After Class

Observe and interview more about the problem situations of fuel and energy.

FORM 1

1. What do you think about while you see the oil leakage tank?

2. Why do you think about that thing?

3. Is this picture advantage or disadvantage for human being?

4. The oil actually can be expired, What accelerate the expiration?

5. Which human behavior is the comparison to the leakage?

6. What is the energy problem that can be found from this picture?

FORM 2

1. What is the reason of the rebellion at Songkhla related to the resistance of Thai-Malaysia pipeline?

2. From this picture, what is the disadvantage to human?

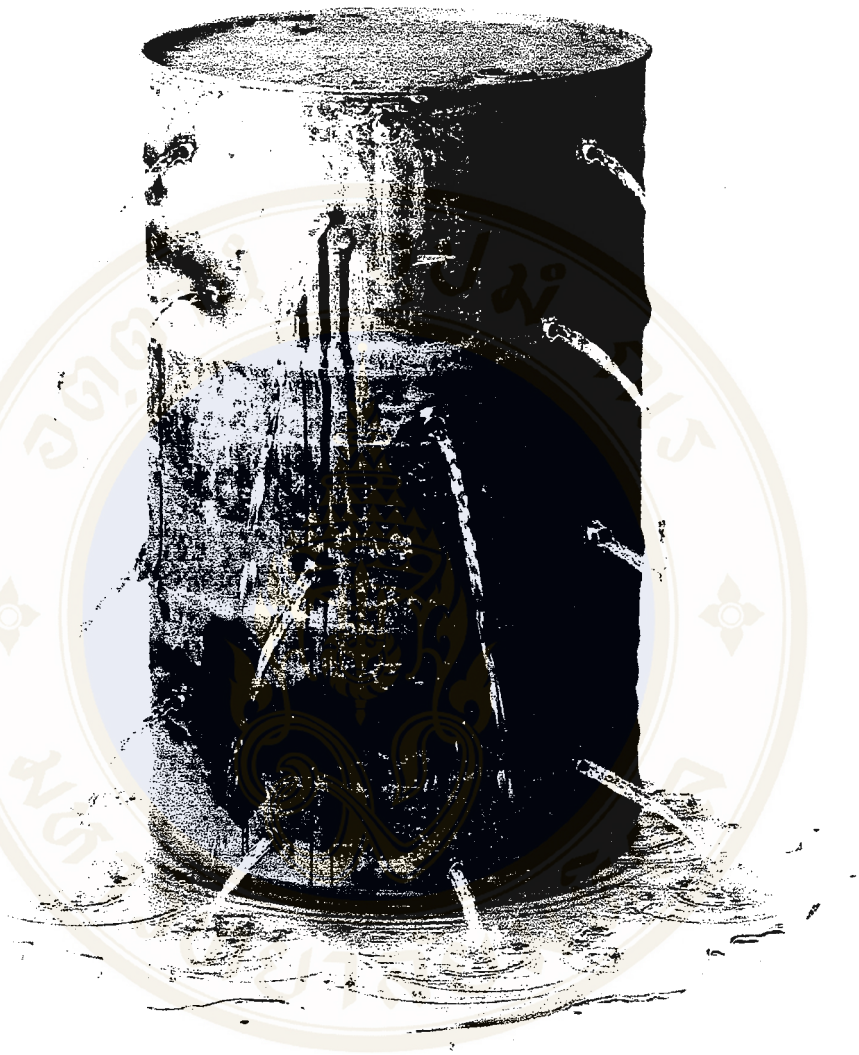
3. What is the possible reason of the people who resist the Thai-Malaysia pipeline?

4. Is this picture related to energy?

5. Is the substitute source of energy important, why?

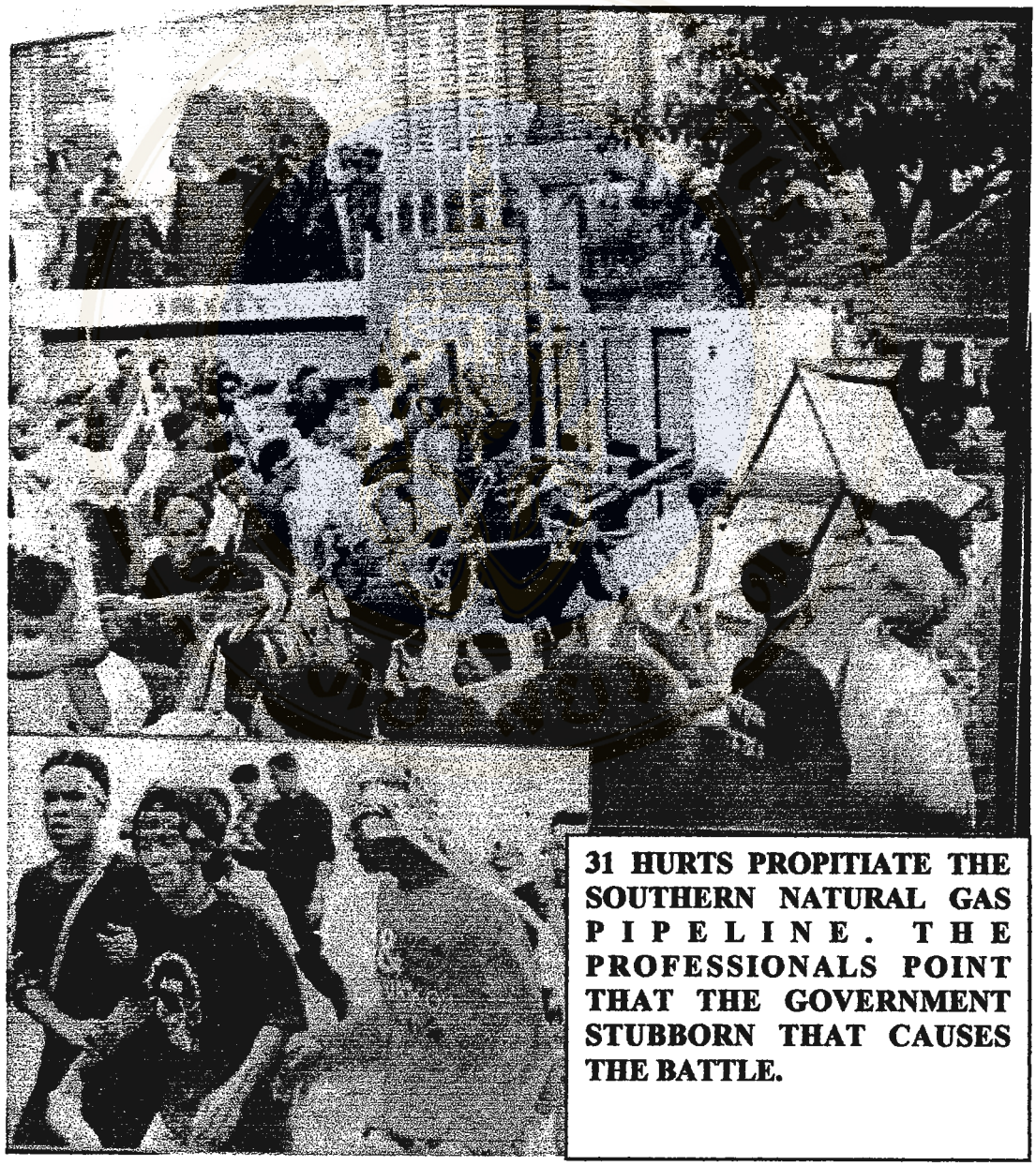
6. Do the energy generation and utilization cause the impact, how?

7. What is the energy problem in this picture?



THE PICTURE OF OIL LEAKAGE TANK

THE regret of the villagers split into 2 sides ended with blood, 31 hurts propitiate the southern natural gas pipeline. The professionals point that the government stubborn that causes the battle.



31 HURTS PROPITIATE THE SOUTHERN NATURAL GAS PIPELINE. THE PROFESSIONALS POINT THAT THE GOVERNMENT STUBBORN THAT CAUSES THE BATTLE.

EDUCATIONAL PLAN 3

Subject the sustainable development of energy : 3 periods

Concept The responsive development, careful utilization and searching for substitution, of current energy demand in order to less the effect to next generation is the sustainable development of energy.

The Learning Objective

1. The students can describe meaning of sustainable development of energy.
2. The students can explain the concept of sustainable development of energy.

Context

1. The meaning of sustainable development of energy.
2. The concepts of sustainable development of energy.

The Learning Activities

Part1 **The activity for construct the meaning of sustainable development of energy.**

1. Step of cognitive conflict construction

Present the energy source selection for generating electricity from the following sources.

1. Oil
2. Coal
3. Nuclear
4. Hydro
5. Solar

6. Garbage

7. Natural Gas

8. Ethanol from plants

Let each student select the best energy source in the world and write down the reason of the selection and answer the question in Form1.

2. Step of reflection

After the students select the energy source then separate 3 students for each group. Let the groups brainstorm for the best answer.

3. Step of cognitive restructuring

Let the students explain the meaning of sustainable development of energy.

After the activity, then further the activity of sustainable development of energy concept construction.

Part 2 ***The activity to construct the concept of sustainable development of energy.***

1. Step of cognitive conflict construction

The teacher distribute documents for presenting the views of three men, those are

1. NUT's view
2. NU's view
3. NOP's view

The students can select that who wants to be who in these three men and write down their reason of selection and answer the question in Form1.

2. Step of reflection

While the students select the person they want to be then separate three of them to group in order to brainstorm for the best selection by following these steps.

2.1 Let the groups conclude their ideas for the group selection.

2.2 Let the group's representative present their opinion about the group selection to class

3. Step of cognitive restructuring

Let the students construct mind mapping by these following steps.

3.1 Let each group discuss about what is the sustainable development of energy in their opinion.

3.2 Let each groups brainstorm to find out and conclude the concept of the sustainable development of energy.

3.3 Write down the concept at the center and drag branches as minor concepts.

3.4 Draw the linkage of those concepts. The bigger concept will near the center. The branch concepts will be further. They should use word as unite such as 1-line 1-word, and use color to help their remembrance and generate creativity.

The Education Media

1. The views of three men
2. Form 1
3. Drawing paper
4. Crayon

The Performance Evaluation

1. During Classes

1.1 Observe the participation in selection of energy source in order to explain the meaning of sustainable development of energy.

1.2 Observe the participation and ideas sharing in people selection.

2 After Class

Observe and interview more about the sustainable development of energy.

VIEWS OF THREE MEN

1. NUT'S VIEW

Have you heard that " Everything can change" like as our life.

We are normally born. Nobody excepted.

We are normally old. Nobody excepted.

We are normally ill. Nobody excepted.

We are normally died. Nobody excepted.

This can be compare to the earth that must be changed. Oil is the important source of energy that we use today and it can be exhausted in one day. It is going to expired, sooner or later is depend on however we use. But it should not be afraid because human is so wise to handle.

2. NU'S VIEW

I know that nowadays we have a lot of problems. An activity must result to others. Have you heard that "Plucking the flowers shakes stars". The lignite that we use for generating power contains sulfur dioxide that causes the air pollution. The oil production causes the environmental impact. Moreover there is not enough energy for long life. I regret for the kids that they will face the problems that bigger than I can handle. What I do today is proceeding my suitable life even sleeping, eating and carefully behave.

3. NOP'S VIEW

I am scientist. I have abundance of knowledge about energy that you may not know. The solar energy can separate to 5 groups.

1. Reflected to the space without usage about 30%.
2. Absorbed by earth (keep balancing) about 47%.
3. Earth gravity about 22%
4. Wind wave 1%
5. Photosynthesis less than 1%

Coal and oil are energy, which come from plan's photosynthesis that is accumulated less than 1% of solar energy. They use 200 – 600 million years for transforming to be coal and oil. Have you know that the reflected energy is plentiful. I will send satellite for receiving the solar energy surrounding the earth all days and nights. We will forever have energy.

FORM 1

1. Who is your choice?

2. Why this person is your choice?

3. What are the advantages of this person?

4. Who is going to be the cause of disadvantages in the future?

5. Who is being the most advantage in present through people in next generation, and why?

6. Do you insist the person in question 1 or would you like to change the answer, why?

_____

_____

7. What is the sustainable development of energy in your opinion?

_____

_____

8. What is the relation of the picture you select and the sustainable development of energy?

_____

_____

EDUCATIONAL PLAN 4

Subject The method of sustainable development for energy : 3 periods

Concept The energy conservation method is the sustainable development of energy by means of scientific and technology, management planning for energy utilization and educating people for adjusting the behavior.

The Learning Objective

1. The students can explain the guidance for energy conservation.
2. The students can explain the implementation guidance that can sustain the development of energy.

Context

1. The guidance for energy conservation
2. The implementation guidance that can sustain the development of energy

The Learning Activities

1. Step of cognitive conflict construction

Separate 3 students for each group. Let the groups draw a picture from their imagines that come from the card specification, which teacher gives by these steps.

Step 1 Lets the students draw scene from card1.

1. Scene is Thailand in year 2600 B.E..

Step 2 Draw the actors from card 2.

2. There are 3 actors.

1. The scientist

2. The planning department manager

3. The teacher

Step 3 Draw the living style from card 3.

3. Determine living style: All Thai living style involves to the energy. More driven the economic, more energy demand careless the limited of energy.

Step 4 Draw special event from card 4.

4. The special event: One day the limited sources of supplies that will expired in next five years. We cannot find new source of substitution. What will you do in order to belong the lifetime of energy and to find out the new substitution sources if you all are leader?

2. Step of reflection

2.1 The students conclude the group opinion if they are the group leaders.

2.2 The representatives of each group present the idea if they are the group leaders.

3 Step of cognitive restructuring

Let the students restructure the cognitive by doing these activities.

3.1 Let the students show ideas how can they prolong the limited sources of energy.

3.2 Let the students brainstorm to find out the ideas how can they prolong the limited sources of energy.

3.3 Write down the concept of the important of energy at the center and draw branches.

3.4 Draw the linkage of those concepts. The bigger concept will near the center. The branch concepts will be further. They should use word as unite such as 1-line 1-word, and use color to help their remembrance and generate creativity.

The Education Media

1. Drawing paper
2. Crayon
3. Card 1, 2, 3 and 4

The Performance Evaluation

1. During Classes

Observe the participation in drawing the imagination and presenting their ideas about the guidance for sustainable development of energy.

2. After Class

Observe and interview more about the guidance of energy conservation and the implementation for sustainable development of energy.

WORK ORDER CARD

CARD1

1. Scene is Thailand in year 2600 B.E..

CARD1

1. Scene is Thailand in year 2600 B.E..

CARD2

2. There are 3 actors.
   1. The scientist
   2. The planning department manager
   3. The teacher

CARD3

3. Determine living style: All Thai living style involves to the energy. More driven the economic, more energy demand careless the limited of energy.

CARD4

4. The special event: One day the limited sources of supplies that will expired in next five years. We cannot find new source of substitution. What will you do in order to belong the lifetime of energy and to find out the new substitution sources if you all are leader?

EVALUATION FORM
The educational plan for the sustainable development of energy for Mathayomsuksa 4

Instruction This evaluation form consists of 15 evaluation items. There are 5 scales for each item:

4.50 – 5.00	Mean	Strongly agree
3.50 – 4.49	Mean	Agree
2.50 – 3.49	Mean	Somewhat agree
1.50 – 2.49	Mean	Disagree
1.00 – 1.49	Mean	Strongly agree

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1. Which Scale that the objective is related the context?
   - ☐ Scale 1
   - ☐ Scale 2
   - ☐ Scale 3
   - ☐ Scale 4
   - ☐ Scale 5

Suggestion_____
_____

2. Which Scale that the context is properly allocated?
   - ☐ Scale 1
   - ☐ Scale 2
   - ☐ Scale 3
   - ☐ Scale 4
   - ☐ Scale 5

Suggestion_____

3. Which Scale that the context and activities in educational plan for sustainable development are assigned?
   - ☐ Scale 1
   - ☐ Scale 2
   - ☐ Scale 3
   - ☐ Scale 4
   - ☐ Scale 5

Suggestion_____

4. Which Scale that the context and activities in educational plan for important of energy are assigned?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

5. Which Scale that the context and activities in educational plan for energy problem are assigned?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

6. Which Scale that the context and activities in educational plan for sustainable development of energy are assigned?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

7. The activities is consistent to the constructivism theory in which Scale ?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

8. The activities of the cognitive conflicts construction are properly used in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

9. The construction activities of the cognitive conflicts and reflection caused the cognitive restructuring (Constructivist) in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

10. The educational activities result to the solutions for environmental impact in energy in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

11. The educational activities consist to the students center concept in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

12. The educational media support the body of knowledge construction in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

13. The evaluation consists to the objectives in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

14. The educational plan support to the body of knowledge construction in which Scale?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

15. The language proper in which Scale ?

- ☐ Scale 1
- ☐ Scale 2
- ☐ Scale 3
- ☐ Scale 4
- ☐ Scale 5

Suggestion_____

Signature.....

(.....)

Position .....

Date of evaluation ...../...../.....

แบบประเมิน

แผนการสอนการพัฒนาแบบยั่งยืนในด้านพลังงานระดับชั้นมัธยมศึกษาปีที่ 4

คำชี้แจง แบบประเมินนี้ประกอบด้วยรายการประเมิน 15 รายการแต่ละรายการกำหนดผลการประเมินเป็นมาตราส่วน โดยแบ่งเป็น 5 ระดับ คือ

ระดับ 1 หมายถึง	ควรปรับปรุง	(มีคะแนนระหว่าง 1.00 – 1.49)
ระดับ 2 หมายถึง	พอใช้	(มีคะแนนระหว่าง 1.50 – 2.49)
ระดับ 3 หมายถึง	น่าพอใจ	(มีคะแนนระหว่าง 2.50 – 3.49)
ระดับ 4 หมายถึง	ดี	(มีคะแนนระหว่าง 3.50 – 4.49)
ระดับ 5 หมายถึง	ดีมาก	(มีคะแนนระหว่าง 4.50 - 5.00)

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1. จุดประสงค์มีความสัมพันธ์กับเนื้อหาและการจัดกิจกรรมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

2. การแบ่งเนื้อหาที่จัดทำแผนการสอนมีความเหมาะสมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

3. เนื้อหาและกิจกรรมการเรียนการสอนเรื่องการพัฒนาแบบยั่งยืนมีความเหมาะสมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

4. เนื้อหาและกิจกรรมการเรียนการสอนเรื่องความสำคัญของพลังงานมีความเหมาะสมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

5. เนื้อหาและกิจกรรมการเรียนการสอนปัญหาด้านพลังงานมีความเหมาะสมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

6. เนื้อหาและกิจกรรมการเรียนการสอนพัฒนาแบบยั่งยืนในด้านพลังงานมีความเหมาะสมระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

7. การจัดกิจกรรมมีความสอดคล้องกับแนวคิดทฤษฎีคอนสตรัคติวิสต์ในระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

8. กิจกรรมขั้นสร้างความขัดแย้งทางปัญญามีความเหมาะสมในระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

9. กิจกรรมขั้นสร้างความขัดแย้งทางปัญญาและกิจกรรมไต่ตรองมีผลทำให้เกิดการสรุปโครงสร้างใหม่ทางปัญญา (องค์ความรู้) ระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

10. กิจกรรมการเรียนการสอนส่งผลต่องานแก้ปัญหาสิ่งแวดล้อมในด้านพลังงานระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

11. การจัดกิจกรรมการเรียนการสอนมีความสอดคล้องกับการยึดผู้เรียนเป็นสำคัญระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....
.....

12. สื่อการเรียนการสอนส่งเสริมการสร้างองค์ความรู้ในระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....

.....

13. การวัดผลประเมินผลสอดคล้องกับจุดประสงค์การเรียนรู้ระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....

.....

14. แผนการสอนส่งเสริมการสร้างองค์ความรู้ระดับใด

☐ ระดับ 1
☐ ระดับ 2
☐ ระดับ 3
☐ ระดับ 4
☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....

.....

15. ภาษาที่ใช้มีความเหมาะสมระดับใด

☐ ระดับ 1

☐ ระดับ 2

☐ ระดับ 3

☐ ระดับ 4

☐ ระดับ 5

ข้อคิดเห็นเพิ่มเติม .....

.....

ลงชื่อ .....

(.....)

ตำแหน่ง .....

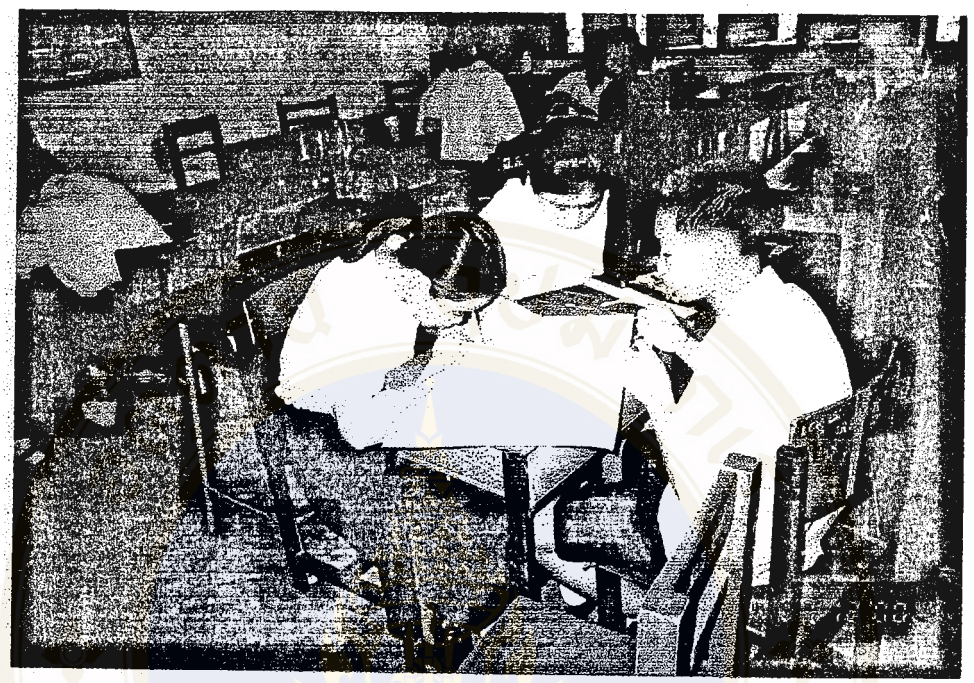
วันที่ประเมิน...../...../.....

Good interrelation of the 16 members of target group

The participation of the members in order to conclude group idea

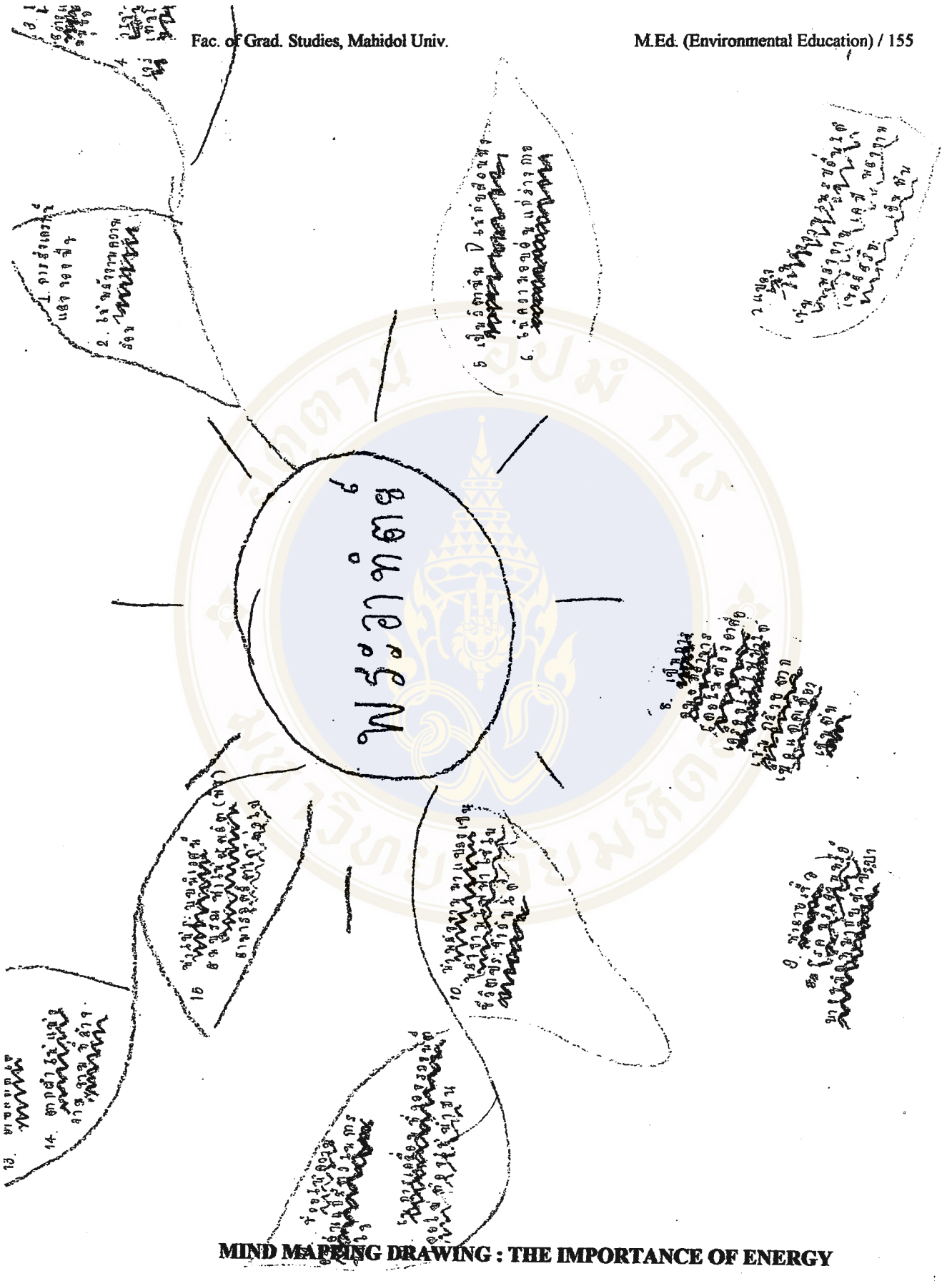
Drawing Imagination activity

Mind mapping activity

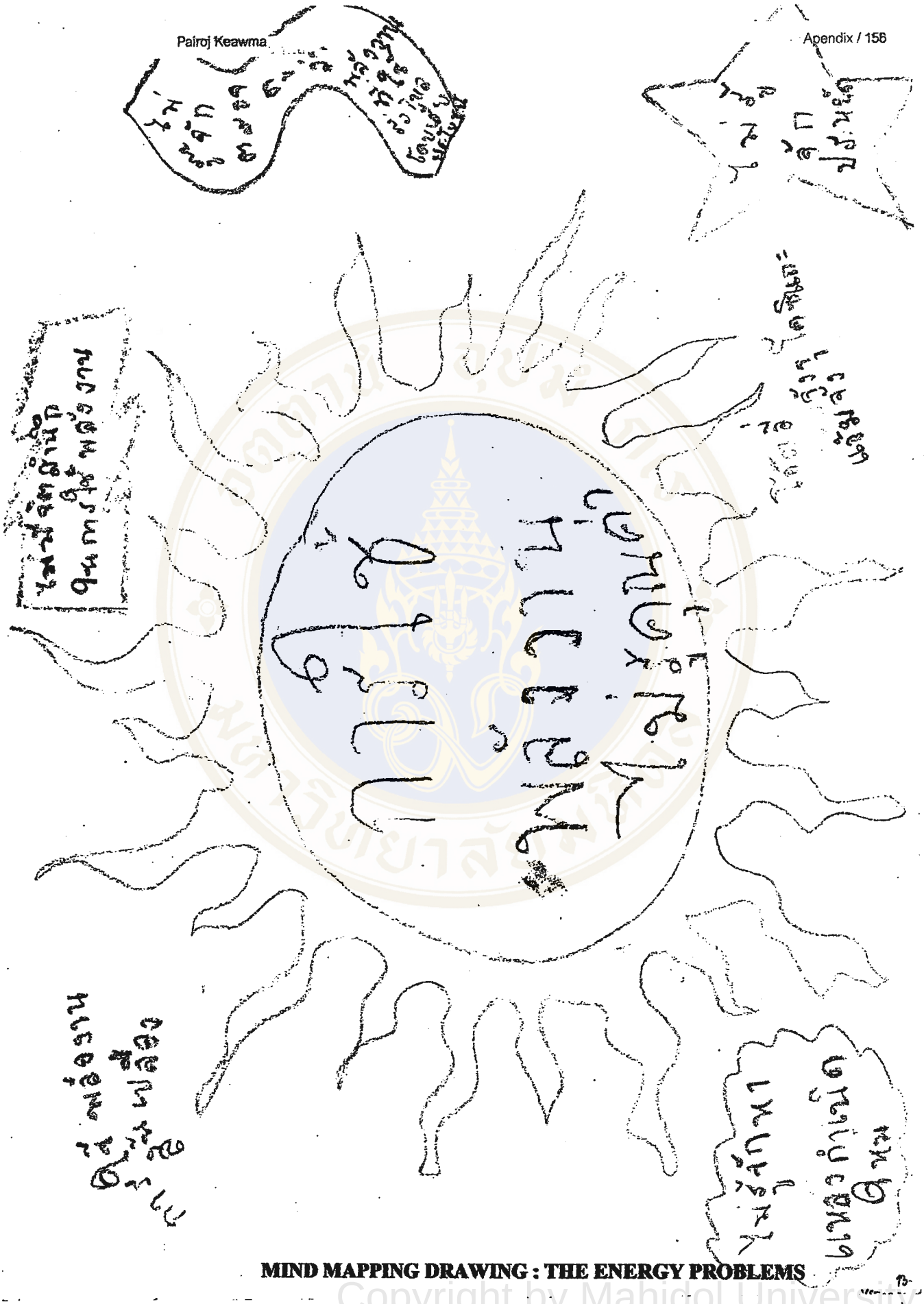


Drawing IMagination activity

Presentation their ideas to class



MIND MAPPING DRAWING : THE IMPORTANCE OF ENERGY



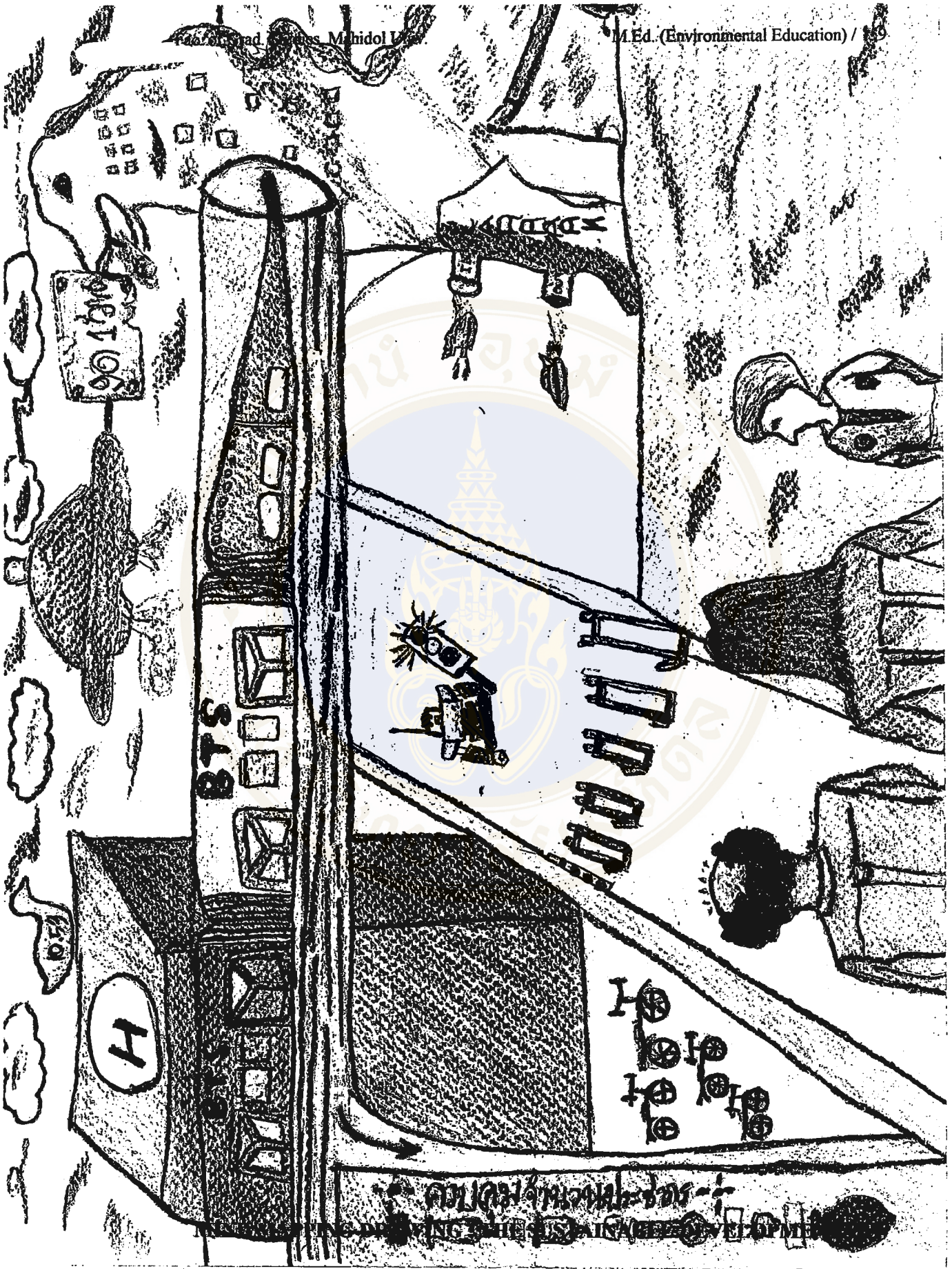
MIND MAPPING DRAWING : THE ENERGY PROBLEMS

Pairoj Keawma

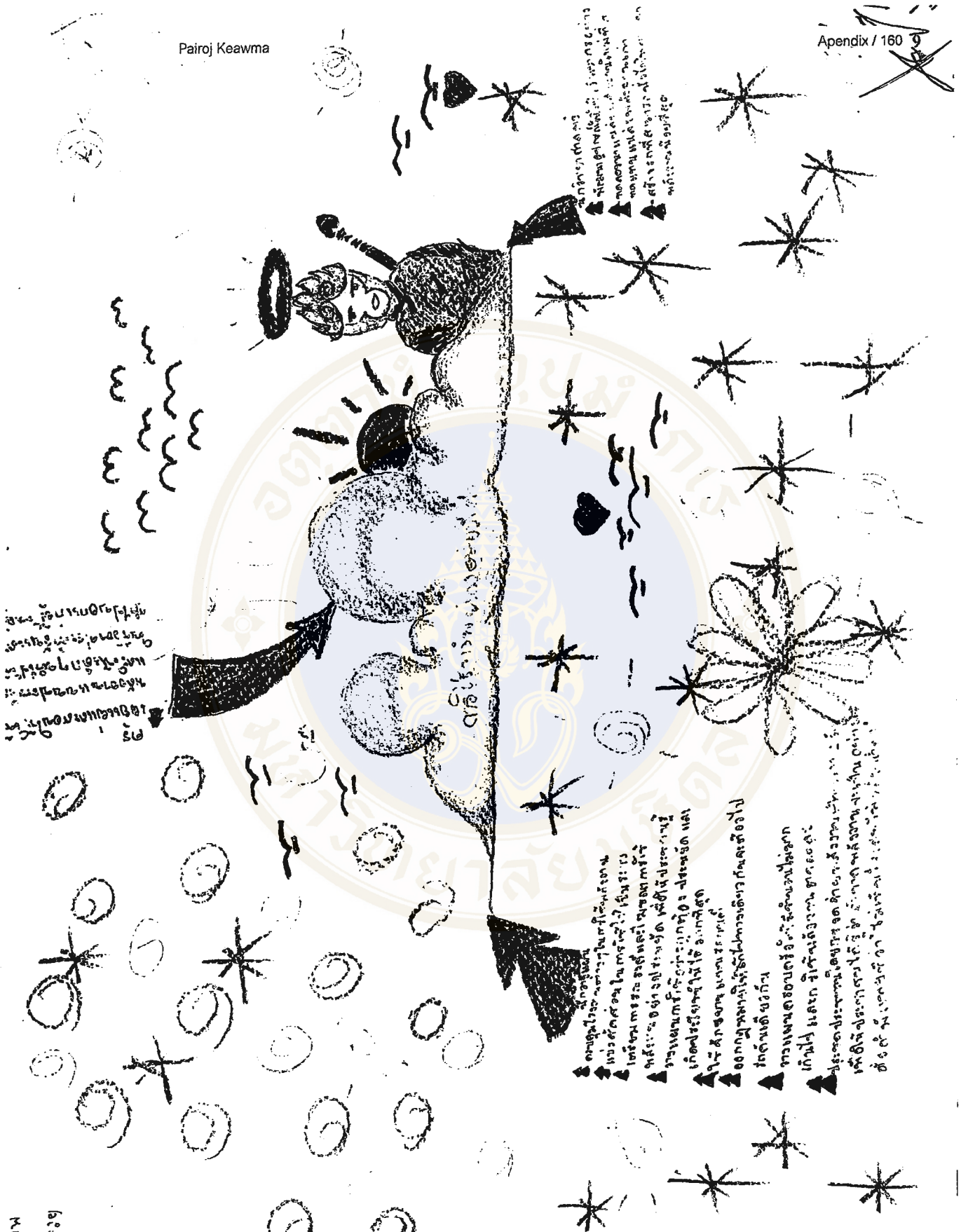
MIND MAPPING DRAWING : THE ENERGY PROBLEMS

MIND MAPPING DRAWING : THE SUSTAINABLE DEVELOPMENT OF

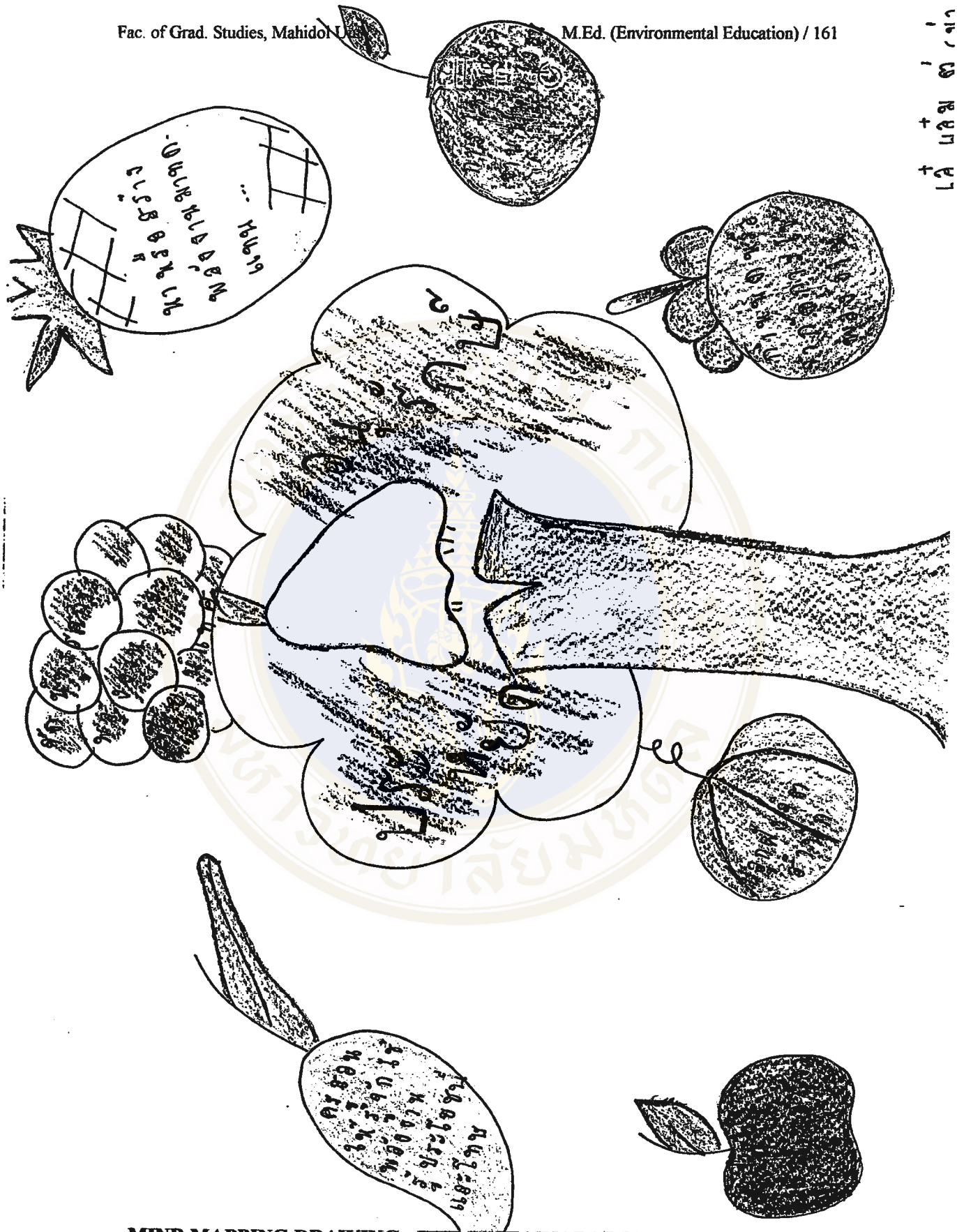
ENERGY



ENERGY GUIDANCE



MIND MAPPING DRAWING : THE SUSTAINABLE DEVELOPMENT OF ENERGY GUIDANCE



MIND MAPPING DRAWING : THE SUSTAINABLE DEVELOPMENT OF ENERGY GUIDANCE

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BIOGRAPHY

NAME	Mr. Pairoj Kaewma
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PLACE OF BIRTH	Chonburi Thailand
INSTITUTIONS ATTENDED	Burapha University , 1989-1992 Bachelor of Education (Biology) Mahidol University , 1999-2001 Master of Education (Environmental Education)
RESEARCH GRANT	Research for Thesis Grant, Faculty of Graduate Studies, Mahidol University.
POSITION & OFFICE	2001- Present , Navamintharachinuthis Suangularbwittayalai School, Muang, Samuthprakarn Position : Teacher 1 , Level 4