

The Effect of Environmental Education Learning for Enhancing Dam Management in the Northeast of Thailand Using Case Study-Based Learning

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Abstract

The purposes of this research were to develop learning plans for dam management in the Northeast of Thailand using case study-based learning being efficient and effective, to study and compare the knowledge, attitude, and environmental ethics concerning dam management in the Northeast of Thailand before and after learning, and different gender. The sample was 72 2nd-year students in Environmental Education program, Faculty of Environment and Resources Studies, Mahasarakham University, being selected by purposive sampling. Research tools were learning plans for dam management in the Northeast of Thailand, knowledge test, attitude test and an environmental ethics test. The statistics used in the research were frequency, percentage, mean, standard deviation, Paired t-test, and One-way ANOVA. The results of the research were found that: 1) The efficiency of learning plans was equal to 86.38/84.17, and the effectiveness index of learning plans was 0.7466. It showed that the students-increased knowledge and resulted in the students progressing from their studies as 74.66 percent. 2) After the learning, the mean score of knowledge, environmental attitude, and environmental ethics of students were significantly higher than before the learning at the .05. 3) There was no different knowledge, environmental attitude, and environmental ethics between students with an different gender.

Keywords: dam management, learning plans, case study-based learning, knowledge, attitude, environmental ethics

1. Introduction

1.1 Introduce the Problem

Education and learning should have an important goal of developing people as citizens to be physically and mentally complete, intellectually, knowledgeable and moral, have ethics and culture to live in balance, have the necessary skills and be able to live happily with others, lifelong continuous self-learning leadership, emphasis on learning to inspire to live a meaningful life, learning to nurture creativity, the ability to create new things, learning to cultivate a public mind hold on to common interests and learning for implementation focus on building work to achieve results, be a qualified citizen self-reliant and lead a happy life. In this regard, the curriculum and methods of education and learning in the 21st century should enable learners to continually learn and develop themselves. The teachers must be able to create and design a learning environment that is supportive and conducive to objective learning, linking knowledge or exchanging knowledge with the community and society as a whole manage to learn through real-world contexts and creating opportunities for students to have access to quality media, technology, tools, and learning resources (Jarungkiatkul, 2018).

Determining the objective function is the effect of a system or destination that education must develop and empower citizens and societies to live with pride. Setting the objective function of education alone is unable to

develop human beings and society but there must be a mechanism to drive policies and strategies that are practical, by taking action. It is necessary to understand the context of the changing world in the 21st century, the basis of educational philosophy as well as the components of the student's living environment. These understandings should be basic knowledge that is short, concise, easy to understand, can be done together, and there are clear guidelines in addition. It makes it possible to think of problems in steps. The present condition of teaching and learning management is quite limited, but in conclusion, it is educational management that is not suitable for the students' conditions, students lack cooperation in various tasks, therefore, educational management should be integrated (Wankaew, 2008).

Dams are large structures for blocking waterways, to be used to store water and prevent floods, including generating electricity. The upper part of the dam consists of a section known as an overflow channel for water above the desired level to flow through the downstream bank. More than half of the world's major rivers are dammed in some way. At present, the dam is an innovation for early development in the National Economic and Social Development Plan, which focuses on expanding cultivation areas and providing energy resources for industrial development. While the dam can respond to development policies but the great detriment of the dam is to harm and destroy the ecosystem, especially fishery resources which is the source of income and food of people. This affects the way of life of people who rely on and rely on natural resources may be summarized in aspects such as economic impact, health effects social, and cultural impact environmental, and ecological impact (Chanchula, 2009).

Case study-based learning is a learning management process in which situations or examples are used to manage learning for learners to help learners become enthusiastic about learning. Promotion students to use critical thinking and skills of solving problems in case study-based must allow learners to learn through group activities. This will help learners learn by interacting with others; gain a broader perspective by listening to and accepting the rational ideas of others. It also allows students to work together to find solutions to problems using a variety of methods. There are several directions for answering questions and an earning call to answer them (Thiangchanrathip, 2009).

Therefore, the researcher has adopted a method of teaching and learning by using case study-based learning, to be applied in the teaching and learning activities of environmental education which contains a total of 7 learning plans including : 1) Basic knowledge about dams 2) Sirindhorn Dam, Nam Son Dam and Huai Luang Dam 3) Ubonrat Dam, Chulabhorn Dam and Phimai Dam 4) Lam Ta Khlong Dam, Lam Phra Ploeng Dam and Meka Dam 5) Lampao Dam, Pak Mun Dam and Yasothon—Phanom Phrai Dam 6) Rasi Salai Dam, Nam Un Dam and Lam Se Bai Dam and 7) Nam Phong Dam, Lam Nang Rong Dam and That Noi Dam, to provide students with more knowledge, attitudes, and environmental ethics in teaching and learning activities.

1.2 Research Objectives

- 1) To develop environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning to be efficient and effective.
- 2) To study and compare the knowledge, attitude, and environmental ethics about dam management in the Northeast of Thailand before and after learning.
- 3) To study and compare the knowledge, attitudes, and environmental ethics about dam management in the Northeast of Thailand with gender differences.

1.3 Research Hypothesis

- 1) Environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning are efficient and effective as 80/80.
- 2) After learning, students have the knowledge, attitudes, and environmental ethics about dam management in the Northeast of Thailand using case study-based learning higher than before learning.
- 3) There are different cores of knowledge, attitudes, and environmental ethics about dam management in the Northeast of Thailand of Students with different gender.

1.4 Research Conceptual Framework

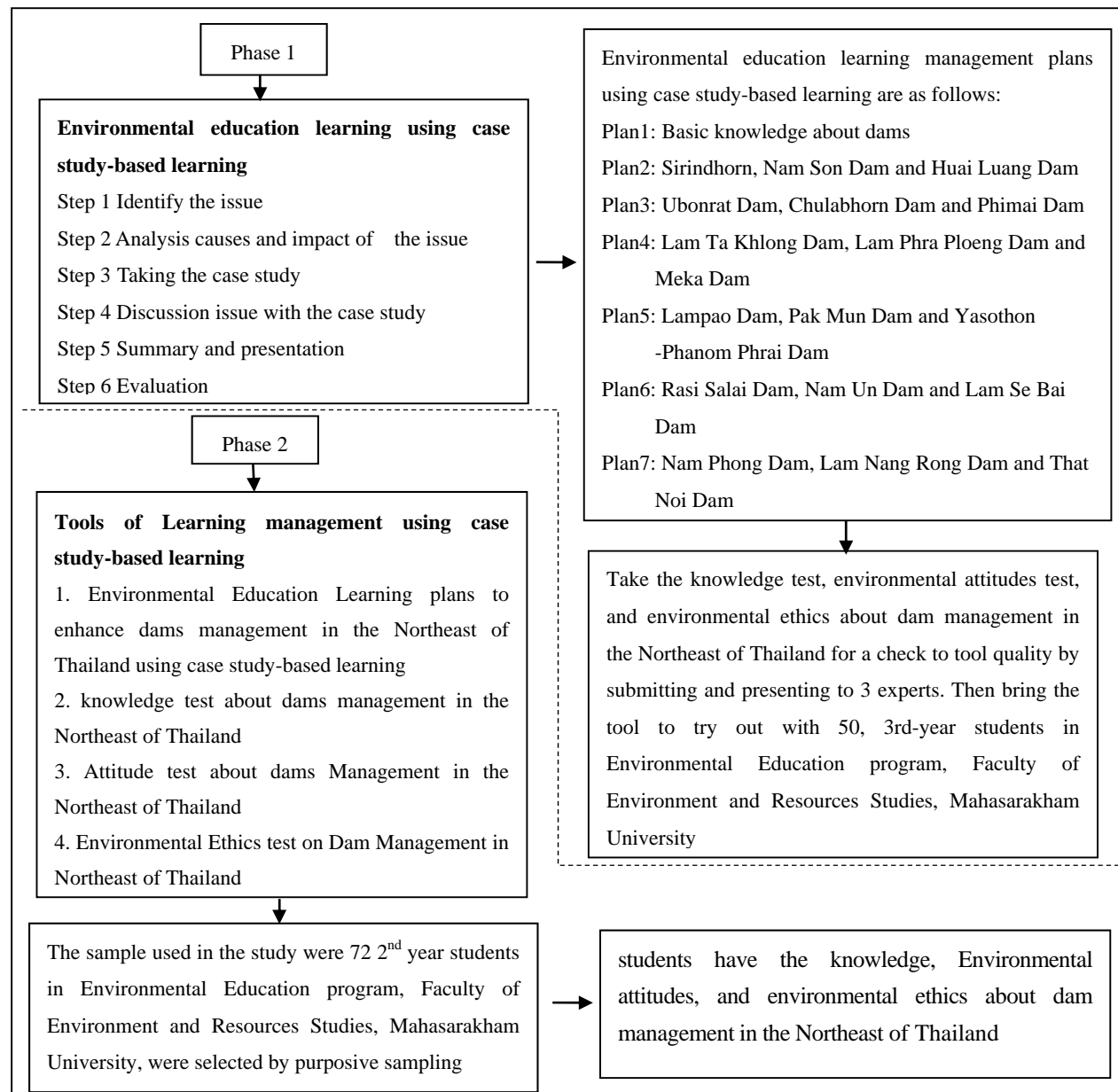


Figure 1. Research conceptual framework

2. Research Design and Method

2.1 Population and Sample

The population used for research were 376 1st-4th year undergraduate students in Environmental Education program, Faculty of Environment and Resources Studies, Mahasarakham University in the first semester of the academic year 2018.

The sample was 72 2nd-year undergraduate students in Environmental Education program, Faculty of Environment and Resources Mahasarakham University enrolled in the first semester of the academic year 2018, which were obtained from purposive sampling.

2.2 Studied Variables

Independent variables: Environmental Education Learning Plans for enhancing dam management in the

Northeast of Thailand using case study-based learning.

Dependent Variable: 1) knowledge about dam management in the Northeast of Thailand; 2) attitudes towards dam management in the Northeast of Thailand and 3) environmental ethics about dam management in the Northeast of Thailand.

3. Data Collection

3.1 Research Instruments

- 1) Environmental Education Learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning.
- 2) Knowledge test about dam management in the Northeast of Thailand.
- 3) Attitude test towards dam management in the Northeast of Thailand.
- 4) Environmental ethics test about dam management in the Northeast of Thailand.

3.2 Creation and Quality of Tools

- 1) Study information, concepts, theories, research papers related to dam management in the Northeast of Thailand.
- 2) Use data to create research tools, including:
 - a) Environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning, consisting of 7 learning plans.
 - b) Knowledge test about dam management in the Northeast of Thailand, there are choices of 4 options A, B, C, and D, 35 questions, the correct answer received 1 point, the wrong answer received 0 points, the wrong answer gave 0 points, 35 items total 35 points. The criteria for interpreting the points are as follows (Srisaat, 2000). It showed that the average score =0.00–7.00 means that the students have the least level of knowledge, the average score was 7.01–14.00 means that the students have a low level of knowledge, the average score = 14.01–21.00 means that students have moderate knowledge, the average score = 21.01–28.00 means that the student's knowledge was at a high level and the average score = 28.01–35.00 means that students have the knowledge at the highest level.
 - c) Attitude test towards dam management in the Northeast of Thailand, there were 5 levels as follows: the average score = 1.00–1.80 for strongly disagree, the average score = 1.81–2.61 for disagree, the average score was 2.62–3.41 for neutral, the average score = 3.42–4.21 for agree and the average score = 4.22–5.00 for strongly agree, total 35 items (Srisaat, 2000).
 - d) Environmental ethics test about dam management in the Northeast of Thailand, there are 35 items of 4 options which are A, B, C and D. There are 4 levels set by the ethical rating as follows (Wongchantra, 2016). Level 1: average score 1.00–1.75 for myself, Level 2: average score 1.76–2.50 for the relatives and friends, Level 3: average score 2.51–3.25 for society and Level 4: average score 3.26–4.00 for the rightness and goodness.
- 3) Bring the tools used in the research to send 3 experts to consider the consistency, along with finding the appropriateness, accuracy and checking the accuracy of the content, found that:
 - a) Environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning, were found that the coherence (IOC) of the learning plans was 1.00, with a mean of 0.50 and above, and the suitability was 4.27, showing that the appropriateness of the environmental education learning plans was at a very reasonable level which can be used to collect information.
 - b) Knowledge test about dams management in the Northeast of Thailand, was found that the consistency value (IOC) was 0.96, considered to be consistent with the specified criteria, can be used to collect information.
 - c) Attitude test towards da management in the Northeast of Thailand, was found that the consistency value (IOC) was 0.97, considered consistent with the specified criteria, can be used to collect information.
 - d) Environmental ethics test was found that the compliance value (IOC) was 0.96, considered consistent with the specified criteria that can be used to collect information.
- 4) The research tools were tested (try out) with 50 3rd year undergraduate students in Environmental Education program, Faculty of Environment and Resources Studies, Maharakham University, that are not the sample to find the difficulty power to classify each item and the confidence values for the whole issue as follows:

- a) Knowledge test about dam management in the Northeast of Thailand, it was found that the difficulty value was between 0.90–0.96, the discriminant power was between 0.20–0.72, and the confidence value in the whole version was 0.74 which was meet the specified criteria can be used to store data.
 - b) Attitude test towards dam management in the Northeast of Thailand, it was found that the power rating for each item was between 0.20–0.81 and the confidence value of the whole issue was 0.92, which was by accordance with the specified criteria, can be used to collect information.
 - c) Environmental ethics test, it was found that the power rating for each item was in the range of 0.21–0.86 and the confidence value in the whole version was 0.91, which was in accordance with the specified criteria, can be used to store data.
- 5) Bring the tools used in the research to improve and make a complete version, to collect data with the sample.

3.3 Data Collection

- 1) Prepare environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning, the knowledge test, the attitude test, and an environmental ethics test about dam management in the Northeast of Thailand.
- 2) Students take the knowledge test, the attitude test, and the environmental ethics test before learning.
- 3) Enter teaching activities environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning. There were a total of 10 weeks of teaching, 3 hours a week, a total of 30 hours, as shown in Table 1.

Table 1. Environmental education learning for enhancing dam management in the Northeast of Thailand using case study-based learning

Week	Learning activities plans	Period (hour)
1	Introduce the learning activity and pretest for knowledge, attitude and environmental ethics	3
2	Activity plan 1: Plan1: Basic knowledge about dams	3
3	Activity plan 2: Sirindhorn, Nam Son Dam and Huai Luang Dam	3
4	Activity plan 3: Ubonrat Dam, Chulabhorn Dam and Phimai Dam	3
5	Activity plan 4: Lam Ta Khlong Dam, Lam Phra Ploeng Dam and Meka Dam	3
6	Activity plan 5: Lampao Dam, Pak Mun Dam and Yasothon -Phanom Phrai Dam	3
7	Activity plan 6: Rasi Salai Dam, Nam Un Dam and Lam Se Bai Dam	3
8	Activity plan 7: Nam Phong Dam, Lam Nang Rong Dam and That Noi Dam	3
9	Summary of learning activities about dam management in the Northeast of Thailand	3
10	Posttest for knowledge, attitude and environmental ethics	3
Total		30

- 4) Teaching and learning environmental education for enhancing dam Management in the Northeast of Thailand using case study-based learning, there are steps as follows:
 - a) Identify the issue about dams management in the Northeast, let learners read and understand the content, get to grips with important issues and understand the relationship of various issues.
 - b) Analysis of causes and impact of the issue of dams in the Northeast, and students can identify problems.
 - c) Taking case study dams management in the Northeast and prioritizing dam solutions and management in the Northeast.
 - d) Discussion issue with case study dam management approach in the Northeast, taking into account the advantages, disadvantages and impacts of the most appropriate management approach.
 - e) Summary and presentation of the results from a case study about dams management in the Northeast of Thailand, to exchange knowledge with each other in class.
 - f) Evaluate students on how to present their work in front of the class.
- 5) Take a post-test with a knowledge test, an attitude test and an environmental ethics test about dam management in the Northeast of Thailand which is the same set as the pre-test.

3.4 Statistics Used in Data Analysis

- 1) Basic Statistics Are Frequency, Percentage, Mean and Standard Deviation.

2) Statistics Used to Determine Tool Quality.

- a) Conformity index values for research objectives IOC judgment criteria, if it is 0.50 or higher, then the conformity Index is applicable.
- b) Difficulty value of the knowledge test on dam management in the Northeast.
- c) Power values are classified by item.
- d) Test Confidence.
- e) Process efficiency value (E_1).
- f) Result efficiency value (E_2).
- g) The effectiveness index was analyzed using the methods of Goodman, Fletcher, and Schneider.

3) The Statistics Used in the Hypothesis Experiment Were Paired T-Test and One-Way ANOVA at the Statistical Significance Level of .05.

4. Results

4.1 *The Effect of Environmental Education for Enhancing Dam Management in the Northeast of Thailand Using Case Study-Based Learning Being Efficient and Effective*

The result of efficiency and effectiveness of learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning was found that: Efficiency (E_1) was 86.38% and Effectiveness (E_2) was 84.17%. Therefore, the learning plans were the efficiency of the course at 86.38/84.17, which met the set criteria. The effectiveness index (E.I.) of the Environmental Education Learning Plan was 0.7466. This means that the students have increased knowledge and resulted in the students having an increase in their learning progress after the implementation of the learning plans by 74.66%, which meets the standard that can be used.

4.2 *The Results of a Comparative Study of Knowledge, Attitudes, and Environmental Ethics About Dam Management in the Northeast of Thailand*

1) The results of knowledge about dam management in the Northeast of Thailand, was found that before learning, the students' average scores of overall knowledge was at a low level, which was equal to ($\bar{x} = 13.12$), and after learning, the students had the average score of overall knowledge at the highest level, which was equal to ($\bar{x} = 29.45$). When comparing the average knowledge scores, it was found that after learning, the students had knowledge about dam management in the Northeast of Thailand higher than before learning statistically significant .05.

2) In the results of attitudes towards dam management in the Northeast of Thailand, it was found that before learning, the student's average score of the overall attitude was at the level of disagreement, which was equal to ($\bar{x} = 1.60$). and after learning, the students' average scores of attitudes overall were at the agreed level, which was equal to ($\bar{x} = 4.01$). When comparing the average scores of attitudes towards dam management in the Northeast of Thailand, it was found that after learning, the student's score of attitude toward dams management in the Northeast of Thailand was higher than before learning statistically significant .05.

3) The results of environmental ethics about dam management in the Northeast of Thailand, was found that before learning, the students' overall environmental ethics average score was for self-interest level, the value equal to ($\bar{x} = 1.53$), and after learning, the students' overall environmental ethics score was for goodness level, the value is equal to ($\bar{x} = 3.50$) when comparing the average score of environmental ethics about dams management in the Northeast of Thailand, it was found that after learning, the students' average score of environmental ethics about dams management in the Northeast of Thailand was higher than before learning statistically significant .05.

4.3 The Results of the Study and Comparison of Knowledge, Attitudes, and Environmental Ethics of Students with Different Gender, It Was Found That There Were no Difference of Knowledge, Attitude, and Environmental Ethics About Dam Management in the Northeast of Thailand of Students with Different Gender

Table 2. The results of the comparison of an average score of knowledge, attitudes and environmental ethics about dam management in the Northeast of Thailand by using Paired t-test before learning and after learning (n=72)

Item	Before Learning		Levels	After Learning		Levels	t	df	p
	\bar{x}	S.D.		\bar{x}	S.D.				
Knowledge	13.12	1.28	Low	29.45	1.71	Highest	-58.83	71	.000*
Attitudes	1.60	0.22	Disagree	4.01	0.19	Agree	-74.77	71	.000*
environmental ethics	1.53	0.08	For myself	3.50	0.07	For goodness	-162.89	71	.000*

Note. * It was statistically significant at the .05 level.

Table 3. The results of the comparison of knowledge, attitudes and environmental ethics about management in the Northeast of Thailand of students with different gender by using One-way ANOVA (n=72)

Item	Gender	quantity	One-way ANOVA			
			\bar{x}	S.D.	F	Sig.
Knowledge	Male	46	17.76	3.04	0.06	0.80
	Female	26	18.00	5.17		
Attitudes	Male	46	4.03	0.19	0.54	0.46
	Female	26	3.99	0.20		
environmental ethics	Male	46	3.49	0.08	1.41	0.23
	Female	26	3.52	0.07		

5. Conclusions

The efficiency of the environmental education learning plan for enhancing dam management in the Northeast of Thailand using case study-based learning was 86.38/84.17, which met the set criteria. The Effectiveness Index (E.I.) was equal to 0.7466. It means that the students have more knowledge and result in students having more progress in learning after the implementation of the learning plans, accounting for 74.66 percent, which meets the standard that can be used.

The Results of a Comparative Study of Knowledge, Attitudes and Environmental Ethics About Dam Management in the Northeast of Thailand

- 1) After learning, the students' knowledge about dam management in the Northeast of Thailand was higher than before learning statistically significant .05.
- 2) After learning, the student's attitude towards dam management in the Northeast of Thailand was higher than before learning statistically significant .05.
- 3) After learning, the students' environmental ethics about dam management in the Northeast of Thailand was higher than before learning statistically significant .05.
- 4) There Were no Difference of Knowledge, Attitude, and Environmental Ethics About Dam Management in the Northeast of Thailand of Students with Different Gender

6. Discussion

6.1 The Result of an Efficacy Study and Effectiveness According to the Criteria of the Environmental Education Learning Plans About Dam Management in the Northeast of Thailand

The results of the study on the efficiency of the environmental education learning plans for enhancing dam management in the Northeast of Thailand using case study-based learning, it was found that the efficiency of the process (E₁) was 86.38% and the efficiency of the result (E₂) was 84.17%. Therefore, environmental education learning plans were the efficiency of the study at 86.38/84.17, which met the 80/80 criteria. The efficiency of the process (E₁) and the efficiency of the results (E₂) were effective according to the set criteria; the effectiveness Index (E.I.) was 0.7466. This means that students have increased knowledge, and resulted in students having an increase in learning progress after using the learning plans was 74.66%. The researcher has studied the theory and related research defined the scope and content structure of the lesson plan and defined the content of 7 plans.

The duration of teaching is 3 hours each time, a total of 30 hours, the lesson plans have been assessed by experts, resulting in an environmental education learning plans which are based on the concept of Khamlalieng (2001) said that efficiency is a performance that causes satisfaction to human beings. And Yuthasutthipong (2007) said that efficiency must take into account operations that can achieve results according to the set objectives. And Durongdej (2009) said that effectiveness means the ability to operate to achieve the set objectives. And Ngamsa-ad (2008) said that effectiveness refers to the success of a job that meets expectations defined in the objectives or goals. This is consistent with the research of Natphong, Boonserm and Praimee (2021) has studied the application of geographic information systems in the study of the initial environmental impact on undergraduate students. The results showed learning plan for the application of GIS in preliminary environmental assessment, the efficiency index was 91.42/80.67, the effectiveness index was 0.7034, indicating that the students' knowledge increased and the bachelor students progressed in their learning after learning and consistent with the research of Pronyusri, Boonserm and Junkaew (2021) have studied the teaching of environmental education by using problems and group processes-based learning for undergraduate students, the results showed that environmental education lesson plan using problems and group processes-based learning for undergraduate students, it has an efficiency of 86.12/82.12 and an effectiveness index of 0.6476, it showed that students have increased knowledge and make undergraduate students have more progress in learning after studying. And consistent with the research of Ploysopon and Phaudjantuk (2019) have studied the results of using a case study-based learning management plan in the course of psychology for teachers of second-year students. The objectives were to create a case-based learning management plan as a teacher psychology course with efficiency according to the 80/80 criteria. The results showed that the efficiency of the case study-based learning management plan as a teacher psychology course was 85.29/82.35.

6.2 The Results of the Study and Comparison of Knowledge, Attitudes and Environmental Ethics About Dam Management in the Northeast of Thailand of the Students Before and After Learning

1) The results of the study and comparison of knowledge about dams management in the Northeast of Thailand, it was found that after learning, students' average score of knowledge was higher than before learning because the researcher has taught using a case study-based learning theory with a total of 6 steps as follows: step 1 identify the issue, step 2 analysis causes and impact of the issue, step 3 taking case study, step 4 discussion issue with a case study, step 5 summary and presentation and step 6 evaluation. It is a method of educating students who are interesting by giving examples about dam management in the Northeast of Thailand so that students can think to analyze the current situation as it happens, making students more knowledgeable after studying. According to the concept of Suwan (2011) said that the meaning of knowledge is a preliminary behavior which the learners have done or by seeing, hearing, remembering. and Sophakan (2007) said that knowledge is the perception of facts, events, details resulting from observations, education, and experiences in both natural and social environments, basic knowledge or background of the individual that the person remembers or collected and can be expressed in observable or measurable behavior which is consistent with the research of Ritsumdaeng, Boonserm and Sookngam (2021) have studied teaching environmental studies using case studies and games-based learning for undergraduate students, it was found that after learning, the student's knowledge of the environment was significantly higher than before learning at the .05 level. And consistent with the research of Sookngam, Wongchantra and Bunnaen (2021) have studied the development of training courses on environmental education according to the King's science in soil, water and forest conservation, it was found that after training, students have average knowledge of soil, water, and forest conservation according to the royal science higher than before training, statistically significant at the .05 level. And consistent with the research of Praimee and Boonserm (2021) studied the organization of learning activities on solid waste and waste management by using problems and proposition-based learning, it was found that after learning, students have average grades in solid waste and sewage management was higher than before learning significantly at the .05 level.

2) In the results of the comparison of attitudes towards dams management in the Northeast of Thailand, it was found that after learning, the students' score of attitude toward dams management was higher than before learning statistically significant .05. This is a result of the process of organizing activities that are taught using case study-based learning, some steps that allow students to participate in thinking, analyzing and synthesizing well dam management in the Northeast of Thailand. As a result, students have an attitude towards dam management in the Northeast more after learning which is in line with the concept of Guptanon (2008) said that attitude is the inner feeling of a person who uses it, to evaluate or judge things. And Sereerat (1999) has given the meaning that attitude is a feeling of a person towards something or the inclination caused by learning to respond to stimuli in a consistent direction. And Attamana (2015) said that the definition of attitude is a

combination of thoughts, beliefs, opinions, knowledge, and feelings of a person towards something consistent with the research of Pronyusri, Boonserm and Junkaew (2021) have studied the teaching of environmental education by using problems and group processes based learning for undergraduate students, it was found that the students had scored for their environmental attitude after learning is higher than before learning statistically significant at the .05 level. This is consistent with the research of Thinkamchoet and Wongchantra (2018) have studied the ASEAN natural resources and environment conservation camp for youth in Roi Et province, it was found that youth had more attitudes towards conservation of natural resources and the ASEAN environment after joining the camp than before joining the camp. And consistent with the research of Wongchantra, Toomhome, Phansiri and Junkawe (2016) have studied the development of a green product training manual for students in Environmental Education program, Mahasarakham University, it was found that the students had higher mean scores on attitude after training higher than before training, statistically significant at the level .05.

3) The results of a study and comparison of environmental ethics related to dam management in the Northeast of Thailand, it was found that after learning, the students' average score of environmental ethics about dams management was higher than before learning statistically significant .05. This is a result of the process of organizing activities that are taught using case study-based learning, enabling students to participate in synthesizing data from case studies and have students present their analytical concepts of dam management in the Northeast of Thailand, as a result, students have more environmental ethics after studying. This is based on the concept of Wongchantra (2012) said that environmental ethics is a principle that one should behave towards the environment, this has resulted in the existence of the environment in ecological equilibrium and favorable to all things that depend on the environment to survive. And Weerawattananon (1993) said that environmental ethics is an environmental practice for human beings that takes integrity and correctness on the principles of morality and kindness which be treated with the environment. And Sorasurachat (2015) said that ethics is behavioral qualities, society expects people in that society to behave correctly in their conduct and have freedom within the boundaries of conscience. This is consistent with the research of Udornpim and Wongchantr (2021) have studied the results of training for environmental protection volunteers in schools to enhance knowledge, ethics, and volunteering, it was found that the students had a statistically significantly higher level of environmental ethics after training than before training at .05. This is consistent with the research of Praimee and Boonserm (2021) has studied the result of learning activities on solid waste and waste management using problem-based learning, it was found that the students had average scores on environmental ethics after learning was significantly higher than before learning at the .05 level. This is consistent with the research of Tadsawa and Saifa (2021) studied the development of a digital ethical reasoning program using outcome-based education and case study-based learning for junior high school students, it was found that students who are organized learning using a program promoting digital ethical reasoning based on outcome-based education concepts and case study-based learning are capable of post-experimental digital ethical reasoning statistically significantly higher than before the experiment at the .05 level.

6.3 The Results of a Comparative Study of Knowledge, Attitudes and Environmental Ethics About Dam Management in the Northeastern of Thailand Before and After Learning of Students with Different Gender

The result of the study comparing knowledge, attitude and environmental ethics of the students of a different gender was found that there was no difference in a mean score of knowledge, attitude, and environmental ethics about dam management in the Northeast of Thailand of students with a different gender. This is a result of teaching and learning activities that include examples as a case study in the classroom for students to gain knowledge and understanding. This is a process that causes motivation to make students of different gender interested and curious, thus making students' knowledge, attitudes and environmental ethics are no different which is based on the concept of Menasavet (1982) said that knowledge is very important in carrying out different activities because it is a process that causes behavioral changes. And according to the concept Sereerat (1999) said that attitude is a feeling of a person towards something or the inclination caused by learning to respond to a mole in the direction consistent with the composition, understanding, feeling, and behavior. And according to the concept of Yodlorchai (2019) said that gender is a status caused by psychological, behavioral, social and cultural factors. This is consistent with the research of Maikami and Wongchantra (2018) have studied the development of manuals to enhance attitudes in the use of green products for students of the Faculty of Environment and Resources Studies, Mahasarakham University, which has a purpose to study and compare the attitudes of students of different gender, the results of the study on the use of green products. It was found that there is no difference in attitude towards using green products among students of a different gender. This is consistent with the research of Thinkamchoet and Wongchantra (2018) studied the ASEAN natural resources and environment conservation camp for youth in Roi Et province, it is objectives are to study and compare

knowledge, attitudes, and leadership skills before and after camp activities by gender, it was found that there is no difference of knowledge about natural resources and the environment of youth with a different gender. This is consistent with the research of Praimee and Boonserm (2021) have studied the results of learning activities on solid waste and waste management using problem-based learning have the purpose to compare knowledge, environmental ethics and environmental volunteering of students with a different gender. It was found that there is no difference in knowledge about solid waste and sewage management, environmental ethics, and environmental volunteers among students with a different gender. And consistent with the research of Junkaew, Wongchantra, and Bunnaen (2021) studied the effects of environmental education learning activities using area-based learning in Khok Hin Lad Community Forest in Maha Sarakham, Thailand. It was found that there is no difference in knowledge, attitudes and environmental ethics among students of a different gender.

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