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Research Article

Promoting adaptation to climate change using a manual for high school students at Sisawat Wittaya Municipality School, Mahasarakham Province, Thailand

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Abstract

This research aimed to investigate the differences in levels of knowledge, attitude, and awareness of adaptation to climate change among a group of high school students before and after the implementation of the Manual for Adaptation to Climate Change. Thirty-two eighth-graders from Sisawat Wittaya Municipality School, located in Mahasarakham's Muang district, were selected through purposive sampling. The research tools were three sets of evaluation forms that tested the participants' levels of knowledge, attitude, and awareness of climate change adaptation. The data were analyzed using mean, percentile, standard deviation, and paired-Test. The study found a low level of student knowledge on adaptation to climate change in the pre-test; it was moderate during the post-test (significant difference at 0.05). As to students' attitude toward adaptation to climate change, the pre-test score was rated at an "Agree level," while the post-test indicated "Highly Agree", indicating that the students' attitude toward the adaptation to the climate change was improved. The attitude score in the post-test was significantly higher than that in the pre-test at the 5% level. Moreover, student awareness increased (highly agree) after the Manual was introduced to them.

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Introduction

The rays sent to earth from the sun are trapped and stored on earth in the form of a heat wave. The earth has its own system of keeping the world's temperature at an appropriate level to accommodate the presence of all creatures. During the past decades, factors such as the increase of world population, an influx of urbanization, and the industrial revolution have accelerated the severity of global warming, which results in a higher world temperature. Scientists have speculated that minor changes in the world temperature can catastrophically lead to climate change (Sibutta and Sangjun, 2002). Human beings have always relied on nature to provide the necessities of life - water, food, building material, and medicine (Revermann, 2017). Sometimes, this relationship with nature is very direct and easy to see ; other times, it is more indirect and hard to see. A good understanding of nature and its ecosystem is necessary to

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prepare for the possible impact of climate change (United States Environmental Protection Agency, 2017., Steven L. Chown et al. 2010).

Climate change refers to earth thermal alterations, which can be a direct or indirect result of human activities. (Veeravatananond., 2012; United States Environmental Protection Agency, 2017; Union of Concerned Scientists, 2021). Climate change should not be confused with weather fluctuations caused by natural weather turbulences. The emission of greenhouse gases from human activities such as burning of fossil fuel, industrial production, deforestation, and natural-unfriendly agriculture, is fundamental to the emergence of climate change. The escalating amount of greenhouse gases increases heat accumulation in the air, the phenomenon that results in increasing world temperature. The changing world climate has a wide range of effects. It was estimated that Thailand emitted about 292.62 million tons of carbon dioxide in 2010, 54.5% of which came from energy consumption-related activities, 19% from land exploitation and deforestation, 17.7% from agricultural activities, 5.6% from industries, and 3.2% from households. Climate change in Thailand is observed in terms of both annual average temperature and the highest and lowest temperature records. The overall temperature of Thailand was at 0.5 oC above the average, while rainfall rate was found to be 4% less than average during the first 3 months of the year. These thermal and hydrological changes are related to the severe drought that hit the country in 2014 - 2015. During these years, there was no report of rain storms in any areas of the country. However, the country had merited a visit from three cyclones that passed around the region. The changing climate affects not only the changing weather in the area; it also causes the influx of salt water and erosion of land along major river banks. It also affects people' health, agricultural production, and other ecosystems (Office of Natural Resources and Environmental Policy and Planning, 2015).

Climate change has become an international concern, triggering collective measures at the international level to suppress the emission of greenhouse gases. Thailand has yet to establish concrete or practical measures to resolve the issue. Thailand should fine-tune its efforts to follow the international policy of keeping down greenhouse gases, while the Thai people should be urgently made aware of the threatening situation. In the recent past,

Thailand has campaigned for the use of cloth bags in lieu of plastic ones. But this measure is not sufficient to help reduce the emission of carbon dioxide. It is argued in this research that new lifestyles, which involve less production of plastic should be introduced, alongside promoting climate change awareness. Some of the long-held daily practices, such as drinking from straws and using plastic bags, practices that are not only unimportant but also damaging to climate health, should be made obsolete. Therefore, changing ways of living should be a potential strategy to lessen the impact of greenhouse effects (Greenista Society, 2011).

Researchers embarked on creating awareness and giving helpful suggestions to make people adapt to the changing climate. They developed a manual that aims to keep a target group of learners well-informed about the solid waste management (Singseewo, and Tritip, 2016), the environmentally friendly packaging materials (Singseewo and Kimhanta, 2017) and the waste recycling bank in schools (Singseewo, and Klaoklang, 2017) are showed that the students' level of knowledge score of the posttest was higher than the pretest score at 5% level of significance. The expectation was higher scores on these aspects after the manual has been introduced to them. Eighth graders at Sisawat Wittaya Municipality School, Talad Sub-district, in Mahasarakham's Muang district were chosen for the study. The manual's content reflected the science lessons that students must learn based on the science curriculum. Moreover, the researchers saw that this is the right time for eighth graders to learn about changing behaviors in support of environmental nourishment. It was hoped that the manual for adaptation to climate change would help increase the students' knowledge, attitude, and awareness of the impacts of climate change. It is hoped that this would lead to changing lifestyles that would mitigate the impact of climate change.

Objectives

- To obtain comparative results about students' knowledge on adaptation to climate change before and after the implementation of the manual that promotes adaptation to climate change among eighth graders in Sisawat Wittaya Municipality School.

- To obtain comparative results about students' attitude toward adaptation to climate change before and after the application of the manual to the target group.
- To obtain comparative results about students' awareness of adaptation to climate change before and after the application of the manual to the target group.

Research Importance

The implementation of the manual for adaptation to climate change should equip high school students at Sisawat Wittaya Municipality School with higher levels of knowledge, attitude, and awareness regarding behavioral adaptation to climate change while being able to apply the knowledge they obtained in their daily lives.

Materials and Methods

Research Model

This research was based on the Quasi Experimental Research discipline. Data were collected from one group of samples, using t "one group pretest-posttest design." The students' scores on the pretest and the posttest were compared to portray the levels of knowledge, attitude, and awareness of adaptation to climate change after the application of the manual. Research plan based on the One Group. Pre-test - Post-test Design

Table 1.

Experimental Design

Group	Pre-test	Using the manual	Post-test
E	O_1	X	O_2

Symbols and their meanings E = Experimental group O1 = Pre-test O2 = Post-test X = Application of manual for the promotion of adaptation to climate change

Research Area

The research was conducted at the Sisawat Wittaya Municipality School in Mahasarakham's Muang district, Maha Sarakham Province , Thailand.

Population and Samples

The research population was a group of 32 students who enrolled in grade eight at Sisawat Wittaya Municipality School, Maha Sarakham Province, Thailand. The research samples were 32 of the eighth graders who were selected through a purposive sampling method.

Research Variables

The independent variable was the manual for the adaptation to climate change about 4 learning modules

- Fundamental knowledge about climate change
- Situations of climate change
- Impacts of climate change and
- Adaptation to climate change

Dependent variables

- Knowledge relating to adaptation to climate change
- Attitude toward adaptation to climate change
- Awareness of adaptation to climate change

Research Timeframe

The research was divided into three working phases.

Phase 1 : Conducting fundamental data review on 12-30 September, 2016

Phase 2 : Creating and testing the quality of the research instrument between 1 October, 2017 and 1 January, 2018

Phase 3: Conducting training for assessment and data analysis on 3, 24 February and 3,10 March, 2017. The total training time was 4 weeks with a total of 10 hours' training time.

Research Instruments

The instrument was a manual for the adaptation to climate change about 4 learning modules :

- Fundamental knowledge about climate change
- Situations of climate change
- Impacts of climate change and
- Adaptation to climate change

Assessment tools consisted of three sets of tests including :

- Knowledge relating to adaptation to climate change test
- Attitude toward adaptation to climate change test
- Awareness of adaptation to climate change test

Data Collection

This working procedure was divided into three phases.

Phase 1: Conducting fundamental data review, which involved collecting data on school geography, school curriculum, subjects that students could enrol in, and interviewing teachers about science topics taught in class

Phase 2: Creating and testing the quality of the research instrument. This phase had two categories.

The promoting tool was the manual for the adaptation to climate change. The manual contents were confined to the contents of the eighth graders' science curriculum. There were four learning modules : fundamental knowledge about climate change, situations of climate change, impacts of climate change, and adaptation to climate change.

The assessment tools used to evaluate students' levels of knowledge, attitude, and awareness of adaptation to climate change. There were three assessment tools:

- An assessment form with regard to knowledge on climate change adaptation consisted of 15 questions with 4 alternatives,
- An assessment form with respect to attitude consisted of 10 statements to which students had to agree; a five-scale rating from 1 to 5 were used, with 1 as the least level of agreement and 5 as the highest level of agreement, and
- An assessment form involving awareness which was a set of 10 statements that the students indicated their levels of agreement, based on the five-scale rating mentioned in b.

Phase 3: Environmental study transmission process divided into three steps as explained below : An introductory step was conducted in order to create a good learning atmosphere prior to the application of the manual. The administering step involved implementing of the four learning modules. During these learning steps, the students were encouraged to do group work, which involved designing strategies which support adaptation to climate change. Entertaining learning activities such as participating in competitions, games, and quizzes were also used.

The assessment step was the phase at which the students' levels of knowledge, attitude, and awareness on the adaptation to climate change were evaluated after the implementation of the manual.

Statistics for Data Analysis

Statistics used for data analysis were frequency, percentile, mean, and standard deviation.

Statistics for the assessment of equipment quality: IOC, discrimination, index of difficulty, reliability. Statistics for hypothesis verification was the paired t-test with significance at the level of .05

Conclusion

The following observations were made before and after the manual was introduced to the students :

The students' level of knowledge on climate change was low, but it became moderate after the manual was introduced. The students' knowledge score of the posttest was higher than the pretest score at 5% level of significance.

Table 2.

Compare the Differences Between Scores from Test Results Before and After Using Manual

Variable	Pre-test			Post-test			df	t	p
	$\bar{X}$	S.D.	Level	$\bar{X}$	S.D.	Level			
Knowledge (N=15)	5.66	2.33	low	9.09	2.31	moderate	31	-6.566	.000*

* significance at .05 level

The students' attitude toward climate change in the pretest was observed be at the "agree" level. After the manual was introduced, this changed to "highly agree". The attitude scores obtained in the post-test were higher than the pretest scores at the 5% level of significance.

Table 3.

Compare the Differences Between Scores from Questionnaire Results Before and After Using Manual

Variable	Pre-test			Post-test			df	t	p
	$\bar{X}$	S.D.	Level	$\bar{X}$	S.D.	Level			
Attitude (N=10)	4.10	0.19	agree	4.59	0.11	highly agree	31	-6.901	0.000*

* significance at .05 level

The students' average awareness score on the adaptation to climate change observed in the post-test was placed at the "highly agree" level.

Table 4.

Secondary School Students' Awareness with Using Manual

Variable	Post-test		
	$\bar{X}$	S.D.	Level
Awareness [N=10]	4.60	0.57	Highly agree

Discussion and Conclusion

The findings with respect to the students' average knowledge level can be attributed to the fact that the knowledge transmission in environmental studies depends on the use of effective learning medium. Both lectures and the manual were utilized to impart knowledge on the topic. The total time used for this purpose was 12 hours, which spread across a duration of 4 weeks. The increase in knowledge is partially explained by Singseewo (2011, 2015) and Veeravatananond (2012) who stated that environmental studies involve the process of making people aware of the importance of the environment. The process also broadens public understanding about people-environment relationship, which leads to higher level of attitude and awareness on the importance of environment. The children and the youth must learn that the quality of human life depends on the quality of the environment and they must have the skill and confidence needed to take action on this belief (Driskell and Chawla 2009). With greater knowledge on the environment, people tend to participate more actively in making environmental decisions and engaging in environmental care. Promoting the use of the manual for adaptation to climate change was also based on the working principles of environmental interdisciplinary approach, which emphasizes that environmental studies should encourage studying for life, life-long learning, living in harmony with nature, learning about current and future environmental issues, creating environmental etiquette, system learning, collaborative learning, integrated content teaching, problem-solving skills, and creating attitude and norms for environmental preservation (Singseewo, 2011; Veeravatananond, 2012; Singseewo and Tritip, 2016; Klakayan and Singseewo, 2016 and Singseewo, 2017).

To follow these learning principles, project-based learning is used in environmental studies to encourage students to focus on the topic of their own interest. Students conduct their own learning system, starting from analyzing the

problem, defining a problem-solving method, implementing the problem-solving strategy, and evaluating and assessing the project (Singseewo, 2017). And some research is taught socio-environmental issues using mixed methods based on adapted problem-based learning (Suksringarm, Singseewo, and Appamaraka, 2019). Conducting environmental projects (Thiragaew, 2006) allowed students do group work and plan strategies for adapting to climate change. Students were asked to present the method to the class, which made learning meaningful (Greeo, 1992). Similar findings were observed by Phugaroon (2013) who promoted the conservation of Boongpatarm swamping area among second-year environmental students from Mahasarakham University. Students' knowledge was low in the pretest and moderate in the posttest. The posttest knowledge score was higher than the pretest one at 5% level of significance. The significant difference was also evidenced in other research (Noiwong, 2014; Saijumpha, 2014; Rermsri, 2014).

As to students' attitude, the post-test score was found higher than the pretest one at the 5% level of significance. More specifically, the average attitude scores in the pretest and the post-test were rated at the "agree" and the "highly agree" levels, respectively. This may be attributed to the students being well-prepared for the activities. They were also exposed to entertaining group activities. The students took part in the question-and-answer session, which triggered their creative thinking. The assessment of the students' attitude before and after the implementation of the environment-care-promoting manual may have contributed to the significantly higher post-test score because doing the test made the students aware of the content that they had learned. The combination of these factors promoted positive attitude among the students, as Veeravatananond (2012) and Singseewo (2011) and Boottarat, Singseewo, and Poungsuk, (2021) and Kombusadee, and Kurukodt, (2021) postulated that environmental studies help students and farmers to understand the relationship between human and the environment, a type of understanding that leads to the creation of positive environmental attitude, environmental participation, and environmental etiquette among learners. Muangman and Suwan, (1986) defined attitude as an individual's mental readiness that represents the pinpointed idea and belief of each individual. Attitude, as prompted by emotion and affection, would direct the individual to act in approval for or against each particular stimulator. In a study by Worapharb (2014), a significantly higher level of attitude was also identified after a waste separation manual was introduced to a group of secondary school students in Mahasarakham's Kantarawichai district. A study by Sriwisai (2013), which aimed to promote plastic use reduction in Ban Goodpeng village in Mahasarakham's Muang District, found that villagers' average attitude score on the reduction of plastic bags was at a low level in the pretest. However, the post-test score was moderate, implying that the campaign could improve the villagers' attitude toward the reduction of plastic bags. The reason for the increase in attitude score in the post-test came from the nature of the environmental study, which engaged learners in asking and answering questions.

The students' average post-test score on the awareness of adaptation to climate change was observed at the "highly agree" level. In teaching the manual contents, the teacher gave lectures on the modules as the students were evaluated throughout the training session. The students were encouraged to work in groups and to have thoughtful discussion with their group members. Being immensely exposed to group discussion, answering questions, and having interaction with their peers contributed to the higher post-test score. Wongtanom (2004) defined awareness as a type of feeling that an individual has on a particular simulator and the particular type of feeling that the person has directs the person's reaction toward something. Gandit (2005) defined awareness as an evaluative type of feeling that an individual has on something. A similar finding was found by Jaturachai (2014) who conducted a research on the development of knowledge, awareness, and critical thinking behavior that helped reduce the severity of global warming and Jaturachai (2014) applied the idea of the Four Noble Truths and cognitive instruction methods into the teaching of environmental conservation with a group of eleventh graders. In this study, the students' levels of post-test knowledge and awareness of the reduction of global warming impact were higher than the scores observed in the pretest ($p<.001$).

In summary, the use of the manual to promote awareness on adaptation to climate change could raise the students' level of knowledge, awareness, and attitude. The students should be able to apply whatever knowledge they learned on a daily basis while expanding the idea to other people.

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