

## **Creating Learning Experience Model in Environmental Chemistry for High School Students**

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### **Abstract**

The purposes of this study were 1) to analyze environmental chemistry content and 2) to create the Learning Experience in environmental chemistry for high school students. The samples consisted of 20 students in grade 12 from high school in Phetchaburi province Thailand. The data were collected by literature review and student's achievement of pre- and post- Learning Experience Model implementation. Simple statistics including means and standard deviation were used for data analysis. The finding showed that environmental chemistry content was included in science's learning area of the Basic Education Core Curriculum B.E. 2551 of Thailand. The content of the environmental chemistry in this study was improvement water quality by chemical process and the structures of Learning Experience were content, objective, learning situation, media and evaluation. The evaluation of student's learning achievement found that the achievement of post learning was higher than pre learning and the satisfaction of learning experts on the structures of Environmental Chemistry Learning Experience was high with mean at 2.70 out of 3.00 and standard deviation (S.D.) was 0.20.

**Keywords:** Creating Learning Experience, Environmental chemistry, High school students

### **1. Introduction**

Sciences have played an important role in our present and future world communities, as it has concerned all of us in our daily lives and livelihoods. Sciences also involved technologies, instruments, devices and various products at our disposal, which facilitate our life and work. Science also improve quality of life of people for example health science and environmental science [1]. However, Thai students had scientific average mean score lower than that of standard score especially complicated scientific knowledge such as chemistry and physics according to the international scientific assessment of PISA (65 from OECD and partner countries). There were 42.8% of all students understanding chemistry and physics under minimum standard baseline (The institute for the promotion of teaching science and technology, 2010) [2]. Since, this situation was a significant education problem, a lot of researchers intend to find the

best solution to solve this issue and improve learning outcomes including: developing joyful learning method [3], using an education iPhone game and traditional game [4], using problem based learning and impact of culture process [5], using e- learning [6], learning by doing [7], learning online with large community college system [8]. Therefore, this study focused on designing Learning Experience to promote student's learning outcomes. The Learning Experience was very interesting alternative solution to enhance scientific learning outcomes because this solution could improve cognitive, psychomotor and affective domain of students [9]. The objectives of this study were to analyze environmental chemistry content and create the Learning Experience in environmental chemistry for high school students in local community of Thailand by reviewing literature from the Basic Education Core Curriculum B.E. 2551 of Thailand and designing the Learning Experience in environmental chemistry by researchers.

## **2. Sample**

The samples were chosen by purposive sampling method and there were 20 students in grade 12 from a high school located in Phetchaburi province, Thailand.

## **3. Methods**

The methodology in this study could be divided into 3 steps;

- (1) Analyzing environmental chemistry contents for high school students by literature review from the Basic Education Core Curriculum B.E. 2551 of Thailand.
- (2) Creating the Learning Experience in environmental chemistry for high school students by researchers.
- (3) Evaluating the effectiveness of Learning Experience in environmental chemistry for high school students by considering learning achievement test and satisfaction of 9 learning experts on Learning Experience designed. Because the samples in this study less than 30, this research used only simple statistics including means and standard deviation for data analysis.

## **4. Results**

### **4.1 Environmental chemistry content for high school students**

According to the Basic Education Core Curriculum B.E. 2551 of Thailand, there were 8 learning areas in which every student had to know including, (1) Thai Language, (2) Mathematics, (3) Science, (4) Social Studies, Religion and Culture, (5) Health and Physical Education, (6) Arts, (7) Occupation and Technology, and, (8) Foreign Language. Environmental Chemistry was not a main learning area but it was inserted in Science. Students in grade 12 had to achieve 3 domains including cognitive, psychomotor and affective domains therefore, they had to understand many kinds of important particles that form components of atomic structures, sequencing of elements in the Periodic Table, chemical reactions and writing chemical equations, factors affecting rates of chemical reaction, understand kinds of binding forces between particles and various properties of substances that are related to binding forces. Moreover, they

had to show interest, dedication, responsibility, care and honesty in investigating and seeking knowledge by applying instruments and methods that yield accurate and reliable results and show recognition, care and concern as well as appreciative behavior for utilization and conservation of natural resources and the environment and volunteer to cooperate with the community for protection and care for natural resources and local environment.

As indicated above, this study was to create environmental chemistry content for high school students involving improvement water quality by chemical process as follows:

(1) The important of chemical process for the environment

Chemistry is a basic science whose central concerns were the structure behavior of atoms, the composition and properties of compounds, the reactions between substances with their accompanying energy exchange, and the laws that unite these phenomena into a comprehensive system. In general, chemical reagents were applied as a significant tool for solving environmental problems especially water quality treatment such as alum, lime and chlorine. The benefits of chemistry for environmental operation were easy to use, costly, and convenient.

(2) Simple water treatment by chemical process

Suspended solid in wastewater was sunk by chemical reagents namely alum, aluminum salt, and organic polymer which easy to find in household as well as this process was called coagulation and fluctuation process. For more detail, coagulation was a process used to neutralize charge and from a gelatinous mass to trap particles thus forming a mass large enough to settle or be trapped in the filter. Flocculation was gentle stirring to encourage the particles thus forming to agglomerate into masses large enough to settle or filtered from solution.

In water treatment, coagulation and flocculation were practically always applied subsequently before physical process. The coagulation and flocculation consisted of the following steps:

(1) Coagulation and flocculation: using chemical reagent such as alum in household to destabilize and increase the size of the particles; mixing; increasing of flog size.

(2) A physical separation of the solid form liquid: this separation was usually achieved by sedimentation, flotation or filtration.

## **4.2 The Learning Experience in Environmental Chemistry for high school students**

### **4.2.1 The components of the Learning Experience**

Learning Experience was enthusiasm expression of student on learning situation designed by instructor [10]. Students could change their behavior depend on the Learning Experience designed. From Lawan's model [9] Learning Experience consists of 6 components as following:

(1) The appropriate content had to be related with local environmental niche and student's characteristics.

(2) The content had to cover fact or doing elements.

(3) The objective had to be educational objective including cognitive, psychomotor and affective domain.

(4) The learning situation included instructor's behavior and student's behavior. Instructor's behavior with providing learning activities for students and student's behavior interacted with those learning activities.

(5) The media as tools for supporting students understand the content.

(6) The evaluation of student's behavior in learning situation assessment according to standard criteria.

#### 4.2.2 The Learning Experience in Environmental Chemistry

This study was designed to present environmental chemistry involving improvement water quality by chemical process as the Learning Experience for high school students. The details were shown in Table 1.

### 4.3 The effectiveness of Learning Experience in Environmental Chemistry for high school student's evaluation

#### (1) Student's learning outcomes

The evaluation of student's learning outcomes found that every student had higher post-test score (12.92) than pre-test score (15.31) (Table 2).

As indicated above, this research found that repeated explanation and demonstration until the learners got the objective was the importance key of effectiveness [11]. Because of complicated content, the learners needed more time to understand. Repeated explanation was the positive method to reach student's learning outcome but the negative side of this learning situation was waste of time. Therefore, the learning situation designed in this research was appropriate for infinite study time or more than 20 minutes.

#### (2) The satisfaction of 9 learning experts on the Learning Experience

The level of satisfaction in learning experts on all structures of the Learning Experiences in Environmental Chemistry topic in improvement water quality by chemical process for high school students was high as indicated in Table 3.

Table 1. The Learning Experience in Environmental Chemistry for high school students.

Content	Objective	Learning situation		Media	Evaluation
		Instructor	Learners		
The importance of chemical process for the environment.	To explain the important of chemical process for the environment.	1. Explained content about the meaning and importance of chemical process for the environment. 2. Asked the students about the meaning and the importance of chemical process for environment. 3. Explained the content again if the students could not answer 100 % correctly.	1. Listened 2. Answered 3. Listened and answered again if they could not answer 100 % correctly	1. Chemical reagents such as alum, lime and chlorine. 2. The benefit of chemical process for environmental diagram.	Every student answered the question at 100 % correctly.
The simple water treatment by chemical process.	Explained about how to use chemical reagent for water treatment and the chemical process of water treatment.	1. Explained content about how to use chemical reagent for water treatment and the chemical process of water treatment. 2. Demonstrated how to use alum to improve water 3. Asked the question about chemical improvement process. 4. Explained and demonstrated again if the student could not answer at 100 % correctly.	1. Listened 2. Watched. 3. Answered 4. Listened and watched the demonstration again if they could not answer 100 % correctly.	1. Wastewater 2. Alum 3. Water improvement process.	Every student explained about chemical improvement process at 100 % correctly.

Table 2. The student's learning outcomes.

Learning outcomes (Full score = 20)		Percent of increment	S.D.
Pre-test	Post-test		
12.92	15.31	11.92	0.20

Table 3. The satisfaction of learning experts on the Learning Experience's components.

Components	Score (full score=3.00)	S.D.
Content	2.89	0.33
Objective	2.89	0.33
Instruction's learning situation	2.89	0.33
Learner's learning situation	2.67	0.50
Media	2.67	0.50
Evaluation	2.44	0.73
Timing	2.44	0.53
Overall	2.89	0.33

As indicated above, this research found that the level of satisfaction in 5 structures of the learning experience such as content, objective, instruction's learning situation, learner's learning situation and media were higher than evaluation and media. Because of limiting time, not only instructor but also learner needed more time to get their objective. The instructor needed time for explanation, demonstration question and evaluation while as the learner needed more time for listening, watching, understanding and answering [12]. For this reasons, the importance condition for using this model in the future was appropriate time. The suitable time should be fit for all activities or more than 20 minutes.

## 5. Conclusion

The objectives of this research were analysing environmental chemistry content for high school students and creating the Learning Experience in Environmental Chemistry for high school students. The results showed that high school students understood complicated sciences especially environmental chemistry by Learning Experience designed by this study because of learning situation. Repeated explanation and demonstration until the learner reached the purpose was the reason that affecting student had post-test score higher than that of pre-test score. As indicated from the satisfaction of learning experts, this study could conclude that Learning Experience in Environmental Chemistry topic in improvement water quality by chemical process was appropriate for high school students and it could promote student's learning outcomes.

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