A Development of Science Laboratories on "The Basic of Wastewater Management for Students Living Along Saen Saeb Canal"

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Abstract
There were four purposes of the study: 1) to develop and identify the educational qualities of science laboratories **"**The Basic of wastewater management for students living along Saen Saeb canal". 2) to study learning outcomes with regard to the knowledge of Mathayom 1(grad 7) in science laboratories 3) to study the Mathayom 1 students' attitudes toward water resources in the science laboratories and 4) to study the Mathayom 1 students' toward satisfaction in the science laboratories.
The study was accomplished through two stages of operation: 1) The development and quality evaluation of science laboratories by teaching experimentation with a group of three students and nine students successively, and 2) the performance of experimental teaching by inviting a single sample group (sampled from 4 classes of 40 Mathayom 1 students, from Kasemphitaya school, Bangkok, Thailand) for 16 periods (50 minutes a period) of experimental teaching.
The results were as follows:
1) The science laboratories were of a high educational quality (very good level). 2) Learning outcomes of students exposed to instruction utilizing the developed science laboratories were found to be positive: the students' post-test scores on knowledge were significantly higher than their pre-test scores, 3) Students' post-test scores with regard to attitude toward water resources were designated as at a "good level". 4) The students' toward satisfaction in the science laboratories were of a highly level.

Keywords: science laboratories, attitude toward water resources, basic of wastewater management for students

Introduction

The Saen Saeb canal was built by the order of King Rama III during the conflict between Siam and Annam about Cambodia to establish a water transport for soldiers and weapons to Cambodia. The construction started in 1837 and was completed three years after. [1] Saen Saeb canal was once filled with and abundance of lotus, King Rama IV in his 4th reign (1851-1868) built Sra Pathum Palace (Lotus Pond Palace) in Siam District. The Saen Saep starts from Mahanak canal or Khlong Mahanak around Mahakan Fortress in Bangkok, and terminates into the Bang Pa Kong River in Chachoengsao province. [1]

In the past, canals in Bangkok had an important role in the boat transport, commerce, agriculture and domestic consumption, and there were many communities along the canals. At present, the current social and economic situations are changing as an urban society is expanding from inside to outside. In the metropolitan area, buildings are congested along the canals where have become residential and business areas as well as are a key route for the water transportation. Such rapid changes have made the water quality in any canal including Saen Saeb canal poor. [2]

There are various factors affecting the water quality in Saen Saeb canal and the following factors contribute to the problems: 1) excessive organic inputs from tributaries, households, businesses and industries, point- and non-point sources; 2) too much sediments in the water and at the bottom of the canal which generate a high oxygen demand for the water; 3) resuspended sediments due to the shallow depth and turbulence from the boats; and 4) waves from the boats which are not dissipated due to the fast speed of boats and the vertical nature of the walls; as a result the waves last for excessively long time and exacerbate the sediment resuspension. [3]

The water quality data from research found that the amount of dissolved oxygen (Dissolved Oxygen: DO) is between 0.3 to 3.1 milligrams per liter Which is somewhat lower than the standard four types of surface water, which was set to 2 milligrams per liter. While the impurities in the form of BOD (BOD: Biochemical Oxygen Demand), the average is between 4.3 to 15.3 milligrams per liter. Which is higher than the standard four types of surface water, which is equal to 4 mg per liter for the polluted water. [4] Caused by the buildings along the canal, very keen to have a proper waste water management systems. Some buildings are equipped with septic - water seepage. Which is sufficient to treat wastewater to meet regulatory standards related to the sewage plant of some kind. As well as some of the measures to control the discharge of effluent from land. Gasoline service station. The community wastewater treatment system to discharge wastewater into public waterways. If the people do not realize the importance of the canal was not then aware of the development and rehabilitation. In the coming years will be very keen to ditch the crisis. Affect the quality of water that can not be utilized. [5]

Therefore, the two ways to solve the problems and reduce the impact are: 1) to encourage all office buildings in Bangkok to effectively operate sewage system in the entire area; and 2) to educate people, residents and students about maintaining the water quality in the canal, generating enthusiasm for the long-term canal conservation. [6]

So in science teaching for students living along Saen Saeb canal, the researcher developed of the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal", were divided into 6 laboratories directions: 1) Basic Investigation of Water Quality, 2) How to make a home grease trap, 3) How to make the water clear by sedimentation, 4) How to make a simple water filter, 5) Biological wastewater treatment and 6) Let's find out how to improve water quality. The researcher expects the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal" will encourage students to have an understanding of the basic of wastewater management. Students will have more attitudes towards water resources higher environmental conservation. This will result in sustainable solutions to environmental problems in the community. [7]

Research goals:

1. to develop and identify the educational qualities of science laboratories "The Basic of wastewater management for students living along Saen Saeb canal".

2. to study learning outcomes with regard to the knowledge of Mathayom 1 (grad 7) in science laboratories.

3. to study the Mathayom 1 students' attitudes toward water resources in the science laboratories.

4. to study the Mathayom 1 students' toward satisfaction in the science laboratories.

Methods

The study was accomplished in 8 steps:

1) Development of the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal" into 6 laboratory directions : 1) Basic Investigation of Water Quality, 2) How to make a home grease trap, 3) How to make the water clear by sedimentation, 4) How to make a simple water filter, 5) Biological wastewater treatment and 6) Let's find out how to improve water quality.

2) Determination of the quality of the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal", by specialist science teachers. A total of 5 people evaluated five areas: 1) Objectives, 2) Content, 3) Experimental method, 4) Experimental equipment and 5) Post-Test. Each area was evaluated with one of the following ratings: [8]

1.00 -1.50 = very low
1.51-2.50 = low
2.51- 3.50 = medium
3.51-4.50 = good
4.51-5.00 = Very good

3) Evaluation of the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal",by conducting a teaching experimentation with a group of three students and nine students successively, before the real trial.

4) Performance of experimental teaching by inviting a single sample group (sampled from 4 classes of 40 Mathayom 1 students, from Kasemphitaya school, Bangkok, Thailand) for 16 periods (50 minutes a period) of experimental teaching.

5) Evaluation of the students' learning outcomes with regard to the knowledge in science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal".

6) Evaluation of attitude toward water resources in the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal".Tests to measure attitudes toward environment used three levels as follows: 0 = low, 1 = medium, 2 = good. The evaluation criteria was set at 2.00 (good level) or higher.

7) Evaluation of students' toward satisfaction in the science laboratories, through studying the in the science laboratories on **"**The Basic of wastewater management for students living along Saen Saeb canal". Tests to measure toward satisfaction of the science laboratories used five levels, as follows:

1.00 -1.50 = very low
1.51- 2.50 = low
2.51- 3.50 = medium
3.51-4.50 = high
4.51-5.00 = highest

The evaluation criteria was set at 4.00 high.

Results

The results of the research were as follows:

1. The quality of the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal"was divided into 6 laboratory directions: 1) Basic investigation of water quality, 2) How to make a home grease trap, 3) How to make the water clear by sedimentation, 4) How to make a simple water filter, 5) Biological wastewater treatment and 6) Let's find out how to improve water quality, by a total of five specialist science teachers, who evaluated five areas: 1) Objectives , 2) Content, 3) Experimental method, 4) Experimental equipment and 5) Post-Test. The details reshown in Table 1.

Table 1: The quality of the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal", evaluated by a total of five specialist science teachers.

Areas / Laboratory	Objectives	Content	Experimental methods	Experimental equipment	Post-Test	$\overline{X}$	Levels
1) Basic Investigation of Water Quality	4.40	4.60	4.40	4.40	4.40	4.44	good
2) How to make a home grease trap	4.60	4.40	4.40	4.60	4.40	4.48	good
3) How to make the water clear by sedimentation	4.40	4.60	4.40	4.40	4.60	4.48	good
4) How to make a simple water Filter	4.60	4.40	4.60	4.40	4.40	4.48	good
5) Biological wastewater treatment	4.40	4.40	4.60	4.20	4.40	4.40	good
6) Let's find out how to improve water quality	4.40	4.80	4.40	4.60	4.60	4.56	very good
Total Average	good 4.46	very good 4.53	good 4.46	good 4.43	good 4.46	good 4.47	**good**

Table 1 Shows the quality of the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal"evaluated by specialist science teachers. Quality was evaluated across five areas: 1) Objectives, 2) Content, 3) Experimental method, 4) Experimental equipment and 5) Post-Test. The respective averages of each area were as follows: 4.46 good, 4.53 very good, 4.46 good, 4.43 good, 4.46 good, while the total average across all areas was 4.47 good.

2. Achievement of knowledge learning outcomes, among students who used knowledge in science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal", was assessed using the average pretest and posttest scores. The details of the results are shown in Table 2.

Table 2: The comparison of the achievement of knowledge learning outcomes among students who used the, assessed by pretest and posttest.

average score	n	$\bar{x}$	SD	df	t
pre-test	40	20.28	1.49		
				39	4.32*
post-test.	40	29.55	1.32		

Table 2 compares the average achievement of knowledge learning outcomes among students who used the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal", assessed by pretest and posttest. The increase in posttest scores on pretest scores was statistically significant .05.

3. Evaluation of attitudes toward water resources among students learning in science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal". The details are shown in Table 3.

Table 3: The average post-test score on attitude toward water resources among students learning in science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal"

average score	n	$\bar{x}$	SD	μ=2	df	t
post-test	40	2.78	0.47	2	39	2.25*

Table 3 Shows the average post-test score of attitudes toward water resources among students learning in science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal". The average value of 2.78 (good level) was higher than the criteria set at 2.00, and was statistically significant .05.

4. Evaluation of students' toward satisfaction in the science laboratories, through studying the in the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal". The details were shown in Table 3.

Table 3: The average posttest score of students'toward satisfaction in the science laboratories, through studying in the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal"

average score	n	$\bar{x}$	SD	μ=4	df	t
post-test	40	4.23	0.30	4	39	4.28*

Table 3 Shows the average post-test score of students'toward satisfaction in the science laboratories, through studying in the science laboratories on **"**The basic of wastewater management for students living along Saen Saeb canal". The average value of 4.28 (high level) was on the same level as the criteria set at 4.00, and was statistically significant .05.

Conclusions

The results were as follows:

1) The science laboratories were of a high educational quality (very good level). Since the development of the science laboratories on "The basic of wastewater management for students living along Saen Saeb canal" has developed a systematic and through evaluation by experts in the various fields fully and improve the efficiency in the standard reliable prior to the actual trial.

2) Learning outcomes of students exposed to instruction utilizing the developed science laboratories were found to be positive: the students' post-test scores on knowledge were significantly higher than their pre-test scores.

3) Students' post-test scores with regard to attitude toward water resources were designated as at a "good level".

4) The students' toward satisfaction in the science laboratories were of a highly level.

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