The Development of Science Activity Packages Learning on "The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)" for Mathayomsuksa 1. Students

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Abstract

There were three Purposes of the study: 1) to development and identify educational quality of science activity packages learning on "The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)". 2) to study learning outcomes; knowledge and science process skills of Mathayomsuksa 1. (Grade 7) Students by science activity packages learning on "The Impact of PM.2.5" and 3) to study attitude toward environment of MS. 1. Students by science activity packages learning on "The Impact of PM.2.5". The study was accomplished through two stages of operation; 1) development and quality evaluation of science activity packages learning by the experts and conducting a teaching experimentation with a group of three students and nine students successively. 2) performing experimental teaching by employing the science activity packages learning with the sampling coming up with a group in one class (from 4 class of 40 MS.1 of Sriboonyanon school) for 14 periods (50 minutes a period) for the experimental teaching. The results were as follows:

1. The science activity packages learning were at higher educational quality good level.
2. Learning outcomes of students exposed to instruction utilizing the developed science activity packages learning were found positive: 1) students' post-test scores on knowledge were significantly higher than their pre-test scores. 2) students' post-test scores on science process skills were significantly higher than their pre-test scores.
3. Students' post-test scores on attitude toward Environment designated as "good level".

Keywords: Science Activity Packages Learning, Impact of Particulate Matter 2.5 Micrometer, Attitude Toward Environment

Introduction

Air pollution has emerged as a critical global environmental issue, particularly in developing countries. The extensive use of machinery in construction, industrial processes, and agriculture has led to widespread health and ecosystem impacts. Among various air pollutants, fine particulate matter (PM2.5) has garnered significant attention due to its severe adverse health effects on humans. In Thailand, like many developing countries, has experienced rapid industrialization and urbanization, leading to a deterioration in air quality. PM2.5, consisting of tiny particles with a diameter of 2.5 micrometers or less, poses a serious threat to public health. The primary sources of PM2.5 in Thailand include industrial emissions, vehicular exhaust, and biomass burning. These emissions contain harmful substances such as heavy metals, organic compounds, and sulfates, which can penetrate deep into the respiratory system and cause a variety of health problems.

Solving the problem of PM2.5 pollution is a complex environmental challenge that requires cooperation from various stakeholders. Multi-faceted strategies are important at multiple levels. At the government level, stringent regulations and policies should be implemented to reduce air pollution, promote sustainable energy sources, and invest in the research and development of pollution-reducing technologies. In the private sector, businesses should be encouraged to adopt environmentally friendly practices, such as using green technologies and promoting public transportation among employees. At the community level, individuals can play a key role in reducing polluting behaviors, including limiting the use of private vehicles, avoiding the burning of agricultural waste, promoting waste segregation, and actively participating in community tree-planting programs. These efforts are essential to further improve air quality and create a sustainable environment over time.

As schools should play an important role in teaching about the impact of PM2.5 so that students have knowledge and understanding of how to improve air quality through various methods to reduce the impact of PM2.5 by preparing such content to be inserted in related subjects, especially science, which has experimental equipment ready for students to seek knowledge appropriate to the content. Teachers should develop a set of learning activities on science about the impact of PM2.5 to be used as a guideline for students' learning. Students will learn by themselves and put it into practice until they achieve success and self-esteem, which will inspire students to try to seek the truth, resulting in knowledge, thinking skills, scientific process skills, and promoting students' creativity in developing knowledge and attitudes towards environmental conservation.

As a researcher who is a science teacher of MS.1, I saw the importance of this problem. Therefore, I created a set of science activities for learning on the topic of "The Impact of PM2.5 Micrometer (PM.2.5)", which is divided into 7 units: 1) Sources of PM2.5, 2) Impacts of PM2.5 on Living Things, 3) Methods of Measuring PM2.5, 4) Methods of Preventing Danger from PM2.5, 5) Equipment for Preventing Danger from PM2.5, 6) Testing Plants That can Absorb PM2.5, and 7) Proposing Science Projects to Improve Areas Affected by PM2.5. The researcher expects that the set of science activities will help students gain knowledge and understanding in preventing dangers from PM2.5. In addition, students will have more scientific process skills and attitudes towards environmental conservation, which will result in being able to solve the PM2.5 problem in the community sustainably.

Research goals:

1) To development and identify educational quality of science activity packages learning on “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)”.
2) To study learning outcomes; knowledge and science process skills of MS. 1. Students by science activity packages learning on “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)”.
3) To study attitude toward environment of MS. 1. Students by science activity Packages learning on “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)”.

Methods

The study was accomplished in 8 steps:

1) Development of the science activity packages learning on “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)” were divided into 7 units: 1) Source of PM.2.5, 2) Effects of PM2.5 on living organisms, 3) Methods of measuring PM2.5, 4) How to prevent danger from PM.2.5, 5) Equipment to protect against PM 2.5 hazards, and 6) Testing plants that can absorb PM2.5, and 7) Propose a science project to improve areas affected by PM 2.5.
2) Determination of the quality of the science activity packages learning on “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)”, by specialist science teachers. A total of 5 people evaluated five areas: 1) contents, 2) using language and illustrations, 3) learning activities, 4) experimental kit, and 5) post-test. Each area was evaluated with one of the following ratings:
    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) The evaluation results of the science activity set “The Impact of Particulate Matter 2.5 Micrometer (PM.2.5)” were used to adjust and revise its quality. This process was guided by expert advice until the evaluation results reached at least "Good." The revised activity set will then be used for experimentation with groups of 3 and 9 students.
4) Evaluation of the science activity packages learning by specialist science teachers, by conducting a teaching experimentation with a group of three students and nine students successively, before the real trial.
5) Performance of experimental teaching by inviting a single sample group (sampled from 4 classes of 40 MS. 1 (grade 7) students, from Sriboonyanoon school, Nonthaburi, Thailand) for 14 periods (50 minutes a period) with the following details: 1.) Source of PM.2.5, 1 periods, 2) Effects of PM2.5 on living organisms, 2 periods, 3) Methods of measuring PM2.5, 2 periods, 4) How to prevent danger from PM.2.5, 2 periods, 5) Equipment to protect against PM 2.5 hazards, 2 periods, 6) Testing plants that can absorb PM2.5 well, 2 periods, and 7) Propose a science project to improve areas affected by PM2.5., 3 periods. Every activity will use the method of teaching and learning by searching for knowledge using scientific methods, from observation, from experimentation, from searching online, and then discussing together to summarize new knowledge points and discussing together how to use such knowledge to solve the problem of PM.2.5.

Figure1: Students Experiment With Using PM2.5 Measuring Devices to Measure Dust Levels in the School Area Near the Chao Phraya River

Figure 2: Students Experiment With Using a PM2.5 Measuring Device to Measure Dust Levels in a Garden Area Inside the Classroom

Figure 3: Students Presented Their Learning Outcomes Through Each Learning Activity Set

6) Assessment of students' knowledge gained from learning in the science activity packages learning on, "The impact of particles of 2.5 micrometers (PM.2.5)", which divides the assessment of the desired behavior into 4 areas: 1) knowledge, 11 points,

2) comprehension, 12 points, 3) Process of scientific inquiry, 8 points, 4) Application of scientific knowledge, 9 points, total 40 points.

7) Assessment of students' scientific process skills gained from learning in the science activity set on "The Impact of 2.5 Micrometer Particles (PM.2.5)", which divides the assessment of desired skills into 8 areas: 1) Observation, 3 points, 2) Measurement, 4 points, 3) Calculation, 5 points, 4) Classification, 8 points, 5) Hypothesis, 6 points, 6) Data analysis, 3 points, 7) Experimental skills, 8 points, 8) Interpretation data and conclusion skills, 3 points, total 40 points.
8) Evaluation of attitude toward environment, through learning in science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)”, which divides the assessment of desired skills into 3 areas: 1) Environmental conservation awareness, 2) Environmental conservation behavior, 3) Efficient resource utilization behavior. Tests to measure attitudes toward environment used three levels as follows: 0 = low, 1 = medium, 2 = good. The evaluation criteria were set at 2.00 (good level) or higher.

Figure 4: The Assessment of Students’ Scientific Process Skills Gained From Learning in the Science Activity Set on “The Impact of 2.5 Micrometer Particles (PM.2.5)”

Results

The results of the research were as follows:

1. The quality of the science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)” were divided into six units: 1) Source of PM.2.5, 2) Effects of PM2.5 on living organisms, 3) Methods of measuring PM2.5, 4) How to prevent danger from PM.2.5, 5) Equipment to protect against PM 2.5 hazards, and 6) Testing plants that can absorb PM2.5, and 7) Propose a science project to improve areas affected by PM.2.5, by a total of five specialist science teachers, who evaluated five areas: 1) contents, 2) using language and illustrations, 3) learning activities, 4) experimental kit and 5) post-test. The details are shown in Table 1.

Table 1: The Quality of the Science Activity Packages Learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)", Evaluated by a Total of Five Specialist Science Teachers

Areas / **Units**	Contents	Using language and illustrations	Learning activities	Experimental kit	Post-test	$\overline{X}$	Levels
Source of PM.2.5	4.62	4.52	4.62	4.44	4.52	4.54	very good
Effects of PM2.5 on living organisms	4.80	4.48	4.65	4.60	4.46	4.59	very good
Methods of measuring PM2.5	4.48	4.45	4.47	4.53	4.45	4.47	good
How to prevent danger from PM.2.5.	4.46	4.45	4.58	4.45	4.40	4.47	good
Equipment to protect against PM 2.5 hazards	4.40	4.51	4.53	4.40	4.43	4.45	good
Testing plants that can absorb PM2.5	4.52	4.52	4.52	4.43	4.48	4.49	good
Propose a science project to improve areas affected by pm2.5.	4.80	4.46	4.55	4.48	4.43	4.54	very good
Total average	very good 4.58	good 4.48	very good 4.56	good 4.47	good 4.45	**4.50**	**good**

Table 1 shows the average quality of the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)" evaluated by specialist science teachers. Quality was evaluated across five areas: contents, using language and illustrations, learning activities, experimental kit and post-test. The respective averages of each area were as follows: 4.58 very good, 4.48 good, 4.56 very good, 4.47 good, 4.45 good, while the total average across all areas was 4.50 good.

2. Achievement of learning outcomes among students who used the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)" was assessed using the average pretest and post-test scores. The details of the results are shown in Table 2.

Table 2: The Comparison of the Achievement of Learning Outcomes Among Students Who Used the Science Activity Packages Learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)", Assessed by Pre-test and Post-test

Average score	n	$\bar{x}$	SD	df	t
Pre-test	40	20.89	1.49	39	4.30 *
Post-test	40	28.48	1.58	39	

Table 2 compares the average achievement of knowledge learning outcomes among students who used the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)" assessed by pre-test and post-test. The increase in post-test scores on pre-test scores was statistically significant .05.

3. The achievement of learning outcomes with regard to science process skills in the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)" was assessed by comparing the average pretest and post-test scores. The details are shown in Table 3.

Table 3: The Comparison of the Average Achievement of Learning Outcomes, With Regard to Science Process Skills, Among Students in the Science Activity Packages Learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)" This Was Assessed Using Pre-test and Post-test

Average score	n	$\bar{x}$	SD	df	t
Pre-testt	40	20.29	1.48	39	4.33*
Post-test	40	29.53	1.32		

Table 3 compares the average student achievement of learning outcomes, with regard to science process skills, the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)", using pre-test and post-test scores. The increase in post-test scores on pre-test scores was statistically significant .05.

4. Evaluation of attitudes toward water resources among students learning in the science activity packages learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)". The details are shown in Table 4.

Table 4: The Average Post-test Score on Attitude Toward Environment Among Students Learning in the Science Activity Packages Learning on "The Impact of 2.5 Micrometer Particles (PM.2.5)"

Average score	n	$\bar{x}$	SD	μ=2	df	t
Post-test	40	2.78	0.45	2	39	2.26*

Table 4 shows the average post-test score of on attitude toward Environment among students learning the science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)”. The average value of 2.78 (good level) was higher than the criteria set at 2.00, and was statistically significant .05.

Conclusions

The results were as follows:

1) The science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)” were of a high educational quality (good level).
2) Learning outcome achievement among students exposed to instruction utilizing the developed the science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)” was found to be positive: 1) Students’ post-test scores on knowledge were significantly higher than their pre-test scores. 2) Students’ post-test scores on science process skills were significantly higher than their pre-test scores.
3) Students’ post-test scores on attitude toward environment, among students learning in the science activity packages learning on “The Impact of 2.5 Micrometer Particles (PM.2.5)”, were designated as at a “good level.”

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