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The Effect of Using Philosopher's Heart Principle on Primary School Students' Scientific literacy and Language abilities: The Study in Thailand

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Abstract. Scientific literacy is claimed as a slogan of science education, that why many research tried to promote students scientific literacy. The objective of this study was to examine the effectiveness of the science learning units following the Philosopher's Heart Principle (PHP) on scientific literacy and language abilities for sixth grade in the topic of matter and properties of matter. The participants were two classrooms (62 students) by randomly selected using cluster sampling. One classroom would be the experimental group and another would be the control group. The research instrument was scientific literacy and language abilities test. The data was statistically analyzed by using t-test for independent sample before and after completing the learning units. The results indicated that the scientific literacy and language abilities mean scores, of the experimental group, were statistical significantly higher than the control group at the .05 level.

Keywords: scientific literacy, language abilities, Philosopher's Heart Principle

1. Introduction

In the era of intense economic competition, manufacturers also need scientifically literate workers who have a good understanding of, and the ability to do science (Yuengyong, 2009)[1]. Moreover, rapid expansion of the number of scientific and technological products becomes increasingly a part of everyday life, this means everyone needs to have some scientific literacy so as to make decisions and engage in debates about scientific issues (Tasakorn & Pontabodee, 2005)[2]. As Laugksch[3] (2000) pointed out that the benefits of promoting scientific literacy that result in the progression of national economies, science itself, science policy, and democratic practices. Moreover, individuals who have scientific literacy in the appropriate level have more chances to negotiate ways of living.

The NRC states the individual should have the awareness of the impacts of science and technology on the individual and society, and have the ability to read, write and participate in conversations about science as well (NRC, 1996)[4]. There are a number of definitions of scientific literacy proposed, for example, National Research Council (NRC) defines scientific literacy as the knowledge and understanding of key science concepts and principles, the application of scientific knowledge and scientific ways of thinking for individual and social purposes. In Thailand, the Ministry of Education defined the term "scientific literacy" as having knowledge and understanding of science concepts, basic principles and science process skills;

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having scientific minds; and enabling individuals to utilize them for living and communicate with others (Ministry of Education, 2002)[5]. Yuengyong (2009) stated that the definition of scientific literacy in Thailand related to the application of science knowledge with respective social economic, technology, value and cultural surroundings.

Osborne[6] (2000) and Hodson[7] (2003) mentioned to scientific literacy that can be perceived in four different ways .1) Cultural is developing the capacity to read about and understand issues relating to science and technology in media. 2) Utilitarian is having the knowledge, skills, and attitudes that are essential for a career as scientist, engineer or technician.. 3) Democratic is the broadening knowledge and understanding of science to include the interface between science, technology, and society. 4) Economic is formulating knowledge and skills that are essential to the economic growth and effective competition within the global market.

Glynn and Muth[8] (1994) stated that achieving the goal of scientific literacy, students should not only have knowledge and ability in science itself, but also have the reading ability to evaluate informational science text and the writing ability to communicate their thoughts to others. Likewise, Norris and Phillips[9] (2003) indicated that fundamental language abilities such as reading and writing are necessary for everyone to communicate or participate in conversations about science related issues. Thus, to improve scientific, literacy the integration of science and language abilities would be an effective approach.

The Philosopher's Heart Principle [PHP] or the SU JI PU LI principle, is one of the principles that is known by all Thais. This principle is claimed as an effective method for learning which learners can practice language skills and improve academic achievement. The PHP is related to language use skills which consists of four learning skills including: 1) listening; 2) thinking; 3) questioning; and 4) writing (Tungcharoen, 2009)[10]. H.R.H. Princess Maha Chakri Sirindhorn[11] (1999) mentioned the components of PHP as follows: SU abbreviated from SU-TA-MA-YA-PAN-YA, which means the wisdom comes from perceiving data such as listening, reading, or even searching data from any sources. JI abbreviated from JIN-TA-MA-YA-PAN-YA, which means the wisdom comes from thinking. When the individual received new information, they should reasonably think to judge and make decisions, about those data, as to if they should rely on it or not. PU abbreviated from PUD-CHA, which means questioning. After perceiving and analyzing data, the individuals should ask for additional information or determine answers to questions for constructing new knowledge. Therefore, a questioning skill is an important learning skill for gathering knowledge and experience. LI abbreviated from LI-KIT, which means writing or journaling. After finding out an answer, message receivers should keep a record of data for memorizing or even communicating their findings to others. Writing today does not use only pens or pencils, but also covers saving files in a database. In summary, the PHP is a Thai principle, which combines using basic language skills for the individuals to learn and accumulate knowledge to become literate.

Yosaphattharapinyo[12] (2004) supported the idea that the use of the PHP could encourage students' interest in science learning, specifically, students were more confident to ask questions, paid attention to learning, and authorized themselves to keep records after receiving new data. In addition, Kanchanakunchon[13] (2007) stated that using learning activities using the PHP as a guiding principle could improve students' mathematics achievement and communication skills. Rithdech[14] (2006) and Rithdech[15] (2010) also supported the idea that the PHP principle could develop students' analytical thinking and Thai language achievement. This draws on literature reviews that using the PHP as a guiding principle may be a learning approach that is suitable for promoting Thai students' scientific literacy and language abilities at the primary school level.

2. Research Aim and Hypotheses

The purpose of the study was to examine the effect of using science learning units following the Philosopher's Heart Principle on sixth grade students' scientific literacy and language abilities in the Bangkok Metropolitan Area, Thailand. There are two hypotheses as follows;

The scientific literacy mean score, of the experimental group is higher than the control group.

The language abilities mean score, of the experimental group is higher than the control group.

3. Research Question

What is the effect of using science learning units following the Philosopher's Heart principle on Thai students' scientific literacy and language abilities?

4. Method

4.1. Participants

Participants included 62 sixth grade students from a middle-size school under the Department of Education Bangkok Metropolitan Administration located at Phayathai district, Bangkok Thailand. All students were studying in the first semester of the 2011 academic year. Two classrooms were randomly selected from four classrooms using the cluster sampling. One classroom would be assigned as an experimental group taught by using science learning units following the PHP while another would be the control group taught by using normal instruction guided from IPST teacher's manual. The two groups did not differ significantly on any demographic variables.

4.2. Science learning units

Science learning units following the Philosopher's Heart Principle applies the PHP as the guided learning principle to construct learning activities. The learning units compose of three instructional steps: 1) engagement (E), 2) operation (O), and 3) evaluation (E) as shown in FIGURE 1. Engagement step was the step of starting new lessons and examining students' prior knowledge. During this step, students are stimulated in their learning motivation through talking, questioning or even doing an activity. The developed learning units consist of nine lesson plans, learning activities, instructional materials, and assessment and evaluation guides for the teacher. The scope of the content are properties of matter, changes of substances, separation of substances, and substances used in daily life which is specified for sixth grade students in 2008 basic core curriculum. An example of learning activities that applied the PHP was an activity in the separation of mixtures topic. In the first E step, the teacher had the experimental group students read a short tale about inventing simple water filters. The story was a boy-scout group lost in the jungle and everybody was very thirsty. One of them suggested how to invent a simple water filter by using available materials found in the jungle. After that the teacher had students thought about and addressed the problem that the characters faced with. In the O step, the teacher brought materials, the same as appeared in the story, and let students in each group proposed a way to arrange those materials in order. Then, the students conducted the proposed experiment and recorded their results. In addition, the students were able to repeat or renovate their experiment to find the best way in receiving the clearest water. In the last E step, the students drew a conclusion and communicated their results to others.

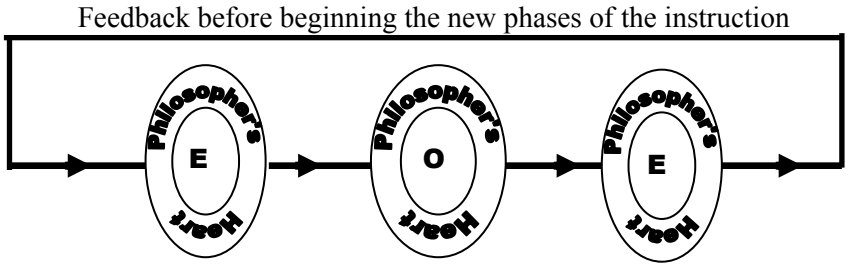

Fig 1. Three instructional steps in Science learning units following the Philosopher's Heart Principle

MeasuresScientific literacy and language abilities test [SLT] developed by the researcher consists of two parts. The first part was a scientific literacy and reading ability test [SRT]. The scientific literacy test measures three dimensions of SL: 1) Explaining phenomena scientifically, 2) Identifying scientific/science issues, and 3) Using scientific evidence. The reading ability test measures student's performance in retrieving information and interpretation of that information. The SRT test is composed of 30 multiple choice test items that some items are assigned to measure scientific literacy or reading ability whereas some are able to measure both performances. The reliability of SRT was 0.75. The second part was writing ability test that measures writing performance in story ordering, idea communicating, word spelling, and picture narrating.

The test was a writing essay from selected picture in the topic of "Destroyed Nature". The Pearson correlation of the writing test was 0.89.

4.3. Research Design

The research design of this study was pretest-posttest control group design in which the learning units following the PHP served as the independent variable and the measure of students' scientific literacy and language abilities served as dependent variables. In this study, the experimental group and the control group consisted of students who took a pretest and posttest. Only experimental group received treatment. The SLT served as a research instrument which the data from the test was collected before and after completing the intervention.

5. Results

The first hypothesis was the experimental group, taught by using science learning units following the PHP, would show higher scientific literacy than would the control group taught by normal instruction. We tested that hypothesis by using The T-test for independent samples. The results, shown in Table 1, indicated that there were no significantly differences between two groups' scientific literacy scores in pretest. However, the posttest result was changed. The scientific literacy mean score, of the experimental group, was significantly higher than the control group, which means that the student's learning, through the developed learning units, has a significant improvement on scientific literacy.

Table 1. The Comparison of scientific literacy scores between the experimental and the control group.

Test / Groups	Pretest				Posttest			
	N	$\bar{x}$	S.D.	t	N	$\bar{x}$	S.D.	t
Experimental Group	31	8.39	2.43	1.567	31	12.55	3.34	5.200*
Control Group	31	7.39	2.59		31	8.35	3.01	

N = number of students $t_{(.05;\ df60)} = 1.671$

The second hypothesis was the experimental group, taught by using science learning units following the PHP, would show higher language abilities than would the control group taught by normal instruction. The hypothesis was tested by the same approach and the results were similar to the above. The pretest students' language abilities mean scores of both groups were not different. After that the experimental group received treatment, the language abilities mean posttest score, of the experimental group, was significantly higher than the control group (Table 2). That means the student's learning, through the developed learning units has a significant improvement on language abilities.

Table 2. The Comparison of language abilities scores between the experimental and the control group.

Test / Groups	Pretest				Posttest			
	N	$\bar{x}$	S.D.	t	N	$\bar{x}$	S.D.	t
Experimental Group	31	16.87	6.07	0.151	31	25.00	5.89	2.544*
Control Group	31	16.61	7.36		31	21.06	6.32	

N = number of students $t_{(.05;\ df60)} = 1.671$

6. Discussion

The results of integrating the Philosopher's Heart Principle (Su, Ji, Pu, Li) into science instruction indicated that students' scientific literacy and language abilities were increasing. That due to students had more chance to critically listen and read science ideas that related to their everyday life contexts, to generate a question about the topic, to think critically, and to write for communicating what they understood to others. There results here consistent with many research reports. For example, Glynn and Muth (1994), and Thier[16] (2002) stated that reading science stories, comics and cartoons could develop students' understanding in science and also their language abilities. Moreover, those activities can stimulate reading and learning motivation (Guthrie and colleagues, 2006)[17]. Kanchanakunchon (2007) and Klentchy[18] (2008) reported writing tasks such as writing essays related to science issues could improve communication skills. Hapgood

and Palincsar[19] (2007) pointed out that integrating reading, writing, and oral language into science instruction could help students learn science effectively and practice language skills simultaneously. In conclusion, the integration of Philosopher's Heart Principle into science instruction promote students to read, think, ask, and write about science those are the reasons why students have increased in scientific literacy and language abilities after learning with PHP.

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