A Survey of Scientific Competency of Grade 10th Students in Thailand

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Abstract
The purpose of this study was to survey the scientific competency of grade 10th students. The sample was 141 students of academic year 2016 from Sarakhampittayakhom school in Thailand that selected by purposive sampling. The instrument was the 7 items from 2 situations of scientific competency test that measured in 3 sub-competencies including 1) explain phenomena scientifically, 2) evaluate and design scientific enquiry and 3) interpret data and evidence scientifically. The data was analyzed by using mean, percentage and standard deviation. The results showed that the mean score of scientific competency was 4.52 of 14. Each sub-competencies of scientific competency were explain phenomena scientifically, evaluate and design scientific enquiry and interpret data and evidence scientifically were 1.61 of 4, 1.40 of 2 and 1.50 of 8 respectively. In addition the results indicated that the scientific competency of students was low level and each sub-competencies of the scientific competency were medium, high and low level respectively.

Keywords: scientific competency

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Introduction

The results of education in Thailand indicate that it can not prepare the students to be the ability people in science and technology–based world (IPST. 2011: 29). It always sees from the news that people bank on a strange animal or tree. It indicates that more people did not use science in life. They are unreasonable thinking. They do not analyze the information to finding the answer systematically and do not investigate the information before they confide in. However, it was obviously seen from the international assessment of Programme for International Student Assessment (PISA). It was scientific literacy assessment that the scientific competency was a main. The results of scientific literacy in PISA of grade 9^{th} students in Thailand in 2000, 2003, 2006, 2009, 2012 and 2015 were average scores of 421, 423, 429, 425, 444 and 421 respectively. It showed that the average scores of scientific literacy were less than the OECD average score from 2000 to 2015. The OECD average score was 500. (IPST. 2016: 4-6). It indicated that Thai's student had low level of scientific competency as compared with the international students.

In currently world, the scientific competency is important for lifelong learning. Forasmuchas, people get a lot of information, news and issues about science and technology. They must have the information, media, and technology skills. They can systematically solve the problem. They always ascribe or conclude from the information and separate between opinion and information. They must determine by verified data or evidence. If people do not have the scientific competency, they will decide amiss or not the best choice in daily life. It does not allow them to live in currently world happily. Consequently, the scientific competency allows people to be performance to know and understand the world, and use science to solve the problem in daily life (IPST. 2009: 7). The scientific competency consists of 3 sub-competencies including 1) explain phenomena scientifically competency which recognize, offer and evaluate explanations for a range of natural and technological phenomena. It is emphasis because the students must understand the phenomena or the situation. They can link science information to explanation and reasoning (Bayer and Davis. 2008: 382). Additionally, they can apply science knowledge appropriately in everyday life and the application must relate to the social environment and the culture (Suriyawadee. 2015: 1322). 2) Evaluate and design scientific enquiry competency which describe and appraise scientific investigations and propose ways of addressing questions scientifically. It is very important because the students usually encounter the phenomena or the situation. When they encounter the problem, they have to find the solution by using scientific process for solving the problem. Consequently, they must evaluate and design appropriately the solution in daily life. 3) Interpret data and evidence scientifically competency which analyze and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions. Nowadays, the information is many type such a graph, a table, a diagram, and etc. The students must point out the major information, analyze, translate, and conclude correctly. Furthermore, they can propagate the data appropriately (OECD. 2012: 4). As a result, the scientific competency is important to preparing student to be ability for the future. It emphasizes knowledge and skills that must use in real life.

As mentioned, the scientific competency is very important to the students. It helps for decision making in daily life. It allows them to live in currently world gladly.

Consequently, the researchers must survey the scientific competency of grade 10th students in Sarakhampittayakhom school, Muang, Mahasarakham, Thailand. The researchers hope that the result of this study will index whether the students can be the quality citizen in the future. In addition, the researchers expect that the results will be useful to create the learning activities that encourage the scientific competency.

Research Purpose

The purpose of this study was to survey the scientific competency of grade 10th students.

Sample

The sample was 141 grade 10th students from 3 classrooms which have same levels of the learning achievement of academic year 2016 from Sarakhampittayakhom school in Thailand.

Research Instruments

The instrument in this research was the scientific competency created by Institute for the Promotion of Teaching Science and Technology (IPST) in Thailand. It was the 7 items from 2 situations of scientific competency test. The items were divided 2 types include 1) complex-multiple choices and 2) open-ended questions. It measured in 3 sub-competencies including 1) explain phenomena scientifically that the full score was 4, 2) evaluate and design scientific enquiry that the full score was 2 and 3) interpret data and evidence scientifically that the full score was 8. The test was scored by using the rubrics score which created of IPST. The results were interpreted by using the interpretation of mean which was divided to 3 levels including high, medium, and low respectively (Boonchom Srisa-ard. 1990). The criteria of interpretation of score showed in Table 1.

Levels	Mean core			
	Scientific competency (14)	Sub-competencies		
		Explain phenomena scientifically (4)	Evaluate and design scientific enquiry (2)	Interpret data and evidence scientifically (8)
High	0.00 - 4.66	0.00 – 0.66	0.00 – 1.33	0.00 – 2.66
Medium	4.67 - 9.33	0.67 – 1.33	1.34 – 2.67	2.67 – 5.33
Low	9.34 - 14.00	1.34 – 4.00	2.68 – 2.00	5.34 – 8.00

Table 1 The criteria of interpretation of mean score

As mentioned above, it sees that the scores of each sub-competency are not equal. The researchers measured mostly the sub-competency of interpret data and evidence scientifically. The second was the sub-competency of explain phenomena scientifically. The minimal measurement was the sub-competency of evaluate and design scientific enquiry. It caused from the indicator in the national basic education curriculum for high school. The most important indicator for high school required the students to analyze data, interpret meanings of data and evaluate conformity of the conclusions or main substance for verification with the hypotheses. It found that this

indicator conformed with the sub-competency of interpret data and evidence scientifically. Moreover, the indicator still required the students capability in applying the results from exploration and verification, regarding the methodology and bodies of knowledge, applying results to problem-solving in new situations and in real life which related to the sub-competency of explain phenomena scientifically. In addition, the requirement of the curriculum standard need the students to pose questions and plan for observation and propose methods for exploration and verification, collect data systematically and accurately record results of exploration and verification which related to the sub-competency of evaluate and design scientific enquiry.

Procedure

In this research, the data of the scientific competency of grade 10^{th} students was collected by using the scientific competency test. The process of collecting data as following:

1. The researchers selected the sample from 3 classrooms of grade 10^{th} student in academic year 2016 from Sarakhampittayakhom school by using purposive sampling.
2. The researchers asked the students to do the test for 1 hour.
3. The data was collected and analyzed by using mean, percentage and standard deviation

Results

According to the data of the scientific competency that consists of 3 sub-competencies including 1) explain phenomena scientifically, 2) evaluate and design scientific enquiry and 3) interpret data and evidence scientifically. It was collected by the scientific competency test from grade 10^{th} students of academic year 2016 from Sarakhampittayakhom school in Thailand. The data were presented in Table 2.

	Full score	$\overline{X}$	S.D.	Level
Scientific competency	14	4.52	1.96	Low
Sub-competencies				
- Explain phenomena scientifically	4	1.61	0.96	Medium
- Evaluate and design scientific enquiry	2	1.40	0.70	High
- Interpret data and evidence scientifically	8	1.50	1.50	Low

Table 2 Mean score and level of the scientific competency

The students' mean score of the scientific competency was 4.52. It indicated that the students' scientific competency was low level. In addition, the mean score of the sub-competency of explain phenomena scientifically was 1.61. The mean score indicated that it was medium level. Moreover, the mean score of the sub-competency of evaluate and design scientific enquiry was 1.40. The mean score indicated that it was high level. Furthermore, the mean score of the sub-competency of interpret data and evidence scientifically was 1.50. The mean score indicated that it was low level.

Conclusion and discussion

Form the results, the mean score of the scientific competency showed that the students' score was 4.52 of 14. It indicated that the scientific competency of students was low level. In consideration of the learning activity, the inquiry based learning (5E) was the standard learning activity that Institute for the Promotion of Teaching Science and Technology (IPST) promoted for every science classroom in Thailand. Exactly, the inquiry based learning (5E) can support the scientific competency because the students must create the problem from the situation. In order to answer the questions, students work individually or in small groups to explore, observe, and discover the answers. They have to do by themselves. Consequently, the skills that support the scientific competency are practiced. In fact, the Thai context does not support the 5Es learning activities such as the period of learning activity. It is not enough to create the appropriate learning activity. It is only sufficient for allowing the students to do the tasks hurriedly but not enough for paying attention to the activity. As a result, the skills that support the scientific competency are rarely practiced. Moreover, the instructional media that the teacher prepares are not enough, various, and appropriate. Thus, the students do not practice by a wide variety of tasks. From the above reasons, it affects the students' scientific competency was low level. The result was similar to the finding of Institute for the Promotion of Teaching Science and Technology (2016: 16) studied the results of the scientific competency in Thailand. The results showed that the students' mean score was under the office of the basic education commission (432). It indicated that the students were level 2 of the scientific competency. This level was basic level that the students begin to know and take advantage of life's knowledge.

Considering in the sub-competency of explain phenomena scientifically, the mean score was 1.61 of 4. It indicated that the sub-competency of explain phenomena scientifically was medium level. In consideration of the learning activity, the inquiry based learning (5E) was teaching that the students constructed the knowledge by themself. It consisted of 5 steps including 1) engagement, 2) exploration, 3) explanation, 4) elaboration, and 5) evaluation. The explanation step supports the sub-competency of the explain phenomena scientifically. This step is the presentation of the data that is collected, analyzed and translated for explain the problem situation. Hence, they practice to connect the information for the explanation. Furthermore, the presentation allows students to create many format of the presentation such as a model, a picture, a graph, and other. Focus of the learning activity, the teacher can not provide a variety of learning resources for students. The information does not have many formats. It is often texts and picture. Sometimes it is graphs, and hardly ever models. Therefore, the students always conclude and present the information that they collected and the teacher prepared. Consequently, they do not practice to present by using all of formats. Moreover, the students seldom analyze and translate the data from graphs and models. They can not improve these skills fully. In addition, the step that also supported the sub-competency of explain phenomena scientifically is the elaboration. This step is application of the explored knowledge. It is brought to explain the new situation or the phenomena. Therefore, this step allows students to connect the knowledge as well (IPST. 2003). In the classroom, the teacher arranges a new situation that rarely links with new concepts. The teacher does not guide the students to link the new knowledge and the old knowledge or other issues together. Consequently, the students rarely connect the information from many topics. They

normally bring information to explain the situation directly without connection. They can not improve this skill completely. All of mentioned above cause the level of the sub-competency of the explain phenomena scientifically was medium. Similary, Jutamas (2014: 5-6) studied the effects of learning activities in the Genetics using 5 Es and Six Thinking Hats to Enhance Explain Phenomena Scientifically Competency. The results showed that competency in higher posttest criteria 75/75 statistically significant at the .05 level. As a results, it caused this sub-competency was developed.

Considering in the sub-competency of evaluate and design scientific enquiry, the mean score of was 1.40 of 2. It indicated that the sub-competency of explain phenomena scientifically was high level. In consideration of the inquiry based learning (5E) and focus on the steps of engagement, this step is the importing into lessons by using interesting situations. It brings the issue of study (IPST. 2003). The students always practice to set the problem and hypothesis for finding the answer. Thus, this step supports the identification of the question in the study. Moreover, the step that also supports this sub-competency is the exploration. This step is a planning for investigation and collecting the information (IPST. 2003). The students always train to design the ways to find the answer and collect the data to answer the question. Therefore, It promotes this sub-competency as well. In the same way, Jutatip (2014: 6-7) studied the effect of learning activities using 5 Es learning cycle integrated with socio-scientific issues to enhance competency in indentifying scientific issues and achievement on enviromental pollutions for mathayomsuksa 3 students. The results showed that the competency and the achievement were higher than posttest criteria 75/75 statistically significant at the .05 level. Consequently, 5 Es learning cycle caused this sub-competency was developed as well. Furthermore, the test of sub-competency of evaluate and design scientific enquiry measured only distinguish questions that was possible to investigate scientifically. It allowed the score to be high. Consequently, they also caused level of the sub-competency of evaluate and design scientific enquiry was high.

Considering in the sub-competency of interpret data and evidence scientifically, the mean score of was 1.50 of 8. It indicated that the sub-competency of interpret data and evidence scientifically was low level. In consideration of the explanation step of the inquiry based learning (5E), this step is analysis, interpret, and conclude the data for answer the problem (IPST. 2003). Therefore, the students always train these skills to be skillful. However, in currently science classroom in Thailand, the students often copy the data from information to answer questions. They do not analysis and interpret the data before answer. In addition, some periods of learning activity are limited to one hour. Thus, the time of learning is not enough. As a result, at this step, the student must hurry to summarize the information. The analysis and interpretation of the data were not practiced. Consequently, the sub-competency of interpret data and evidence scientifically of the students were not improved. It caused this sub-competency was low level.

Recommendation

This research describes about the level of the scientific competency of only grade 10^{th} students in Sarakhampittayakhom school, Thailand.

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