Thesis Title:

Cambodian Students’ Competency and Teaching Material Development on Chemistry at Secondary Level

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ABSTRACT

Chemistry is known as the core science as it bridges other natural science such as physics, biology and geology. Study chemistry helps ones to describe and explain scientific phenomena in the world. Therefore, chemistry is introduced in school as integrated subject with science since primary level in most countries in the world. However, chemistry has been revealed by many researchers as one of the most difficult subjects for students at the basic education because it includes a number of abstract and complex concepts that requires special intellectual talents and a too much effort to be understood.

In Cambodia, simple chemistry concept is started from grade 4 of primary school, while basic general science concept is introduced from grade 2. However, many researches shown that, science education in Cambodia is in much need of improvement. The quality of science education in Cambodia is mainly facing three key issues: (1) shortage of appropriate educational content, (2) insufficient teaching and learning materials, and (3) lack of qualified, trained teachers. Within this context, Cambodian students seldom experience active learning in chemistry as well as an opportunity to observe a real phenomenon through experiment in chemical laboratory.

Based on the above background, the research on “Cambodian Students’ Competency and Teaching Material Development on Chemistry at Secondary Level” is proposed. The main purpose of the research is to study students’ competency on chemistry at lower secondary school in Cambodia and to develop teaching and learning apparatus from simple and available materials to support students’ learning in Chemistry at secondary school. In order to achieve the research purposes, two research questions are posed:
1. To what extent do lower secondary school students in Cambodia understand the chemistry concept?

2. What teaching apparatus can we develop to support students’ learning in chemistry concepts at secondary school more efficiently and effectively?

The thesis is outlined 7 chapters, in which chapter 1 discusses the overview of the study; chapter 2 studies the Cambodian students’ competency on chemistry at lower secondary school; chapter 3 describes the development of teaching materials for detergent lessons; chapter 4 introduces the development of hand-made conductivity meter and its application to fruit and vegetable solution; chapter 5 presents the development of hand-made conductivity device for thin-film semiconductor and its application to study the effect of surfactants on conductivity of polypyrrole; chapter 6 introduces the development of teaching materials to examine viscosity of carboxyl methyl cellulose; and chapter 7 is the conclusion of the thesis.

Case of the research on Cambodian students’ competency in Chemistry, the data were collected and analyzed quantitatively from 3014 Cambodian students at grade 8 (2nd year of lower secondary school) from 34 public schools across 17 provinces out of 25 throughout the country using the test paper designed by Trends in International Mathematics and Science Study (TIMSS), 2011 standard. The study discussed the comparison by genders, areas, as well as within the regional countries and Japan whom participated in TIMSS-2011 standard. The results showed that Cambodian student's achievement was comparable to those of Thailand, Malaysia and Indonesia, however, they were all still below the ASEAN and international averages and far below Japan. The results also showed that there was not a significant difference in performance between male students (N=613, M=6.34, SD=3.044) and female students (N=690, M=6.44, SD=2.873); p=0.537>0.05. On the other hand, the students from the districts
(N=655, M=6.56, SD=2.971) seemed perform the test slightly better than those from the towns (N=649, M=6.28, SD=2.928); p=0.043<0.05, though their mean scores were just slightly different. The study was also discussed the implication of the results to the current Cambodian education context. The discussion came up with suggestions that Cambodia should pay increased attention to the reform of chemistry learning content and ways of teaching together with developing available teaching materials in order to encourage and provide students with enough opportunities to explore scientific practical work.

In terms of the development apparatus to support teaching and learning chemistry in classroom, a number of simple apparatus had been made from available materials in daily life during the study. The materials for marbling ink, capillary method and dropping method were designed to investigate the effect of detergent on water surface tension. Fabric dyeing method and a hand-made photo meter were developed to determine the concentration of detergent in the aqueous solution. In terms of conductivity concept, hand-made conductivity devices were assembled only from cheap materials and yet they could be applied to measure the conductivity of fruit or vegetable solution and that of thin-film semiconductor such as polypyrrole. Lastly, a dropping method was developed from dropping plastic gun balls along a column of sample solution to estimate the viscosity extent of sodium carboxyl methyl cellulose solution. All materials developed from the study were applied with the secondary school students in Japan and Cambodia during the study to examine their effectiveness in the real classroom. The results from the pre/post tests and questionnaires showed that the developed materials could effectively help the students to construct their scientific knowledge and skills toward positive attitude in science. Since the developed materials
were assembled from simple materials in daily life with easy operation, they could encourage students to learn actively and to handle without difficulty.

In summary, the study revealed the current level of students’ competency in chemistry at lower secondary level compared to the countries in region, as well as the international standard. This finding has provided a very important baseline, in which it can be used basically to develop perspective to improve the quality of science education in the Cambodian school level to meet the regional and international standards. The research also provided a number of new developments of teaching and learning apparatus from available materials in daily life. Those developed apparatus can be used effectively to promote the quality of students’ learning in chemistry classroom, not only in Cambodia as a developing country, but also for other countries around the world.