

学 位 論 文 要 旨

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題 目 Cambodian Students' Competency and Teaching Material
Development on Chemistry at Secondary Level

学位論文要旨（和文2,000字又は英文1,000語程度）

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, three research questions are posed:

1. To what extent do lower secondary school students in Cambodia understand the chemistry concept?
2. What teaching apparatus can be developed to support students' learning in chemistry at secondary school?
3. What are secondary school student's perceptions on the teaching and learning apparatus which were developed?

The research on Cambodian students' competency in Chemistry at lower secondary school can be shown through quantitative data analysis from 1304 Cambodian students in 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 the 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=614, 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 in 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 teaching and learning apparatus for secondary chemistry classroom, a number of simple apparatus had been assembled from available materials in daily life accompany with a number of teaching and learning activities in which all of those are relevant to the secondary chemistry curriculum. 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 photometer 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 methylcellulose solution.

The students' perceptions on the teaching and learning materials and activities developed in the study can be shown through their application in the secondary schools in both Japan and in Cambodia as pilot lessons to examine their possibility in the real classrooms with the students. The results from the pre/post tests and questionnaires showed that the developed materials could significantly hook the students' interests and help the students to construct their scientific knowledge and skills toward positive attitude in science. The students even showed much interest and enjoy the lesson activities, when they worked with the learning apparatus which were assembled from simple and inexpensive materials in their daily life. They could use the developed apparatus in their scientific investigation to achieve the lessons' objectives.

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 standards. This finding provides a very important baseline, in which it can be used basically to develop perspectives 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. The students showed high satisfaction to the developed teaching and learning apparatus and the designed lesson activities which they could enhance their learning chemistry by experiments actively and improve their scientific knowledge and skills in the classrooms.

Keywords: students' competency, content domain, cognitive domain, development of teaching materials, detergent, surface tension, conductivity of aqueous solution, conductive polymer, viscosity of carboxyl methyl cellulose, intermolecular forces.