

Analysis of upper-secondary biology textbook in Cambodia

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This article aims at investigating the characteristic of Cambodian biology textbook for upper secondary school recently published. For the purpose, we compared Cambodian biology textbook and Japanese biology textbook. Outlining the background of textbook development in the context of Cambodia, the analysis is made concerning three points: whole content, students' activities and figures, which are described in the textbooks.

The results are summarized as follows. Cambodian textbook should 1) refer to the relationship among phyla. 2) include genetics and development in Grade 10. 3) include appropriate experiments for the context of Cambodia. 4) illustrate some figures in students' activities. 5) provide accurate figures that are useful for actual students' activities.

Based on the recognition of these problems, this paper attempts to make some suggestions for improving the textbooks.

Introduction

It is widely recognized that a textbook is an important teaching material, especially in science, and many teachers and students consider a textbook as a necessity of studying science (Harms and Yagar 1981, Stinner 1992). Nevertheless, in Cambodia, the comprehensive evaluation of science textbooks has not been carried out. This paper attempts to analyze problems of upper secondary biology textbooks in Cambodia, in comparison with ones in Japan. In general, in order to show the characteristics of something, it is important to make a comparison between something and the other. In this study, Japanese textbook was selected. The reason why Japanese textbooks were selected is that Japan is a developed country in Asia and Japan education system is similar to Cambodian education system. Japanese textbooks have been published for about a century and they have been improved during the period. Therefore, they seem to be high quality.

This paper consists of three parts. First, we describe the background where current Cambodian textbooks were developed. This will promote better understandings of some problems in Cambodian textbooks. Next, problems in Cambodian textbooks are discussed in comparison with Japanese textbooks. It is divided into three points: whole content, students' activities and figures. Lastly, some suggestions are made to improve Cambodian textbooks.

Background of textbook development

Although a close study of textbook development in Cambodia is not necessary for our purpose, it may offer a key to an understanding of problems described in this paper.

Cambodia is well known for the brutal restructurings of a society under the Khmer Rouge regime (1975–1979). At that time, education was seen as one of the obstacles to their ideal communist society. Therefore, most school buildings were destroyed or used for other purposes, educational materials such as books were burned, and a large number of educators were lost at the hands of the Khmer Rouge. However, since the Khmer Rouge went out of power, the Government of Cambodia has been committed to the rehabilitation and improvement of an education system (Nath & Wakabayashi 1999, Nath 1999).

Under the introduction of a new 12-year education system (6–3–3) in 1997, upper secondary textbooks have been developed by the Ministry of Education, Youth and Sport (It is called MoEYS in Cambodia) in collaboration with UNICEF/SIDA (Swedish International Development Agency). In biology, the textbooks of Grade 10, 11 and 12 were published in 1999, 2000 and respectively. It should be noted that they are the first textbooks written in Khmer language authorized by the Cambodian government.

However, unlike Japan, many specialists were not involved in the process of textbook development in Cambodia, due to a lack of human resources. That is, the textbooks were produced by a few authors, referred to foreign textbooks. Also, MoEYS has not established a functional system that examines errors and mistakes and the content of the textbooks. Hence, there has been little substantial evaluation of the textbooks and this has led to some problems that would be discussed in the following part.

Problems in Cambodian textbooks

In this part, problems in Cambodian textbooks are discussed in comparison with Japanese textbooks. As stated earlier, it is recognized that Japanese textbooks are high quality. Perhaps, this is due to careful examination of textbooks under the Criteria for the Examination of Textbooks laid down by the Ministry, and the competitive textbook market. Although Japanese textbooks are not completely ideal for the context of Cambodia, it is entirely fair to say that such quality textbooks would be one of good models in Cambodia, of which 12-year education system (6–3–3) is similar to Japanese one. Therefore, here, we compare Cambodian textbooks with two volumes of a textbook (I B and II) of a certain publishing company in Japan. They are examined concerning three points: whole content, students' activities and figures.

Whole content

Table 1 shows the whole content of upper secondary biology textbooks in Cambodia and Japan. A glance at Table 1 indicates two problems of Cambodian textbooks. One problem is that Cambodia textbooks do not describe the relationship among phyla of living things, which is seen as one of the important knowledge of biology. While Japanese textbook devotes only one chapter to the explanation of each

Table 1. The whole content of upper secondary biology textbooks in Cambodia and Japan

Cambodia	Japanese
Grade 10 (76hours)	IB (130units/50min)
Viruses, Bacteria, and Protists	Structure and Function of Cell
Fungi and Nonvascular Plants	Reproduction and Development
Animals	Genetics and Variation
Forms of Vascular Plants	Life Activity and Change of Substance
Function and Nutrition of Plants	Reaction and Regulation of Living Things
Grade 11 (76hours)	Population of Living Things
Support and Movement	II (65units/50min)
Circulatory and Immune System	Function of Organisms and Protein
Gas Exchange and Excretion	Phenotypic Expression and Nucleic Acid
Biosphere	Evolution and Phyletic Lineage of Organisms
Grade 12 (140hours)	Problem Solving
Mitosis and Asexual Reproduction	
Meiosis and Sexual Reproduction	
Animal Development	
Mendelian Genetics	
Modern Genetics	

※Grade 10, 11, and 12 in Cambodia correspond to 1st, 2nd, and 3rd years of senior high school in Japan respectively

phylum (textbook II), Cambodian textbook devotes much space to this (Grade 10). Nevertheless, because the content of Cambodia textbooks lack “evolution” as seen in Table 1, the relationship among phyla is not well explained. We do not examine why “evolution” is not dealt. Certainly, evolution theory also causes some disputes in USA (Stephen 2000). One possibility is to assume that the religion in Cambodia influenced on this point. Another possibility is that it is difficult to understand the concept of “evolution” and “evolution” has less relation to our daily life. For these reasons, “evolution” may be not dealt.

Another problem is that the content of “genetics” and “development” are not introduced at the early stage of upper secondary learning. That is, in Cambodian textbooks, there are few descriptions concerning genetics and development in Grade 10 and 11, and they are situated at the latter half of Grade 12. It seems that “genetics” and “development” are seen as the further study of biology rather than the basic study. However, although it is widely accepted that “genetics” learning is difficult for students (Elizabeth and Colin 1985, Morimoto 1996, Okebukola 1990), learning of “genetics” and “development” as the basis of biology is essential. One of the reasons for this is that the knowledge of “genetics” and “development” is one of core concepts in recent biology. For example, various organism phenomena cannot be understood without the concept of “genetics”. Another reason is that “genetics” are gradually involved in our daily life. That is, topics such as genetically modified food (it is called GM food in the newspaper or magazine), clone organism and mutation by the various mutagens become matters of concern. Therefore, in Japanese textbooks, “genetics” and “development” are considered as the basis of biology and situated at the earlier parts of IB (Grade 10).

Thus, in Cambodia textbooks, some important contents are missing or not introduced appropriately.

Another significant aspect is the detail description on pathogen and parasite. The

malaria mechanism is explained in the chapter of Protists and several parasites are introduced in the chapter of Animals. It is said that more than one in nine Cambodian children will die before their fifth birthday by the National Institute of Public Health in Cambodia. And it is said that the cause is high levels of infant diarrhea, dysentery and respiratory infection. In this situation, the detail description on pathogen and parasite is useful for Cambodian biology education.

Students' activities

Concerning students' activities, two problems are identified. One is that Cambodian textbooks contain few experiments. Table 2 indicates students' activities shown in textbooks in Cambodia and Japan. As seen in Table 2, Japanese textbooks contain not only observation activities but also experiments, including controlled experiments. In contrast, most of the Cambodian activities are not experiments. They are observation activities, and an exercise of making a graph. For example, in "Drawing a growth curve of bacteria", students are required to draw a graph by data shown in the textbook, but not conduct experiments by themselves. However, this does not suggest that Cambodian textbooks should include all sorts of experiments. In fact, it is understandable that, rather than experiments, the activities such as observations are appropriate in the context of Cambodia. In Cambodia, there are often no electricity and water supply in rural areas and, in even urban areas, the electricity is sometimes cut off. And, schools hardly have laboratories, chemicals and equipments (Chandara 2001). Such a situation, although it is desirable for students to learn more experiments, we need to consider what experiments are more appropriate. For example, the dissection of living things such as fish and frogs, which are obtained easily in Cambodia, might be suitable for the above conditions.

Another problem in Cambodian textbooks is that it is not easy to understand the procedures for some students' activities. Fig.1 shows the descriptions of the observation of animal and plant cells in Cambodian and Japanese textbooks. Although the

Table 2. The students' activities shown in textbooks in Cambodia and Japan

Cambodia Grade 10	Japanese IB
The Execution Working	Experiment
Observation of animal and plant cells	Observation of the several cells
Classification of plant seeds	Observation of plasmolysis
Drawing a growth curve of bacteria	Observation of mitosis
Growth of spoiled fungi	Observation of salivary gland chromosomes in the mosquito
Difference between wild moss and algae	Separation of photosynthesis pigment by paper chromatography
Dissection of the grasshopper	Mating behavior of silkworm moth
Dissection of the frog	Exploration activity
Observation of stems and leaves	Cell growth of the onion
Photosynthesis	Relationship between temperature and development of animals
Phototaxis of the corn	Life cycle of the fern
	Color inheritance of the corn seeds
	Various property of the enzyme
	Function of adrenaline
	Defense reaction of the crayfish
	Property of auxin
	Relationship between plant life and germination
	Environment of the plant community
	Factor of plant community establishment

ការងារប្រតិបត្តិ

សង្កេតមើលកោសិកាសត្វ និង រុក្ខជាតិ

ក. សំភារៈ

បំពង់បន្តក់ បន្ទះកញ្ចក់ ស្ពៃ ឈើចាក់ធ្មេញសំបែក ស្នូលយស្ស៊ុងអ៊ីយ៉ូត មីក្រូទស្សន៍ ក្រដាសជក់ទឹក កូនតង្កៀប ចកកន្ទុយផ្លែ ។

ខ. របៀបធ្វើ និង ការសង្កេត

- បន្តក់ទឹកមួយតំនក់លើបន្ទះកញ្ចក់ស្ពៃ ។ យកផ្លែកខាងសំបែកនៃឈើចាក់ធ្មេញ កោសយកកោសិកាក្នុងមាត់ផ្លែកខាងផ្ទៃខាងក្រៅរបស់វា ។ ត្រីប្រុងឈើចាក់ធ្មេញនោះក្នុងតំនក់ទឹក ហើយគ្របបន្ទះកញ្ចក់ស្ពៃពីលើ ។ សំអាតទឹកដែលល្បឿនចេញក្រៅបន្ទះកញ្ចក់ស្ពៃដោយផ្អិតទឹកក្រដាសជក់ទឹក ។
- ពិនិត្យកមើលកោសិកាទោលក្នុងមីក្រូទស្សន៍ដោយប្រើអុបស៊ីចទីបលេខតូច ។ បន្ទាប់មកមន្ទីលយកអុបស៊ីចទីបលេខធំ ដើម្បីមើលអោយបានច្បាស់ ។ ចូរត្រួតកោសិកាទោលមួយ ហើយដាក់ឈ្មោះណែយ៉ូ ភ្នាស់ណែយ៉ូ ស៊ីតូប្លាស និងភ្នាសកោសិកា ។
- យកកូនតង្កៀប បកយកអេពីដែមតូចមួយ ទំហំប្រហែល 5mm² ហើយដាក់ វាទៅលើបន្ទះកញ្ចក់ ។ បន្តក់ទឹកមួយតំនក់ពីលើ ហើយគ្របពីលើវាដោយបន្ទះកញ្ចក់តូច ។ ចូរសង្កេតមើលកោសិកាអេពីដែមខ្លីមួយចំនួន ដោយប្រើអុបស៊ីចទីបលេខតូច ។ ចូរត្រួត និង ដាក់ចំនងជើងកោសិកាអេពីដែម ។

—B— 動物細胞の観察

① 清潔な指ではおの内側をこすると、だ液と
いっしょにはおの表面の細胞(粘膜上皮細胞)が
はがれて指についてくる。

② その指でスライドガラスにふれるとそこに
細胞がつくのでしばらく乾かす。

③ 乾かした部分にメチレンブルーを1滴たら
して1分間染色する。余分な液はろ紙で吸いと
る。

④ 水を1滴たらしてから、気泡が入らないよ
うに注意しながらカバーガラスをかける。これ
を顕微鏡で観察し、スケッチする。このとき、
細胞と核の大きさを接眼ミクロメーターを使っ
てそれぞれ測定する。

—C— 果肉細胞の観察

① バナナの果肉の部分のスライドガラスに軽
くこすりつける。

② 水を1滴たらしてから、カバーガラスをか
けて顕微鏡で観察すると、果肉細胞が見える。
細胞の中でデンプン粒の入ったものを見がす。

③ カバーガラスのふちからヨウ素液をたらす。
その反対側にろ紙を当てて中の水を吸いとると、
デンプン粒の色が変わる。

＜注＞

(1) 果肉細胞は透明なので、顕微鏡のしぼりを
小さくしたほうがよく見える。

(2) ヨウ素液をたらすと果肉細胞中に、核がう
す茶色に染まってみえることがある。

④ ③で、デンプン粒はヨウ素液によって何色
になったか。

操作①
スライドガラスに
なすりつけてから
乾燥させる。

操作②
メチレンブルー
スポイト

操作③
バナナ

操作④
軽くこすりつける。た
かすって見えにくい。

操作⑤
バナナの果肉細胞
(×300)

操作⑥
ろ紙
ヨウ素液
ろ紙でヨウ素液を吸いとる。

Fig. 1. The descriptions of the observation of animal and plant cells in Cambodian and Japanese textbooks

※ Left: Cambodian textbook (Grade 10) Right: Japanese textbook (I B)

procedure for the observation is almost the same in both textbooks, Japanese textbook is likely to be much easier to understand the procedure. This is because it is illustrated with some figures. Even people who cannot read both Japanese and Khmer texts, like Europeans, can probably have a grasp of some points of the procedure through the figures in Japanese textbook. We may note, in passing, that in Japan figures are considered to play an important role in teaching and learning, and therefore, the number of figures in Japanese textbooks tend to increase year by year.

Thus, in Cambodian textbooks, appropriate students' activities are not well introduced and understanding the procedures for the activities is not easy. Cambodian textbooks need to contrive a way for students to understand the procedures for their activities easily.

Figures

There are some problems in figures inserted Cambodian textbooks. One of them is that some figures do not seem to take actual observations and experiments into consideration. In other words, it does not seem that Cambodian textbook consider the objective of dissection in class. Comparison between the figure of the frog in Cambodian textbook in Fig.2 and the one in Japanese textbook in Fig.3 provides an example.

Generally, the objective of dissection in upper secondary level is to observe main digestive organs, circulatory organs and reproductive organs. That is, students are required to observe gall bladder, liver, stomach, small intestine, large intestine, urinary bladder, colon, rectum, heart, lung, ovary and oviduct. Therefore, textbooks need to highlight these organs. However, Cambodian textbook shows other less significant organs such as the tympanum, vocal sac, brain and spinal cord. In fact, some of them are difficult to observe in upper secondary school. For example, in order to observe the brain, it is necessary to do the fixation by using formalin for weeks. It is difficult to do such treatment in upper secondary level. Thus, suppose students dissect the frog and observe the structure, probably, the figure of Cambodian textbook is less useful as a reference. On the other hand, the figure in Japanese textbook may be helpful to students confirming the positions and colors of main organs. Moreover, Japanese textbook refers to the structure of the human body and helps students with better understanding of the positional relations of organs such as the heart is located two lungs and the liver wraps the gall bladder.

Another problem is inaccuracy of figures. As seen in Fig.4, the explanation of the internal organs of the fish in Grade 10 is a notable example. Several important organs such as air bladder, kidneys, spleen, gall bladder and intestine are not illustrated correctly. Although the air bladder is pointed out, there is no picture. The kidneys attached the ureter should be drawn at the back of the body. The spleen should be drawn near the intestine. The gall bladder should be drawn attached to the small intestine near the liver. Also, the intestine should be tube-like shape. As stated earlier, dissections of living things are value to students' activities in Cambodia. Nevertheless, much attention is not paid the accuracy of figures in living things.

Thus, figures inserted Cambodian textbooks lacks the consideration of actual students' activities such as observation and experiments, and accuracy.

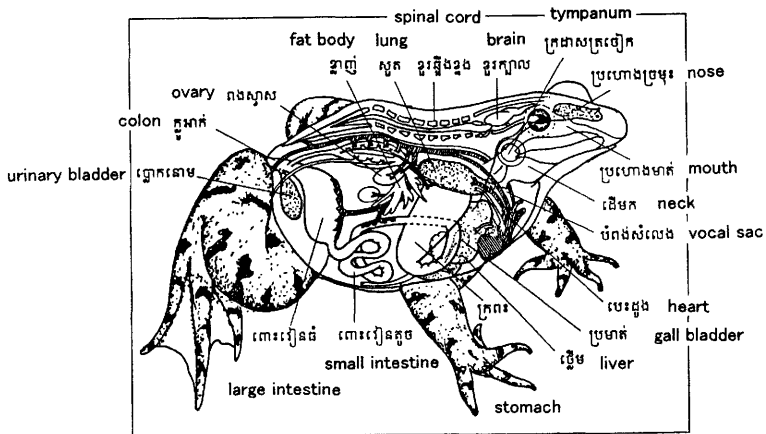


Fig. 2. The explanation of the internal organs of the frog in Cambodian textbook

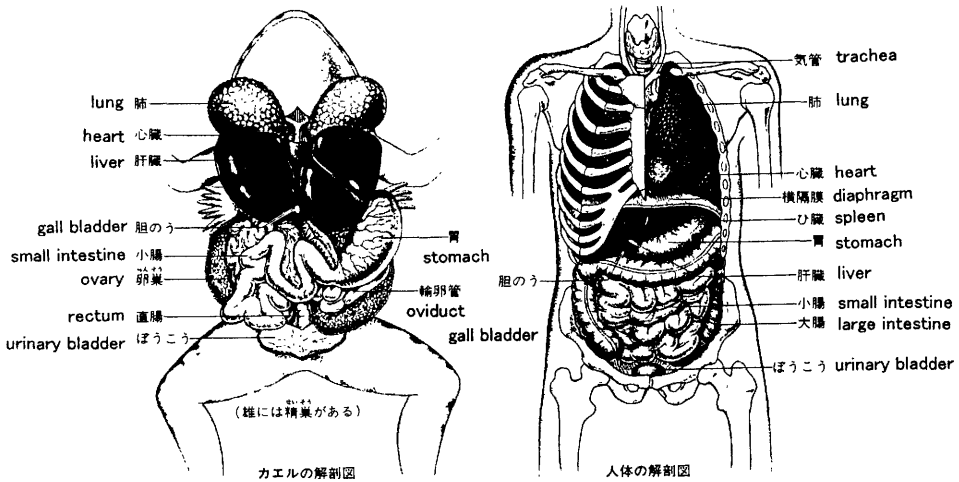


Fig. 3. The explanation of the internal organs of the frog in Japanese textbook

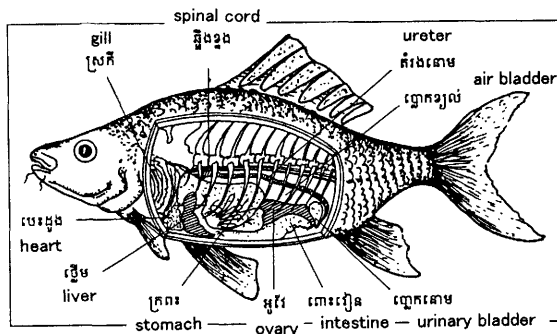


Fig. 4. The explanation of the internal organs of the fish in Cambodian textbook

Conclusion

Textbooks are important as teaching materials particularly in Cambodia, where experienced teachers and references are not sufficient due to its history. Nevertheless, in comparison with Japanese textbooks, several crucial problems are identified in Cambodian textbooks as discussed above. Therefore, to improve Cambodian textbooks, we would like to make some suggestions. That is, Cambodian textbooks should;

1. refer to the relationship among phyla.
2. include “genetics” and “development” in Grade 10.
3. include appropriate experiments for the context of Cambodia.
4. illustrate some figures in students’ activities.
5. provide accurate figures that are useful for actual students’ activities.

We hope that these suggestions will be reflected in future revision. Finally, it is important to note that the writing of this paper was made possible through the opportunity to work for the Ministry of Education, Youth and Sport (MoEYS) in Cambodia as science education specialists of JICA (Japan International Cooperation Agency). However, responsibility for the text rests entirely upon the authors.

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