
Research Paper

Crisis of Biology Education in Japan

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Abstract

As a result of the latest reform of the national curriculum framework, the Course of Study (CS), by the Japanese Ministry of Education (MEXT), some problems have occurred in biology education at the primary and secondary school levels. The major problems are as follows: (1) The contents of study have decreased because the time allotted to science classes was reduced. This has resulted in the incomplete biology education at the compulsory level. (2) In upper secondary schools, students are required to take one of the 2-credit general science subjects, and to select at least one subject among the individual 3-credit science subjects. Therefore, many students possibly do not study enough biological topics to understand the current issues related to life and environmental sciences. (3) Some very important concepts in biological science such as evolution and the continuity of life have lacked from the contents of study not only at the compulsory level, but also in ordinary biology course in upper secondary schools. Molecular biology has also been missing from ordinary biology course in upper secondary schools. (4) Some important concepts related to biology education in other areas of science education such as ions, energy, the characteristics of light, atoms and molecules, etc., have been transferred from the lower secondary school level to the upper secondary school level. Thus, these topics have to be covered in biology education in upper secondary school. (5) The process of textbook “authorization,” which is the screening of textbooks for primary and secondary schools carried out by the officers of MEXT, makes the issues more serious. The contents of each textbook are checked severely to see if they deviate from the CS and its guidelines. As a result, the explanations of some important biology concepts and of the concepts in other science areas which might be required for understanding biological phenomena were requested to be deleted from biology textbooks. This results in restricting biology education and makes it more difficult. **Key words:** *biology education, curriculum framework and guidelines, primary education, Japanese science education, secondary education.*

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Introduction

The modern Japanese national curriculum framework, the Course of Study (CS), and its guidelines for elementary schools were enacted in 1951 and revised four times until 1998: in 1958, 1968, 1977 and 1989. Those for lower secondary schools were also enacted in 1952 and revised in 1958, 1969, 1977 and 1989 (Takakura and Murata 1998, Katayama 1998a, 1998b). The Ministry of Education, Science, Sports and Culture, Japan, which amalgamated with the Department of Science and Technology in 2000 into the Ministry of Education, Culture, Sports, Science and Technology (MEXT), has made the CS and its guidelines (Takakura and Murata 1998, Katayama 1998a, Ministry of Education, Science, Sports and Culture 2000, MEXT website^{*}).

As was mentioned previously (Katayama 1998b), the CS was revised in 1998. The revised CS for elementary schools and for lower secondary schools was enforced from this year (2002) and that for upper secondary schools will be enforced from 2003. In the present report, the authors mention some problems which have occurred and will possibly occur in science education, especially in biology education, at the primary and secondary school levels as a result of the new CS enforcement.

Some Issues in Biology Education at the Primary and Secondary Levels in Japan

Reduction in time allotted to science and biology education

Compared to the previous CS (Ministry of Education, Science, Sports and Culture 1989a, b), the total time allotted to science classes in the new CS (Ministry of Education, Science, Sports and Culture 1998a, b) is reduced by about 17% in elementary schools (Table 1) and by 8% in lower secondary schools (Table 2). According to the new CS for upper secondary schools (Ministry of Education, Science, Sports and Culture 1998c), students are required to take one of the general science subjects, all of which are 2-credit courses (2 hours per week). In addition, students are required to select at least (but enough to satisfy the requirement) one subject among eight individual science subjects, all of which are 3-credit courses (3 hours per week) (Table 3). In the present curriculum framework, students are asked to select at least two of the 4-credit subjects shown in Table 3 (Ministry of Education, Science, Sports and Culture 1989c). Therefore, the time allotted to science classes at the upper secondary school level will possibly be reduced in the new CS.

Table 1 Comparison of the time* allotted for science classes in elementary schools in the previous and current curriculum frameworks

	Grade				Total
	3	4	5	6	
Previous Curriculum Framework	105	105	105	105	420
Current Curriculum Framework	70	90	95	95	350
Reduction (%)	33	14	10	10	17

* The number of school hours (one school hour is 45 min) of lessons per school year

Table 2 Comparison of the time* allotted for compulsory science classes in lower secondary schools in the previous and current curriculum frameworks

	Year			Total
	1	2	3	
Previous Curriculum Framework	105	105	105	315
Current Curriculum Framework	105	105	80	290
Reduction (%)	0	0	24	8

* The number of school hours (one school hour is 50 min) of lessons per school year

Table 3 Subjects in science for general education in the present and new curriculum framework for upper secondary schools

Present Curriculum Framework		New Curriculum Framework	
Subject	Credits*	Subject	Credits*
Integrated Science	4	Basic Science	2
		Integrated Science A	2
		Integrated Science B	2
Physics IA	2	Physics I	3
Physics IB	4		
Physics II	2	Physics II	3
Chemistry IA	2	Chemistry I	3
Chemistry IB	4		
Chemistry II	2	Chemistry II	3
Biology IA	2	Biology I	3
Biology IB	4		
Biology II	2	Biology II	3
Earth Science and Astronomy IA	2	Earth Science and Astronomy I	3
Earth Science and Astronomy IB	4		
Earth Science and Astronomy II	2	Earth Science and Astronomy II	3

* 35 school hours (one school hour is 50 min) of lessons per school year are counted as one credit.

The reduction in time allotted to science classes results in the reduction of the contents of study. Some topics, which had been thought to be difficult to understand for students of a certain year or a certain school level in the previous CS, were transferred to an upper year or upper school level. Some others were simplified or even deleted from the contents of study. As a result, some serious problems have occurred or will occur as described

below.

Incomplete biology education at the compulsory level

As a result of the revision of the CS for lower secondary schools, one of the most important concepts, the evolution of organisms, was deleted from the contents of study. In science textbooks for students in lower secondary schools, strata and fossils appear as topics

of earth science, but there is no explanation of evolution (Katayama and Kanaizuka 2001). Among the topics related to the continuity of life, reproduction is included in the contents of study, but the principles of heredity such as Mendel's Laws are taught only partially at the lower secondary level (Ministry of Education, Science, Sports and Culture 1998b).

Organisms used as teaching materials are restricted very much in the new CS for lower secondary schools (Ministry of Education, Science, Sports and Culture 1998b). As a result, most of the organisms appearing in science textbooks for lower secondary schools are vascular plants and vertebrates (Katayama and Kanaizuka 2001). Using such textbooks, students can hardly understand the diversity and unity of organisms.

In the case of the CS for elementary schools, the previous one (Ministry of Education, Science, Sports and Culture 1989a) already lacked the idea of teaching the above-mentioned concepts. In the revision of the CS, the contents of study decreased and nothing was added (Ministry of Education, Science, Sports and Culture 1998a). Thus, biology education at the compulsory level can be said to have become more incomplete.

Incomplete biology education at the upper secondary level

In ordinary biology (Biology I), the concept of evolution is completely deleted. As well, organisms are taught without any viewpoint of systematics in this subject. As mentioned above, the systematics and evolution of organisms are excluded from the contents of study at the compulsory level. The idea of the "five-kingdoms" presented by Copeland, Whittaker and Margulis is very important to understand not only the systematics of organ-

isms, but also the evolution of organisms (Margulis et al. 1994). Unfortunately, such an idea is missing from the contents of study in ordinary biology in upper secondary schools, as well as at the compulsory level.

Integrated Science B is a subject for upper secondary schools dealing with topics of biology and earth science, and Integrated Science A deals with topics of physics and chemistry (Table 3). The contents of these subjects look like they are there to compensate for the failure of science education at the compulsory level. Systematics (biodiversity) and evolution are included in the contents of Integrated Science B. The principles of heredity including Mendel's Laws are also taught in this subject, although the contents do not fully cover this study area. However, this subject does not deal with cellular and sub-cellular phenomena. In advanced biology (Biology II), students can be taught systematics and the evolution of organisms as well as molecular biology. But, if upper secondary students do not choose any of these subjects, they graduate from secondary school without understanding the world of organisms.

Molecular biology has been missing from the ordinary level in upper secondary schools

As in the present CS for upper secondary schools, the topic "genetic information and its expression" is excluded from the contents of ordinary biology (Biology I) in the new CS. In addition, the topic "proteins and their function in organisms" is also excluded. As a result, most of the topics in biochemistry and molecular biology are only taught in advanced biology (Biology II). It is predicted that the number of students who take Biology II will be very small, so that most students may not have enough knowledge required for considering

current biological and medical issues.

Biology education should cover any lack of important concepts related to biology from other subjects

Some important concepts related to biology education in other areas of science education such as “ions,” “energy,” “the characteristics of light,” “atoms and molecules,” etc., have been transferred from the lower secondary school level to the upper secondary school level. Thus, these topics may have to be covered in biology education in upper secondary schools.

Severe textbook screening was carried out by MEXT

There has been a system of screening these textbooks by MEXT before publication to check whether their contents deviate from the curriculum framework and its guidelines. This process is now called “authorization” (Takakura and Murata 1998, Ministry of Education, Science, Sports and Culture 2000, MEXT website^{* **}). “In the process of authorization of textbooks, books compiled and edited by the private sector are examined to decide whether they are appropriate for use as textbooks through the careful deliberations of the Textbook Authorization Council” (MEXT website^{**}). Science textbook authorization has been carried out by certain examiners in the Elementary and Secondary Education Bureau, MEXT, who have scientific and educational backgrounds.

A laudable purpose of textbook screening might be the correction and improvement of the material in textbooks, but in practice, the purpose of the authorization has become to check that the contents of textbooks do not deviate from the curriculum framework and its

guidelines (Katayama and Kanaizuka 2001, Katayama 2002). As a result of textbook authorization, the diversity of the contents among textbooks seems to have been lost. In the process of authorization of science textbooks for lower secondary schools, as well as Biology I textbooks for upper secondary schools, the explanations related to systematics and evolution were requested to delete completely. Explanations of concepts in other science areas, which might be required for understanding biological phenomena, were also requested to delete from biology textbooks (Katayama 2002). This results in restricting biology education at the upper secondary level and makes biology more difficult to teach.

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- ** Textbook Administration <<http://www.mext.go.jp/english/org/eshisaku/eshotou.htm>> (Nov. 2002)