
Practical Report

Educational Significance of “Fish dissection” in Elementary School Science for Realizing the Preciousness of Life

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In this paper, we analyzed the educational significance of “fish dissection” in elementary school science of Japan. Description of fish dissection has been decreasing in elementary school science textbooks in recent years, though the importance of “natural experience,” “experiential learning,” and the necessity of guidance to understand the “preciousness of life” has been proposed in science education in Japan. For the method of analysis, we investigated mainly the changes in teaching materials for “fish dissection” in the postwar textbooks, and also the notions of dissection and scientific concepts of sixth graders as well as their view of life through classes of “fish dissection.” We examined science textbooks published by four different textbook publishers on the basis of the Course of Study (CS) for Elementary Schools in Japan, which were revised in 1958, 1968, 1977, 1989 and 1998. The results of the study were as follows: Crucian carp (*Carassius cuvieri*) was described as one of the teaching materials for observations and experiments in all textbooks published based on the 1958 and 1968 revisions of the CS. There were, however, no teaching materials on “fish dissection” in any textbooks published by any companies based on the 1977 revision of the CS. “Fish dissection” was described as a reference in a unit in the textbooks published based on the 1989 and 1998 revisions of the CS by some of the four publishers. A questionnaire to the children after the class on “fish dissection” revealed the following facts: First, almost all of the children answered that the practice of fish dissection was good. Secondly, they had a variety of impressions or notions on life and seemed to realize the “preciousness of life”. The facts show the effectiveness of introducing “fish dissection” in elementary school science to let children realize the “preciousness of life”.

Keywords: biology education, elementary school science, fish dissection, preciousness of life, teaching material.

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Introduction

It is often said “The dissection may be against the preciousness of life.” In Japan, fish dissection had been practiced in almost all elementary school science classes from the 1960’s to 1970’s (Iwama *et al.*, 2008). However, there is a report that the ratio of enforced animal dissection in elementary school science is about 10% in recent years (Nishikawa and Tsuruoka, 2007). The low ratio might be attributed to the loathsomeness of dissection itself, difficulty in teaching classes by teachers who have had no experiences of animal dissection, some pressure to stop animal dissection from animal protection groups, and so on.

In this study, we analyze the educational significance of fish dissection in elementary school science. Description of fish dissection has been decreasing in elementary school science textbooks, though the importance of natural experience, experiential learning and the necessity of guidance in understanding the preciousness of life have been proposed in Japanese science education in recent years. We studied the changes in teaching materials for fish dissection in the postwar textbooks. We also examined the notions on dissection and scientific concepts of children as well as their view of the preciousness of life through classes of fish dissection, and analyzed whether fish dissection is really against the preciousness of life, and whether it gives certain negative influence to the children.

Methods of Investigation

1. Survey of science textbooks

We investigated the changes in descriptions of fish dissection in science textbooks to know how the teaching materials for this topic have been treated in elementary school science in Japan. The textbooks were published by four different textbook publishers on the basis of the

Course of Study (CS) for Elementary Schools in Japan, which was revised in 1958, 1968, 1977, 1989, and 1998. We analyzed the units on fish dissection in the textbooks for fifth and sixth graders.

2. Practice of “fish dissection” in classes

We conducted science lessons including a practice of fish dissection in two classes of sixth graders in an elementary school in Tokyo in February, 2008 to know the educational effectiveness of the practice. The class sizes were as follows: Class A was composed of 39 children (19 boys and 20 girls) and Class B was composed of 37 children (18 boys and 19 girls). The total number of children was 76 (37 boys and 39 girls)

The practice was composed of the following three parts.

Part 1. Introduction to fish dissection practice

We allotted one school hour (45 minutes) to an introductory class prior to the fish dissection practice for each class in order to let children realize the preciousness of life.

Part 2. Fish dissection practice

We allotted two continuous school hours (90 minutes) to the fish dissection practice, and we gave the same lesson for each class. We prepared two teachers in each class; that is, one of them was an assistant teacher.

The teaching material for fish dissection was crucian carp (*Carassius cuvieri*). We used live fish in order to show the pulsation of the heart. We put them in a 0.1% Tricain (Tricane) solution for 15 minutes for anesthesia.

Children used a science textbook published in 2005 by [DN]¹⁾ (Fig. 1)²⁾. As the anatomical figure of a fish in the textbook described only five organs, we distributed a copy of an anatomical figure of a fish describing nine organs, which was obtained from a science textbook published in 1974, to each group as supple-

mentary material (Fig. 2).

We divided the students of one class into 12 groups. Each group which was composed of three or four children used one crucian carp.

Part 3. A questionnaire to children on fish dissection

After the classes on fish dissection we asked the children to answer the following questions about fish dissection in a questionnaire to know their responses to the practice.

- 1) Did you wish to do “fish dissection?”
- 2) What did you think about “fish dissection?”
- 3) Which fish organs could you notice?

We analyzed their answers to the questions from several aspects such as “experiential learning,” “scientific knowledge,” “biodiversity” and “preciousness of life.”

Results and Discussion

1. Results of the survey of science textbooks (Table 1)

We analyzed the changes in teaching materials for fish dissection in the following elementary school science textbooks published from four textbook publishers from several viewpoints concerning descriptive modes and

names of fish organs: the textbooks published in 1968 were based on the CS revised in 1958, those published in 1974 were based on the CS revised in 1968, those published in 1986 were based on the CS revised in 1977, those published in 1995 were based on the CS revised in 1989, and those published in 2005 were based on the CS revised in 1998.

Also, the abbreviations [DN] [TS] [KR] and [KS] stand for publishers of elementary school science textbooks in Japan¹⁾.

a. On the science textbooks published in 1968

Fish dissection was described in the textbooks published for the fifth graders (Item No. 3). The total number of pages for the topic in each textbook varied from two to three (Item No. 6) and were 2.4 pages on average.

Crucian carp was described as the teaching material for observations and experiments in all textbooks (Item No.7). The total number of fish organs was eight in [DN], four in [TS], five in [KR] and four in [KS] (Item No. 8). The structure of the body skeleton of fish was described in textbooks by all four publishers, but the muscle construction was described in textbooks by two publishers among four (Item No. 9).

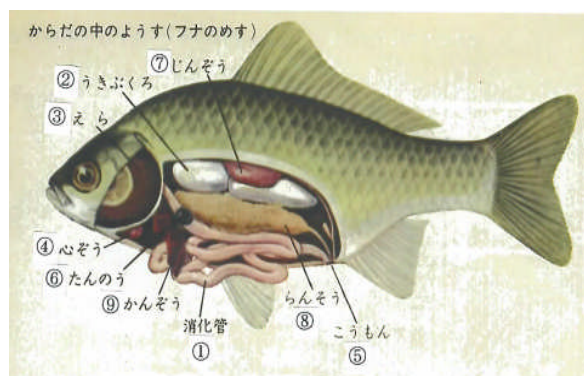
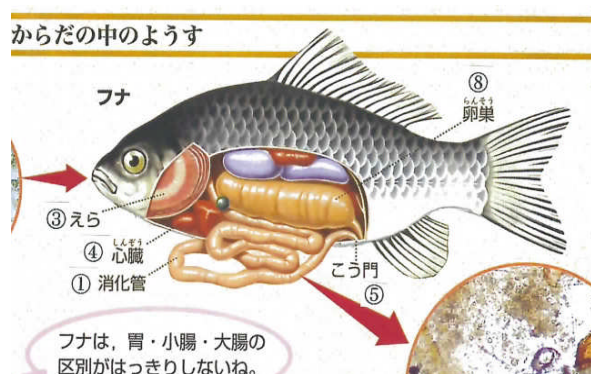


Figure 1 (left) A figure of fish organs in a science textbook published by Dainippon-tosho Co., Ltd. in 2005. Five organs (1: Alimentary canal, 2: Gills, 3: Heart, 4: Anus and 5: Ovary) were described.

Figure 2 (right) A figure of fish organs in a science textbook published by Dainippon-tosho Co., Ltd. in 1986. Nine organs (1: Alimentary canal, 2: Swim bladder, 3: Gills, 4: Heart, 5: Anus, 6: Gall bladder, 7: Kidney, 8: Ovary, and 9: Liver) were described.

Table 1-(1) Changes of the contents related to “Fish dissection” in elementary school science textbooks in Japan

No	Item	DN*					TS*				
		1968	1974	1986	1995	2005	1968	1974	1986	1995	2005
1	Year of publication of textbooks	1968	1974	1986	1995	2005	1968	1974	1986	1995	2005
2	Year of revision of the Course of Study	1958	1968	1977	1989	1998	1958	1968	1977	1989	1998
3	Grade	5th	5th	6th	6th	6th	5th	5th	6th	6th	6th
4	Name of the unit	Life of fish	Structure and function of body	Structure and function of body	Structure and function of body	Structure and function of body	Life of fish	Fish and human bodies	Human bodies	Human and animal bodies	Function of animal bodies
5	Pages of the unit	8	19	18	14	16	8	16	19	16	16
6	Pages of fish dissection	2.2**	3	—	1	0.7	2	3.5	—	—	—
7	Kind of fish	Crucian carp	Crucian carp		Crucian carp	Crucian carp	Crucian carp (Carp)	Crucian carp			
8	Name of organ										
	Gills	+	+		+	+	+	+			
	Heart	+	+		+	+	+	+			
	Alimentary canal	+	+		+	+	+	+			
	Gall bladder	+	+		—	—	—	—			
	Liver	+	+		—	—	—	—			
	Kidney	—	+		—	—	—	—			
	Ovary	+	+		+	+	—	—			
	Swim bladder	+	+		—	—	+	+			
	Anus	+	+		+	+	—	+			
	Total number of organs	8	9		5	5	4	5			
9	Structure of body skeleton	+	+		—	—	+	+			
	Muscle construction	+	+		—	—	—	+			
10	Page of science textbook	168	154	146	122	138	184	184	152	108	124

+ : described in the textbook; — : not described in the textbook.

*DN: Dainippon-tosho Co., Ltd.; TS: Tokyo Shoseki Co., Ltd.; KR: Shinko Shuppansha Keirinkan Co., Ltd.; KS: Kyoiku-shuppan Co., Ltd.

**The textbooks published in 1968 and 1974 are A5 (14.8-by21-centimeter) size and those in 1995 and 2005 are B5 (18.2-by15.7-centimeter) size. The calculation for less than one page is determined by (percentage of page) area.

Source: Journal of Science Education in Japan, Vol.33 No. 2, 2009 (in Japanese)

<To be continued to the next page>

b. On the science textbooks published in 1974

Fish dissection was described in the textbooks published for the fifth graders (Item No. 3). The total number of pages for the topic in each textbook varied from three to five (Item No. 6) and was 3.9 pages on average.

Crucian carp was described as the teaching material for observations and experiments in all textbooks (Item No. 7). The total number of fish organs described was nine in [DN], five in [TS], six in [KR] and five in [KS] (Item No. 8).

Table 1-(2) Changes of the contents related to “Fish dissection” in elementary school science textbooks in Japan

No	Item	KR*					KS*				
		1968	1974	1986	1995	2005	1968	1974	1986	1995	2005
1	Year of publication of textbooks	1968	1974	1986	1995	2005	1968	1974	1986	1995	2005
2	Year of revision of the Course of Study	1958	1968	1977	1989	1998	1958	1968	1977	1989	1998
3	Grade	5th	5th	6th	6th	6th	5th	5th	6th	6th	6th
4	Name of the unit	Life of fish	Body of fish, breeding of fish	Our bodies	Human and animal bodies	Human and animal bodies	Life of fish	Body of fish	Structure and function of body	Structure of human bodies and other animals	Structure of body for living animals
5	Pages of the unit	8	12	19	12	14	14	8	17	16	22
6	Pages of fish dissection	2.5	5	—	—	—	3	4	—	1	1
7	Kind of fish	Crucian carp	Crucian carp				Crucian carp	Crucian carp		Crucian carp (Carp, Mackerel)	Crucian carp (Carp, Mackerel)
8	Name of organ										
	Gills	+	+				—	+		+	+
	Heart	+	+				+	+		+	—
	Alimentary canal	+	+				+	+		+	+
	Gall bladder	—	—				—	—		—	—
	Liver	—	+				—	—		—	—
	Kidney	—	—				—	—		—	—
	Ovary	+	+				—	—		+	+
	Swim bladder	+	+				+	+		—	+
	Anus	—	—				+	+		—	+
	Total number of organs	5	6				4	5		4	5
9	Structure of body skeleton	+	+				+	+		—	—
	Muscle construction	+	+				—	+		—	—
10	Page of science textbook	176	176	148	104	124	184	184	138	124	148

+: described in the textbook; —: not described in the textbook.

*DN: Dainippon-tosho Co., Ltd.; TS: Tokyo Shoseki Co., Ltd.; KR: Shinko Shuppansha Keirinkan Co., Ltd.; KS: Kyoiku-shuppan Co., Ltd.

**The textbooks published in 1968 and 1974 are A5 (14.8-by21-centimeter) size and those in 1995 and 2005 are B5 (18.2-by15.7-centimeter) size. The calculation for less than one page is determined by (percentage of page) area.

Source: Journal of Science Education in Japan, Vol.33 No. 2, 2009 (in Japanese)

The structure of the body skeleton and the muscle construction of fish were described in all textbooks by four publishers (Item No. 9).

c. On the science textbooks published in 1986

At that time, the fifth graders learned about the breeding of fish, and the sixth graders did

human bodies, but there were no teaching materials on fish dissection in any textbooks³⁾.

d. On the science textbooks published in 1995

Fish dissection was included as reference material in the unit on “Structure of Human Bodies and Other Animals” in the textbooks for

the sixth graders published by two publishers among four. The total number of pages on “fish dissection” was one in both [DN] and [KS] (Item No. 6).

Crucian carp was described as the teaching material for observations and experiments in these two textbooks (Item No. 7). The total number of fish organs described was five in [DN] and four in [KS] (Item No. 8). The structure of the body skeleton and the muscle construction of fish were not described in any textbooks (Item No. 9).

e. On the science textbooks published in 2005

Fish dissection was included as reference material in the unit on “Structure of Human Bodies and Other Animals” in the textbooks for the sixth graders published by two publishers among four publishers. The total number of pages on “fish dissection” was 0.7 and one in [DN] and in [KS], respectively (Item No. 6).

Crucian carp was described as the teaching material for observations and experiments in these two textbooks (Item No. 7). The total numbers of fish organs described were five in both [DN] and [KS] (Item No. 8). The structure of the body skeleton and the muscle construction of fish were not described in any textbooks (Item No. 9).

2. Results of practice of fish dissection

a. Introductory classes on “fish dissection”

Prior to the classes on “fish dissection,” we asked children, “Why do we need to dissect fish?” and “Why do we need the experiment even though it takes the life of fish?”

The aim of the class was to let children realize the “preciousness of life.” When we asked children, “Do you not want to dissect fish?” about a quarter of children answered, “No, I do not want to do it.” As for the reasons for it, they said, “I don’t want to kill fish,” and “I am sorry for killing the fish.” So, we told them, “Fish dissection is important to understand our

bodies and learn about animal lives.”

b. Classes on “fish dissection”

At the beginning of the class on “fish dissection,” we asked the children, “Why do we need an experiment even though it takes the life of fish?” again.

Some children still hesitated to carry out the fish dissection at the beginning; however, they soon came to observe it more eagerly. The other children took part in the dissection with excitement from the beginning. During the class, all children could observe the internal organs of crucian carp and could check nine organs with the anatomical figure of a fish which was distributed to each child previously. The pulsation of the heart could be confirmed by all groups. After the experiment, we buried the dissected fish in the ground all together with the feeling of “many thanks.”

3. Children’s recognition of fish organs

After the class on “dissection of fish,” we distributed a questionnaire to the children to know their recognition of fish organs. The results are shown in Table 2. According to the answers about fish organs, the children recognized the nine organs at a high ratio.

The alimentary canal and swim bladder were recognized by all children. Gills and the heart were recognized about 99%, the anus was recognized about 96%, and the gall bladder was recognized by about 91% of them. The kidney, ovary, and liver were recognized by more than 60% of them⁴⁾.

4. Children’s views of “fish dissection”

Another questionnaire to children was distributed after the classes on “fish dissection” to know their view of the dissection. Table 3 shows the children’s answers, and they reveal the following facts.

Prior to the class on “fish dissection,” 20 children out of 76 answered, “I do not want to dissect fish.” The following three reasons for

the answer were presented by them: (1) I will be sick (nine children), (2) I am sorry for killing the fish (five children), and (3) I do not want to kill fish (four children). Six children out of 76 answered, “I have no idea.”

However, after the class on “fish dissection,” a big change occurred; 74 children out of 76 children answered that it was good to practice fish dissection.

5. Children's notions after “fish dissection”

It became clear from the children's answers

that from the practice, they had a lot of notions, such as an impression of experiential learning, recognition of scientific concepts, and awareness of biodiversity as well as the preciousness of life.

Table 4 shows the classification of the description of children's notions in their responses to the questionnaire after the completion of “fish dissection.” All children described something related to experiential learning. Examples are as follows: “I observed real fish, then I understood the structure of a fish body” and “I was

Table 2 Fish organs recognized by children after “fish dissection”

(N=76)

Name of Organ	Boys (37)		Girls (39)		Total (76)		Ratio (%)
	Rec*	Non**	Rec*	Non**	Rec*	Non**	
1. Alimentary canal	37	0	39	0	76	0	100
2. Swim bladder	37	0	39	0	76	0	100
3. Gills	37	0	38	1	75	1	99
4. Heart	36	1	39	0	75	1	99
5. Anus	36	1	37	2	73	3	96
6. Gall bladder	32	5	37	2	69	7	91
7. Kidney	27	10	29	10	56	20	74
8. Ovary	25	12	29	10	54	22	71
9. Liver	20	17	28	11	48	28	63

*Rec: recognition. **Non: non-recognition.

Source: Iwama *et al.* (2009) Journal of Science Education in Japan, **33** (2).

Table 3 Children's views of “fish dissection”

(N=76)

Did you wish to do “Fish dissection”?		What did you think about “fish dissection”?		
		Good	Not good, No idea	Total
Yes	Number	50	0	50
	Ratio (%)	66	0	66
No	Number	18	2	20
	Ratio (%)	23	3	26
No idea	Number	6	0	6
	Ratio (%)	8	0	8
Total	Number	74	2	76
	Ratio (%)	97	3	100

Source: Iwama *et al.* (2009) Journal of Science Education in Japan, **33** (2).

impressed that the body of a fish was very delicate.”

Almost all the children described something related to scientific knowledge. Examples of them are as follows: “The alimentary canal is 60cm long,” “The fish has a two-chambered heart,” and “The heart plays the role of the blood pump.”

Descriptions related to biodiversity were given by about 70% of the children. Examples are as follows: “A fish has gills and a swim bladder” and “The heart of a fish is small.”

Descriptions related to the preciousness of life were given by about 60% of the children. Examples are as follows: “I realized the preciousness of life when I watched the pulsation of the heart of the fish,” “I realized that the body was not usable if it was injured,” and “Although the heart of the fish was very small, it moved very strongly. I realized the vitality of the fish.”

Conclusions

Description of animal dissection has been decreased in elementary school science textbooks in Japan. Crucian carp was described as a teaching material for observations and experiments in all elementary school science textbooks published based on the 1958 and 1968 revisions of the CS in Japan. There was, however, no teaching material on fish dissection in any textbooks which were published based on the CS

revised in 1977. Fish dissection was described only as a reference in a unit in the textbooks for the sixth graders published based in the CS revised in 1989 and in 1998 by two publishers among four. It will be the same status due to the most recent revision of the CS for Elementary Schools in Japan in March, 2008, although science textbooks based on it have not been published yet.

However, fish dissection is very impressive for elementary school children, and it has a high educational effect as shown by our implementation. The results of the questionnaire to children after the class on “fish dissection” revealed the following facts: First, almost all the children answered that it was good to practice the fish dissection. Secondly, through the activity, children gained notions of experiential learning and scientific concepts and impressions of the delicacy of the structure of a body, and they seemed to realize the preciousness of life. Moreover, we got no answer to show that the practice of “fish dissection” was against the preciousness of life or that it gave any negative influence to children.

Although the above facts showed the educational significance of fish dissection in elementary school science, many problems are left unsolved to enforce it in elementary school science. For example, some teachers do not want to do dissection and some children do not want to kill fish or are sorry for killing fish by dissection.

Table 4 Contents of description of children’s notions after “fish dissection” (N=76)

Categories	Boys (37)	Girls (39)	Total (76)	Ratio (%)
Experiential Learning	37	39	76	100
Scientific Knowledge	36	39	75	99
Biodiversity	21	33	54	71
Preciousness of Life	18	28	46	61

Numbers in the table show numbers of answers classified by aspects (multiple answers).

Source: Iwama *et al.* (2009) *Journal of Science Education in Japan*, 33 (2).

It seems that fish dissection is important for experiential learning in order for children to have some notions about the structure and function of human bodies and other animals and to notice the delicacy of the structure of the body that will lead to realization of the “preciousness of life.” It must be worthwhile to reconsider the adoption of “fish dissection” in elementary school science.

Acknowledgements

We thank Prof. Kunio Umeno (Fukuoka University of Health and Social Welfare) for his detailed comments and suggestions and some attendants of the 22nd Biennial Conference of the AABE.

Notes

- ¹⁾ Abbreviations: DN, Dainippon-tosho Co., Ltd.; TS, Tokyo Shoseki Co., Ltd.; KR, Shinkoshuppansha Keirinkan Co., Ltd.; KS, Kyoiku-shuppan Co., Ltd.
- ²⁾ The number within a circle for each fish organ in Figure 1 and Figure 2 was inserted by us corresponding to that in Table 2.
- ³⁾ According to one of the members of the committee that produced the CS at that time, it was difficult even to use the term “dissection” in the CS for Elementary Schools in Japan and its commentary.
- ⁴⁾ The spermary testis has not been described in the CS of Elementary Schools in Japan.

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