

Development of Nuclear Energy and Radiation Textbooks for Elementary School Students

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Introduction

The perception of risk has characteristics of cognitive anchoring induced by strong and negative images, such as the Chernobyl and Fukushima nuclear power plant accidents and the consequences thereof. Thus, perception of risk in nuclear energy, related technologies, and nuclear facilities are affected greatly. To address the gap existing between average citizens and experts, even though it is not due to a simple difference in knowledge, high quality information and education are key components[1]. However, at present, although there is serious social confusion about nuclear energy and radiation, no school subjects or teaching materials have been developed. Therefore, taking the circumstances of the present time and the situation of information receivers, this study aimed to develop textbooks about nuclear energy and radiation targeting elementary school students-the leaders of the next generation.

Methods

In this study, to develop tailored elementary school textbooks suitable for understanding the nuclear energy and radiation, quantitative and qualitative research was carried out in parallel, which included nine steps to ensure the validity of content and structure.

Step 1: A discussion session regarding the status and educational direction of nuclear energy and radiation understanding was held with twelve people representing science teachers of each grade and experts of nuclear energy and radiation. **Step 2:** The format and contents of education on nuclear energy and radiation for students in South Korea and overseas were collected. **Step 3:** Student discussion sessions were held to construct the educational requirement draft that included the information that elementary school students wanted to know about nuclear energy and radiation. **Step 4 :** A partial revision was made to the preliminary survey questionnaire for 13 class lessons through consultation with science teachers and experts. **Step 5:** The educational requirements survey was conducted to select the tailored educational content. **Step 6:** The content and structure validity of the educational content result for nuclear energy and radiation understanding, developed in consultation with the nuclear energy and radiation experts, were reviewed; the statistical analysis results were confirmed. **Step 7:** Twelve experts in the pertinent field addressed in each class lesson wrote the contents, which resulted in the preliminary textbooks. **Step 8:** The textbooks were evaluated in two sets of simulated classes. **Step 9:** The final draft of the textbooks was determined through consultation with the experts.



Step 3



Step 4



Step 8(1)



Step 8(2)

Results

1. Theme suitability for elementary school students

The themes of the 13 lessons had a high suitability frequency (>70%). The lowest rating was 73.7% for “Which jobs are related to nuclear energy and radiation?” (Lesson 11). Theme suitability was measured by assigning one point to each suitable lesson; the overall suitability was rated as 11.18 by elementary school students, 10.10 by elementary school science teachers, and 10.97 by experts. This represents a high average suitability of 10.84. Therefore, the themes were suitable for inclusion in the elementary school textbook.

Table 1. Themes of Suitability for Elementary School Students

Lesson	Theme		Students	Teachers	Experts	Total
1	Definition of nuclear energy and radiation	Suitable	45(78.9)	28(87.5)	43(95.6)	116(86.6)
		Unsuitable	12(21.1)	4(12.5)	2(4.4)	18(13.4)
2	History of nuclear energy and radiation	Suitable	47(82.5)	16(50.0)	39(88.6)	102(76.7)
		Unsuitable	10(17.5)	16(50.0)	5(11.4)	31(23.3)
3	Importance of nuclear energy and radiation	Suitable	54(94.7)	25(78.1)	38(84.4)	117(87.3)
		Unsuitable	3(5.3)	7(21.9)	7(15.6)	17(12.7)
4	Risks of nuclear energy and radiation	Suitable	54(94.7)	31(96.9)	36(80.0)	121(90.3)
		Unsuitable	3(5.3)	1(3.1)	9(20.0)	13(9.7)
5	Coping methods during an incident	Suitable	55(96.5)	30(93.8)	35(77.8)	120(89.6)
		Unsuitable	2(3.5)	2(6.3)	10(22.2)	14(10.4)
6	Utilization of nuclear energy and radiation	Suitable	47(82.5)	29(90.6)	44(97.8)	120(89.6)
		Unsuitable	10(17.5)	3(9.4)	1(2.2)	14(10.4)
7	Nuclear energy generation	Suitable	47(82.5)	17(53.1)	37(82.2)	101(75.4)
		Unsuitable	10(17.5)	15(46.9)	8(17.8)	33(24.6)
8	Irradiation of food	Suitable	46(80.7)	20(62.5)	34(75.6)	100(74.6)
		Unsuitable	11(19.3)	12(37.5)	11(24.4)	34(25.4)
9	Medical radiation	Suitable	50(89.3)	24(75.0)	33(76.7)	107(81.7)
		Unsuitable	6(10.7)	8(25.0)	10(23.3)	24(18.3)
10	Radiation-related products in daily life	Suitable	50(87.7)	23(74.2)	34(75.6)	107(80.5)
		Unsuitable	7(12.3)	8(25.8)	11(24.4)	26(19.5)
11	Nuclear energy and radiation related jobs	Suitable	41(73.2)	25(78.1)	32(71.1)	98(73.7)
		Unsuitable	15(26.8)	7(21.9)	13(28.9)	35(26.3)
12	Energy in the future	Suitable	53(93.0)	29(90.6)	44(97.8)	126(94.0)
		Unsuitable	4(7.0)	3(9.4)	1(2.2)	8(6.0)
13	Concept of Talk-Talk (a study review game)	Suitable	47(82.5)	26(81.3)	40(90.9)	113(85.0)
		Unsuitable	10(17.5)	6(18.8)	4(9.1)	20(15.0)
Theme suitability (average)		Suitable	11.18	10.10	10.95	10.84
		Unsuitable	1.82	2.9	2.05	2.16

2. Contents in the finalized textbooks

The elementary school students wanted to acquire information used in their daily lives, including the definition of nuclear energy and radiation, principles and status of nuclear power generation, and information about irradiated food, medical radiation, and radiation in life.

Table 2. Contents in the Finalized Textbooks

Subject (Target)	Radiation and Life (For elementary school students)
Table of Contents	Chapter 1. What is nuclear energy and radiation?
	Chapter 2. Who discovered the nuclear energy and radiation?
	Chapter 3. Why is nuclear energy and radiation important?
	Chapter 4. Is nuclear energy and radiation dangerous?
	Chapter 5. Let's learn about what to do when an incident occurs.
	Chapter 6. How are nuclear energy and radiation used?
	Chapter 7. What is the nuclear power generation?
	Chapter 8. Why is radiation used for food?
	Chapter 9. What is medical radiation?
	Chapter 10. What kind of irradiated products are in our daily lives?
	Chapter 11. What jobs are related to nuclear energy and radiation?
	Chapter 12. What are energies of future?
	Chapter 13. Concept of Talk-Talk

Conclusion

Before the failure of securing social acceptance due to ignorance about nuclear energy and radiation leads to biased political effects, the correct information should be provided in schools to allow future generations to develop educated value judgments. The present textbooks were developed as a part of such effort.

[1] Slovic P. Perception of Risk from Radiation. In P. Slovic. The Perception of Risk, Earth Scan Publication Ltd, London. 2000:264-274.