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The Effects of a Demonstration School Program on Nuclear Energy for Elementary School Students in Korea

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1. Introduction

Although nuclear energy is an indispensable way for Korea to survive as an export-oriented country in the global market [1, 2], the public is vaguely anxiety about nuclear power generation because of the Fukushima Daiichi nuclear disaster in 2011 caused by the magnitude 9.0 Great East Japan Earthquake [3, 4]. Advancing nuclear energy and radiation technology to drive the country forward should be based on the understanding and acceptance of the public. Korea has provided numerous types of information to increase public acceptance of nuclear energy, but it has been difficult to change adults' perceptions and increase their acceptance of nuclear energy. As a result, social costs are rising. After a pilot program of 13 classes on understanding nuclear energy and radiation offered to elementary school students, who were expected to easily change their perceptions and to experience a relatively greater educational effect, this study analyzed changes to knowledge, attitudes, and behaviors regarding nuclear energy. In addition, this program was the first curriculum of its kind used as a step to lay the groundwork for offering it nationally in the free semester system. Therefore, the study analyzed its appropriateness to educational purposes.

2. Methods and Results

This study ran a program aimed at 52 sixth graders in two elementary school classes in Gyeonggi Province regarding nuclear power and radiation. The program was conducted from March 2016 until July 2016, during which period it provided 13 classes lasting 40 minutes each. Each class had different professional instructors and science teachers. Lectures, experiments, observations, practices, and discussions were the educational methods, which included expert lecturers, science teacher lecturers, cloud chamber experiments, irradiated food observations, practice measuring natural radiation inside the school, opinions, and discussions on nuclear energy. The study employed a tailored textbook developed in nine stages between 2014 and 2015 aimed at elementary school sixth grade students. The "Radiation and Life" textbook for elementary school students comprises the following chapters: 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 accident occurs, Chapter 6. How are nuclear energy and radiation used?, Chapter 7. What is 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 (a study review game).

2.1 Changes to Knowledge, Attitudes, and Behaviors about Nuclear Energy

After the 13 classes teaching about nuclear energy were delivered, the average of five items each on knowledge and attitudes related to nuclear energy increased in a statistically significant way. Regarding behavioral changes, those in favor of accepting nuclear energy in Korea increased by 36.8% after the program, and those who accepted nuclear power facilities in their residential areas increased by 24.5%. To compare the effects of this pilot program, a 40-minute one-time educational class for learning about nuclear energy was conducted for 267 students at the same grade level in 10 elementary schools. The results found that knowledge was 3.23 ± 1.229 points ($p < .011$) and attitudes were 3.88 ± 1.026 points ($p < .010$), which were statistically significant differences. Behavioral changes that resulted from this one-time class were that those in favor of accepting nuclear energy in Korea increased 5.4% after the class and those accepting nuclear power facilities in their residential areas increased 15.1%. The program of 13 classes and the one-time class had educational effects because they increased knowledge and changed attitudes and behaviors about nuclear energy. For a greater educational effect, however, it would be useful to implement the pilot program instead of the one-time class.

2.2 Appropriateness of Educational Targets

The pilot program achieved, on average, more than 90% of its target set based on the educational technology design. It found more than 90% of appropriateness of the course name, human character objectives, educational objectives, course objectives, curriculum objectives, teaching methods, evaluation methods, evaluation application, textbook format, educational grades, and educational type. If the pilot program were employed across the country, the program would be meaningful for helping students to

increase their knowledge, change their attitudes and behaviors about nuclear energy, and, by doing so, to be better able to assess the value of nuclear energy.

Table I: Educational Effects: Changes to Knowledge, Attitudes, and Behaviors

Classifications		Mean ± SD		*t*-value (*p*-value)
		Before education	After education	
Knowledge		1.96 ± 1.525	3.72 ± 0.858	-7.916(.000)
Attitudes		3.73 ± 1.098	4.24 ± 0.830	-2.707(.011)
		Frequency (percentage)		
Behaviors	In favor of nuclear energy in Korea	19 (54.3)	41 (91.1)	Those in favor increased by 36.8%
	Against nuclear energy in Korea	16 (45.7)	4 (8.9)	
	In favor of nuclear energy in the residential area	4 (13.3)	17 (37.8)	Those in favor increased by 24.5%
	Against nuclear energy in the residential area	26 (86.7)	28 (62.2)	

Table 2. Level of appropriateness of education targets

Item	Contents	Percentage (%)
Course name	Radiation and Everyday Life	96.2
Human Character Objective	A human who correctly knows and understands nuclear energy and radiation	90.4
Education Objective	Accurate understanding and correct perception of nuclear energy and radiation	98.1
Course Objective	Knowing the idea and importance of nuclear energy and radiation through experience and experiment	90.4
Curriculum Objective	Understanding the idea, importance, and details of nuclear energy and radiation	94.2
Teaching/Learning Methods	Using various media/methods, such as interesting videos, pictures, experiments, and experiences	94.2
Evaluation Methods	Simple presentations (writing a script, drawing a poster, giving a presentation, and having a discussion)	90.4
Evaluation Application	Not applicable	94.2
Educational Hours	40 minutes per week	88.5
Textbook Format	Tailored textbook	94.2
Educational Grade	Sixth graders	92.3
Educational Type	Creative experience learning or the free semester system	92.3

3. Conclusions

A lack of research and practice on communication strategies could be responsible for the situation in Korea of low support for nuclear energy because Korea does not have public understanding even though it is a nuclear energy exporter. If Korea implemented strategic communications from this point, such efforts could reduce unnecessary social costs. In addition, Korea should provide children with accurate information early in elementary school and help them to make personal assessments before they determine their social acceptance based on ignorance and vague anxiety about nuclear energy and radiation, which leads to negative political outcomes.

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