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Characteristics of Nuclear Power and Radiation Education for Schools in Fukushima Prefecture, Japan

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Abstract
In Fukushima prefecture which was contaminated by radioactive materials released from the TEPCO Fukushima Daiichi nuclear power plant accident in March 2011, nuclear power and radiation education is necessary in school education. To better understand the status and issues of nuclear power and radiation education in Fukushima prefecture, the authors conducted a questionnaire survey among the science teachers of Fukushima prefectural junior high schools in 2013, and interview survey through telephone and questionnaire survey among the boards of education of municipalities in Fukushima prefecture in 2014. A follow-up interview survey through telephone was carried out in 2015.
In the questionnaire survey among the science teachers, questionnaires were sent to 228 schools, of which 125 responded (response rate: 55 per cent). Responding to the question "What fields did you deal with in nuclear power and radiation education?" (multiple answers allowed), the most chosen fields were "Types of radiation" (88/112), "Difference between radiation and radioactivity" (83/112) and "Atoms and atomic nucleus" (79/112). On the other hand, the fewest chosen were "Radiation controlled area" (4/112), "Linear non-threshold model" (5/112) and "Children's vulnerability to radiation exposure" (9/112).
As the results of the interview to the 59 boards of education, 10 municipalities issued original educational materials on radiation, other 5 municipalities had original additional activities for radiation education. In the questionnaire survey, 32 municipalities responded (response rate: 54 per cent). In the original educational materials, there were few contents for discussing about pros and cons of nuclear power plant and noticing to possibilities of children's rights violations in existing exposure situation, such as standards of radiation controlled area or children's vulnerability to radiation exposure. These characteristics were similar to the results of the survey among the science teachers. In the nuclear power and radiation education in Fukushima prefecture, not only the basic knowledge on radiation, but also the contents of human rights education should be included.

1. Introduction
Fukushima prefecture was contaminated by radioactive materials released from the TEPCO Fukushima Daiichi nuclear power plant accident in March 2011. Prior to the accident, the Japanese government had promoted nuclear power for the generation of electricity over several decades, devoting vast resources to public relations to persuade the public that nuclear power was both safe and necessary. These resources included government-sponsored advertisements in newspapers and on television and public educational materials such as a supplementary reader on nuclear power for school children. Consequently, many Japanese people believed that the nuclear power plants in Japan would be safe even if a large earthquake and tsunami occurred – a notion now known as 'the myth of (nuclear power plant) safety' [1]. This is one of the most important educational lessons from the Fukushima nuclear accident.
After the accident, nuclear power and radiation education is necessary in school education based on the educational lessons, especially for children in Fukushima prefecture. In this study, we investigated the status and issues of nuclear power and radiation education in Fukushima prefectural junior high schools and radiation educational activities of the municipalities in Fukushima prefecture.

2. Textbooks and educational materials on nuclear power in Japan

2.1 Textbook Examination Procedure and supplementary reader
The Textbook Examination Procedure for textbooks used in Japanese schools allows publishing houses to create their own textbooks and submit them for official examination and approval by the

Ministry of Education, Culture, Sports, Science and Technology (MEXT). Textbooks approved by MEXT are then placed on display in local communities for public view. The final decision on which books to use rests with local boards of education in the case of public schools, and with the schools themselves in the case of private institutions [2].
The authorized textbooks used in Japanese schools provide relatively little information on nuclear power. The various media described above therefore play a large part in informing the Japanese public about nuclear-related issues, along with the supplementary readers used alongside textbooks by many schools. The supplementary readers used in schools are not required to go through the Textbook Examination Procedure on the grounds that they are educational materials, but not textbooks. The government issues supplementary readers of the contents related to relatively important national policy, such as the use of nuclear power. Once the supplementary readers by the government are issued, they are distributed to almost all schools. Although the use of these materials is optional, with teachers given discretion over whether or not to use them, they are used widely by teachers to supplement the material offered in authorized textbooks.

2.2 The Japanese government's supplementary readers on nuclear power and radiation

Supplementary readers on nuclear power for elementary and junior high school students published by MEXT and the Agency for Natural Resources and Energy (ANRE) in February 2010 were withdrawn within months of the Fukushima nuclear accident. This was because they included inappropriate information proved wrong by the accident, for instance, statements which overestimated nuclear power plant safety: 'Nuclear power plants are designed to withstand large earthquakes and tsunamis'. Other material presented in the readers was clearly biased.
New supplementary readers about radiation instead of nuclear power were issued by MEXT only, without ANRE, to all Japanese elementary, junior high and high school students in October 2011, at a cost of approximately 340 million yen. The readers contained little information about facts and lessons learned from the Fukushima nuclear accident, beyond eight lines in the preface describing the Fukushima accident and although lavishly illustrated, they did not feature photographs of the Fukushima nuclear accident. Furthermore, they made no mention of children's vulnerability to radiation exposure. Students could not be expected to learn important lessons from Fukushima using these supplementary readers.
The Japanese government's 2011 supplementary readers were criticized, not least by the Fukushima Prefectural Assembly, the Fukushima Teachers Union and the Fukushima University Research Group of Supplementary Readers on Radiation to create an original, alternative supplementary reader on radiation to controvert the Japanese government's supplementary readers. As a consequence of broad criticism, re-revised supplementary readers on radiation were issued in 2014, at the cost of approximately 290 million yen. The bureau in charge was changed from MEXT's Atomic Energy Division of Research and Development Bureau to the more neutral, MEXT's Elementary and Secondary Education Bureau. Professional textbook examiners employed to screen school textbooks, were included in the editing process for the first time. Although problems in the context of Education for Sustainable Development (ESD) still remain, the readers' unfairness has significantly improved.

2.3 Nuclear power and radiation education in Fukushima prefecture

The Fukushima Prefectural Board of Education asked Fukushima's 700 elementary and junior high schools to teach all students about radiation. The board advised the schools to spend about two to three hours a year on the subject, focusing on radiation protection and the health effects of exposure [3]. The Fukushima Prefectural Board of Education, modelled its own educational publication about radiation on the Japanese government's supplementary readers in November 2011. It was enlarged and updated some times because of being criticized similarly to the government's reader.
There are 59 municipalities in Fukushima prefecture and each of them has a board of education. Before the nuclear accident, there were 231 public junior high schools in Fukushima prefecture, but three affected by the nuclear accident closed.

3. Methods

3.1 Questionnaire survey of science teachers from Fukushima prefectural junior high schools

To better understand the state of nuclear power and radiation education in Fukushima prefecture in terms of issues such as content, the educational materials available and concerns expressed by educators, the authors conducted a questionnaire survey of junior high school science teachers working in Fukushima prefecture in December 2013. For all 228 public junior high schools, we asked a teacher from each school to answer to the questionnaire.

3.2 Interview survey through telephone and questionnaire survey among the boards of education of municipalities in Fukushima prefecture

In order to characterize radiation educational activities of the municipalities in Fukushima prefecture, the authors conducted interview survey through telephone and questionnaire survey among the boards of education of municipalities in Fukushima prefecture in 2014. A follow-up interview survey through telephone was carried out in 2015.

4. Results

4.1 Questionnaire survey among science teachers from Fukushima prefectural junior high schools

Questionnaires were sent to 228 schools, of which 125 responded (response rate: 55 per cent). Fig.1. shows the result for the question “What fields did you deal with in nuclear power and radiation education?” (multiple answers allowed). The most chosen fields were “Types of radiation” (88/112), “Difference between radiation and radioactivity” (83/112) and “Atoms and atomic nucleus” (79/112). These are the fields of basic knowledge on radiation. On the other hand, the fewest chosen were “Radiation controlled area” (4/112), “Linear non-threshold model” (5/112) and “Children’s vulnerability to radiation exposure” (9/112). These fields are important from the viewpoint of protecting children’s rights, although not included in the Japanese government’s supplementary readers and The Fukushima Prefectural Board of Education’s material. These results indicate that education fields on nuclear power and radiation in schools are framed by the Japanese government’s supplementary readers and the Fukushima Prefectural Board of Education’s material.

Actually, for the question “Do you use educational materials except textbooks?” (multiple answers allowed), the Japanese government’s supplementary reader was most chosen (60/112), followed by Fukushima Prefectural Board of Education’s material (45/112). As shown by the results, educational materials issued by the government or the board of education are chosen easily for the teachers.

Responding to the question “Do you feel anxiety about nuclear power and radiation education?”, 79 per cent (99/125) of teachers chose “Anxious” (81/125) or “Very anxious” (18/125). The reason (multiple answers allowed) most commonly given for anxiety was “Difficulties in ensuring fairness” (54/99), followed by “Lack of knowledge” (42/99), “Lack of educational materials” (41/99), “Difficulties dealing with the Fukushima nuclear accident” (40/99), and “Difficulties dealing with matters with no clear answer” (39/99) .

For the question “What do you think are the issues in nuclear power and radiation education?” (multiple answers allowed), the following issues were the most chosen: “To increase teacher’s knowledge about nuclear power and radiation” (81/125), “To ensure educational materials” (69/125), “To secure time for education” (52/125), and “To improve the contents of supplementary readers” (49/125). These results show that more accurate, fair and balanced educational materials on nuclear power and radiation are required by the science teachers in Fukushima prefectural junior high schools.

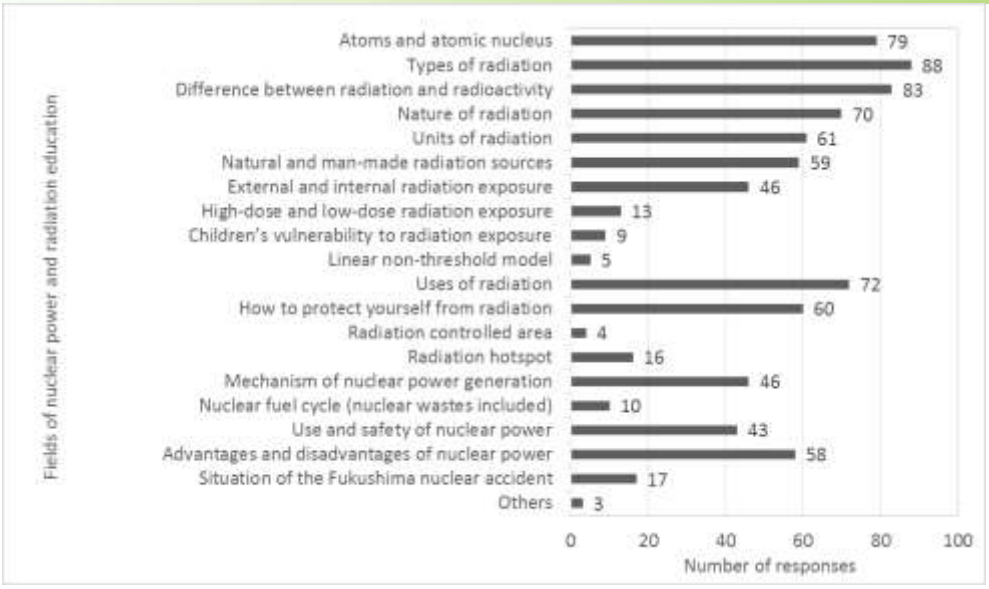

Fig.1. Results of the questionnaire survey among the science teachers of Fukushima prefectural junior high schools for the question "What fields did you deal with in nuclear power and radiation education?". (n = 112, multiple answers allowed)

4.2 Interview survey through telephone and questionnaire survey among the boards of education of municipalities in Fukushima prefecture

As the results of the interview to the 59 boards of education, 10 municipalities issued original educational materials on radiation, other 5 municipalities had original additional activities, such as spending 20 hours for radiation education in Okuma town. Fig.2. shows the location of municipalities.

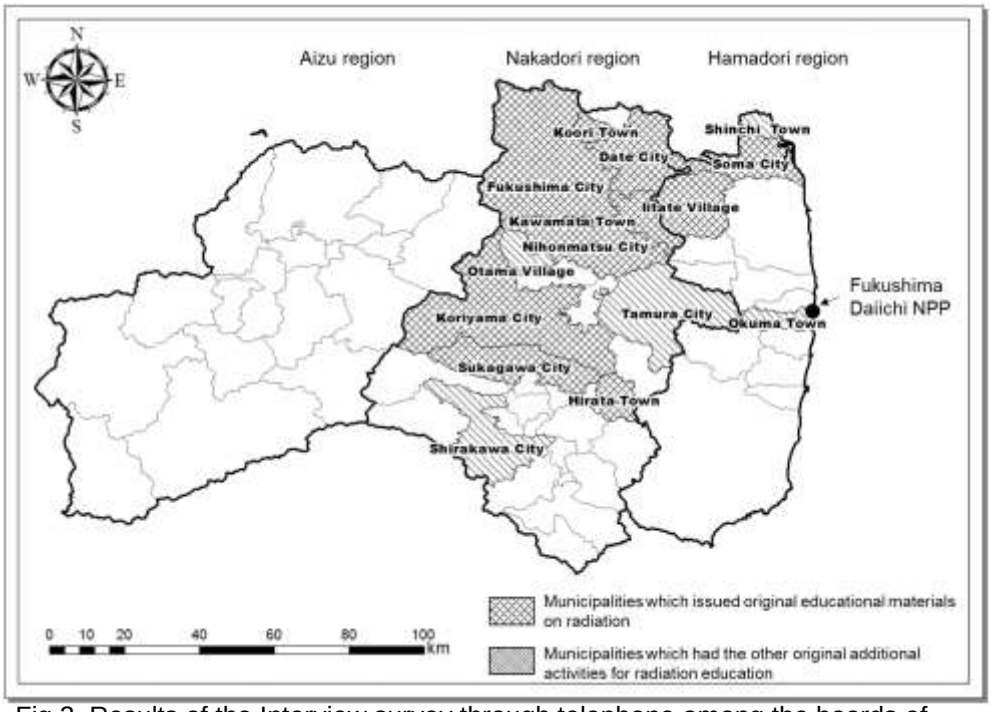

Fig.2. Results of the Interview survey through telephone among the boards of education of municipalities in Fukushima prefecture for the original additional activities for radiation education.

Fukushima prefecture is divided into three regions, Hamadori, Nakadori and Aizu. The municipalities which issued original educational material concentrated in northern and middle part of Nakadori and northern part of Hamadori region. No municipalities in Aizu region had the additional activities. The

fact of relatively few municipalities in Hamadori region indicate many municipalities cannot do more because they have a lot of problems to be solved such as radioactive contamination.

In the questionnaire survey, 32 municipalities responded (response rate: 54 per cent). Fig.3. shows the result for the question “What fields did you deal with in your original educational materials on radiation?”. The most chosen fields were “Types of radiation” (9/9), “Difference between radiation and radioactivity” (9/9) , “Nature of radiation” and “Units of radiation” (9/9). On the other hand, the fewest chosen were “Nuclear fuel cycle (nuclear wastes included)” (0/9), “Radiation controlled area” (1/9), “Children’s vulnerability to radiation exposure” (2/9) , “Linear non-threshold model” (2/9), “Mechanism of nuclear power generation” (2/9) and “Advantages and disadvantages of nuclear power” (2/9). These characteristics were similar to the results of the survey among the science teachers of Fukushima prefectural junior high schools (Fig.1.)

As the current problems in the radiation education, “Declining in concern for radiation” was most often chosen in any area.

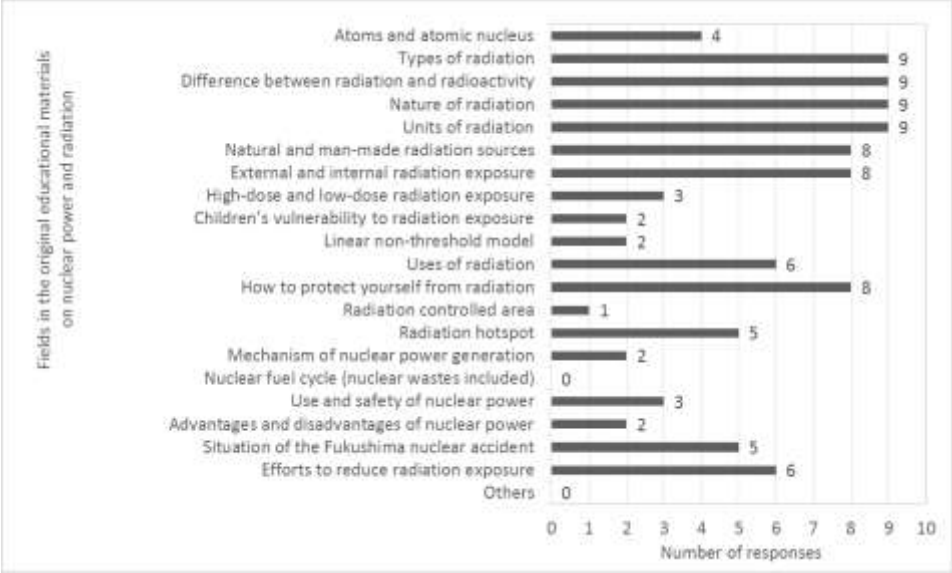

Fig.3. Results of the questionnaire survey among t the boards of education of municipalities in Fukushima prefecture for the question “What fields did you deal with in your original educational materials on radiation?”. (n = 9, multiple answers allowed)

5. Conclusion

In the nuclear power and radiation education in Fukushima prefecture, there were few contents for noticing possibilities of children’s rights violations in existing exposure situation, such as standards of radiation controlled area or children’s vulnerability to radiation exposure, reflecting the Japanese government’s supplementary readers and the Fukushima Prefectural Board of Education’s material. Not only the basic knowledge on radiation, but also the contents of human rights education should be included.

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