

## **Review of Research on the Effects of Nuclear Power and Radiation Education on Students**

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**\*Keywords : Nuclear power, Radiation, Education, Student**

### **1. Introduction**

The Great East Japan Earthquake that occurred off the northeastern coast of Japan in 2011 led to the FDNPP (Fukushima Daiichi Nuclear Power Plant) accident, resulting in the release of large amounts of radioactive materials into the environment. This accident significantly increased public concern about the health effects of radiation and the safety of NPP (Nuclear Power Plants). Since then, nuclear power has been placed at the center of risk perception and policy debates, and the importance of social acceptance of nuclear technology has become increasingly emphasized.

With the rapid growth of AI and data-driven industries in recent years, electricity demand has continued to increase, drawing renewed attention to the role of nuclear power as a stable source of energy supply. However, nuclear power generation requires not only economic efficiency but also social consensus based on public trust and acceptance. Accordingly, enhancing acceptance of nuclear power requires systematic education and bidirectional communication strategies targeting diverse age groups and occupational sectors. In particular, adolescents and students—whose perceptions of nuclear power and radiation have not yet become firmly established—constitute a critical potential group that will influence future policy decisions and the formation of social values. Therefore, the importance of early educational interventions for this population is increasingly emphasized.

Accordingly, prior to implementing nuclear power and radiation education for students, this study aims to review relevant studies

### **2. Materials and Methods**

In this study, we analyzed research conducted by Fukushima Medical University, Soma Central University and Korea University on nuclear power and radiation education on students [1-3]. We also analyzed the research methods, educational contents and educational effects. Three research cases were selected to conduct a comparative analysis of the effects of nuclear power and radiation education from multiple perspectives, including a post-accident regional-based educational case, a study analyzing quantitative

educational effects, and a large-scale nationwide educational program in Korea.

### **3. Results and Discussion**

Fukushima Medical University conducted an analytical study of radiation education in the Fukushima region following the FDNPP accident and published the results in 2020. Based on in-depth interviews with four elementary, middle, and high school teachers and education officials in Fukushima Prefecture, the study examined radiation-related educational programs and their educational effects in one elementary school, one middle school, and two high schools. At the elementary school level, the curriculum emphasized community-based learning, including local food radiation inspections and visits to fisheries, farms, and water treatment facilities, with the aim of helping students understand radiation safety in quantitative terms. As an educational outcome, qualitative findings indicated that students' excessive anxiety regarding local radiation safety was alleviated. At the middle school level, a three-year continuous radiation education program was designed and implemented beginning in September 2011, shortly after the accident. The program adopted a multidisciplinary structure, incorporating radiation dose measurements and evidence-based decision-making. The analysis confirmed improvements in students' data-based judgment abilities, as well as a shift in perception from viewing radiation as a vague source of fear to recognizing it as a subject that can be scientifically analyzed. At the high school level, students engaged in radiation mapping, personal dosimetry measurements, and international collaborative measurement projects. In one high school case (Asaka High School), the proportion of students who reported being able to explain radiation to others increased from 2% before the education program to 46% afterward, while those who reported having "a certain level of understanding" increased from 42% to 98%.

Soma Central Hospital conducted a study to evaluate the effects of radiation education on high school students in the Fukushima region following the FDNPP accident. The researchers implemented a one-time radiation education program for 717 students from three high schools in the Soso area of Fukushima Prefecture and assessed its effects using identical pre- and post-surveys. The educational content included basic concepts of radiation and topics such as environmental

radiation and internal exposure measurement. The survey consisted of 13 items measuring practical knowledge related to radiation in daily life (e.g., food safety and internal exposure), 18 items assessing scientific knowledge (e.g., physical characteristics of radiation), and 10 items evaluating attitudes and behaviors toward radiation. The results showed significant increases in knowledge scores (practical knowledge: mean 5.18 → 8.71; scientific knowledge: 9.15 → 12.27). Changes in attitudes were analyzed not through simple mean comparisons but through cluster analysis. Prior to the education program, students were categorized into three groups: “high anxiety (A),” “low anxiety (B),” and “indifferent (C).” After the program, they were reclassified into “balanced understanding (D),” “increased knowledge but persistent anxiety (E),” and “continued indifference (F).” Cluster analysis revealed a significant redistribution of students’ attitudinal types following the educational intervention. Among students initially classified in Cluster A (n = 208), 31.7% transitioned to Cluster D after the lecture, whereas 63.9% were categorized into Cluster E, indicating that although their knowledge increased, their anxiety persisted. In contrast, 53.6% of students in Cluster B (n = 329) shifted to Cluster D, while 33.8% were classified into Cluster E. Notably, approximately 74% of students in Cluster C (n = 153) moved to either Cluster D (36.4%) or Cluster E (37.7%) after the lecture, with only 25.8% remaining in Cluster F. Overall, following the educational session, 42.1% of students (n = 302) were classified into Cluster D and 42.4% (n = 304) into Cluster E, indicating an increase in balanced understanding alongside the persistence of residual anxiety among a substantial proportion of students. However, some students remained in group E despite improved scientific knowledge, suggesting that cognitive improvement does not necessarily lead to emotional reassurance.

Korea University conducted nuclear and radiation education programs in 2016 and 2017 for 4,934 students from 100 elementary, middle, and high schools across Korea. The effects of the program were evaluated through identical pre- and post-surveys. The two-hour program covered topics such as the nuclear safety management system and basic concepts of radiation, and included limited hands-on activities. The survey measured perceived necessity (5-point scale), perceived safety (5-point scale), objective knowledge (17 items, scored 0–1), safety attitudes (5-point scale), and policy acceptance (a mock vote on NPP construction). The results showed that objective knowledge significantly increased across all grade levels (e.g., elementary students in 2016: 0.37→0.57), and safety attitudes also improved substantially (e.g., elementary students in 2016: 1.49→2.79). While perceived necessity generally increased in 2016, perceived safety declined in some grade levels in 2017, suggesting the influence of broader socio-political factors. In the mock vote, the proportion of students

supporting NPP construction increased after the program (2016: 53.4%→68.6%). Regression analysis indicated that safety attitudes had a stronger influence on safety perception than objective knowledge.

Table 1 compares the three research cases analyzed in this study. The studies by Fukushima Medical University and Soma Central Hospital examined students in the Fukushima region following the FDNPP accident, whereas the Korea University study involved a large nationwide sample of elementary, middle, and high school students in South Korea. Soma Central Hospital and Korea University quantitatively evaluated educational effects using pre–post survey designs, while Fukushima Medical University focused on case analysis and interviews to examine how radiation education was designed and implemented after the accident. Both Fukushima Medical University and Soma Central Hospital incorporated local radiation measurements into their curricula, whereas Korea University emphasized institutional aspects such as safety management and regulation across all grade levels. Quantitative knowledge gains were confirmed in the Soma and Korea studies, and attitudinal changes were analyzed through cluster analysis (Soma) or statistical modeling linking attitudes to safety perception and policy acceptance (Korea). Although quantitative evidence was limited in the Fukushima study, one high school case reported an increase in the proportion of students able to explain radiation from 2% to 46%. Overall, knowledge improvement was consistently observed across the studies; however, increased knowledge did not necessarily lead to emotional reassurance.

It should be noted that the three research cases analyzed in this study did not employ identical methodologies or data collection periods. The Fukushima Medical University study focused on case analysis and interviews to examine how radiation education was designed and implemented after the accident, whereas the Soma Central Hospital and Korea University studies quantitatively evaluated educational effects using pre–post survey designs. Despite these methodological differences, all studies assessed changes in students’ knowledge and attitudes following radiation education. Therefore, this study focuses on the consistency of observed educational effects rather than direct quantitative comparison, allowing for a methodologically reasonable and complementary interpretation of qualitative and quantitative evidence.

Table 1: Research on the effects of nuclear power and radiation education on students

Division	Fukushima Medical Univ.	Soma Central Hospital	Korea Univ.
Region	Fukushima	Soso area, Fukushima	Nationwide (Korea)
Subjects	Elem, mid, high schools	717 high school students	4,934 elem, mid, and high school students
Method	Qualitative case study	Education & pre-post structured survey	Education & pre-post structured survey
Education contents	Local radiation measurement, Regional data use, multidisciplinary curriculum	Basic radiation concepts, internal exposure measurement et al.	Safety management system, basic radiation concepts et al.
Knowledge effect	Limited quantitative presentation	Practical knowledge: 5.18→8.71  Scientific knowledge: 9.15→12.27	2016 : Elem(0.37→0.57) Mid (0.35→0.54) High (0.51→0.69) 2017 : Elem(0.31→0.48) Mid(0.40→0.56) High(0.51→0.66)
Attitude effect	Qualitative reduction of excessive anxiety and self-stigmatization	A→D 31.7%, B→D 53.6%, C→D 36.4%	2016 : Elem(1.49→2.79) Mid (1.72→2.95) High (2.05→3.18) 2017 : Elem(1.54→2.41) Mid (1.80→2.92) High(2.11→3.23)

#### 4. Conclusion

In this study, we analyzed domestic and international research cases examining the effects of nuclear power and radiation education on students. Specifically, we reviewed studies conducted by Fukushima Medical University, Soma Central Hospital, and Korea University. The Fukushima Medical University study employed a qualitative case-based approach, analyzing how radiation education programs were designed and implemented in elementary, middle, and high schools in Fukushima following the FDNPP accident through in-depth interviews with teachers and educational experts. This study suggested potential affective outcomes, including the reduction of excessive anxiety and self-stigmatization among students. In contrast, the studies conducted by Soma Central Hospital and Korea University adopted quantitative pre-post survey designs to empirically evaluate changes in objective knowledge and attitudes following educational interventions. Across the three research, improvements in objective knowledge were consistently observed. However, attitudinal change could not be sufficiently explained by simple mean score increases. In some student groups, anxiety persisted despite gains in knowledge, indicating that perceptions of nuclear power and radiation are shaped not only by cognitive factors but also by affective and socio-contextual influences. Furthermore, the Korea University study demonstrated that safety

attitudes played a more significant role in influencing policy acceptance than objective knowledge alone, suggesting the limitations of knowledge-centered educational approaches. Taken together, these findings imply that educational programs on nuclear power and radiation for students should go beyond the delivery of objective information and incorporate strategies that address emotional stabilization, trust formation, and the broader social context surrounding risk perception.

#### Acknowledgement

This research was funded and supported by Korea Hydro & Nuclear Power Co., Ltd (A24LF13)

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