RI/SRI Licensee Continuing Education Satisfaction Survey

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1. Introduction

Radioisotopes are used in a variety of fields, including health care, industry, power generation, and research. In particular, in medicine, radioisotopes are essential for cancer treatment and diagnosis, and in industry, they are used for non-destructive testing, quality control, and instrument calibration [1]. Despite their versatility, radioisotopes pose a high risk to human health and the environment. Therefore, systematic training and qualification management of personnel handling them is essential.

In Korea, a radioisotope handling license system was established when the Atomic Energy Act was amended in 1958, and subsequent regulations were strengthened to require continuing education for license holders [2].

The radioisotope handling license system was established to ensure that personnel who work with radiation and radioactive materials, including their use, storage, transportation, and disposal, can perform their duties safely and efficiently [2].

Currently, there are seven types of nuclear-related licenses, including Radioactive Isotope Handler (RI), Senior Radioactive Isotope Handler (SRI), Special License for Radioisotope Handling, Reactor Operator, and Senior Reactor Operator, as presented in Article 84 of the Nuclear Safety Law [3].

In order to strengthen the safety education and technical mastery of personnel handling radioisotopes, a system of refresher training for license holders every three years has been established [4].

However, there is a lack of specific analysis of the extent to which current continuing education contributes to actual performance in the field, especially since it is mandatory, and there is a lack of research on the extent to which practitioners' expectations and actual satisfaction with training match.

Continuing education is an essential process for improving competence and ensuring safety in radiation handling, but the quality and outcomes of training can vary depending on the experience of the participants. For example, a study of childcare workers' satisfaction with contactless training found that satisfaction with training varied by worker age, experience, and number of trainings [3]. These studies suggest that satisfaction with and expectations of training may differ based on years of experience. Therefore, by analyzing them in detail, it is possible to derive more effective ways to improve training programs. Therefore, this study aims to analyze the differences in training satisfaction by work experience, including overall satisfaction with the curriculum, and suggest ways to improve the curriculum and strengthen its practical application.

2. Methods and Results

2.1 Study Design

This study analyzed the satisfaction of RI/SRI licensee continuing education by practice experience and compared the difference between expectations and satisfaction with the education in order to derive directions for improvement of the education program.

2.2 Study Population

The study was conducted with 34 trainees who attended the first and second RI/SRI licensee training courses in 2024. The study population consists of a group of RI or SRI licensed trainees with varying levels of practice experience.

The number of trainees in the study by years of experience is shown in the Table. 1.

Table 1: Trainees by years of experience

By work experience	Trainees
0 ~ 5 years	10
6 ~ 10 years	7
11 ~ 15 years	4
16 ~ 20 years	5
21 ~ 25 years	2
26 ~ 30 years	3
31 years	3

2.3 Research Instrument

The survey instrument used in this study was adapted from an existing survey instrument used in the continuing education of RI/SRI licensees, with

modifications and additions made after expert review and pretesting. Each question was based on a 5-point Likert scale (1=not at all true, 5=very true) [5].

Each survey item was keyworded after the survey to facilitate analysis, as shown in Table. 2.

The questionnaire contained a total of 23 items, including organization and years of experience.

Table 2: : Questionnaire Items

Classification	Contents
1	Affiliation
2	Practical experience
3	Expectations for the course
4	Overall satisfaction
5	Essentiality of training time
6	Easy to understand
7	Achievement of Educational goals
8	Acquisition of New knowledge
9	Applicability to work
10	Timeliness
11	Willingness to recommend
12	Instructor knowledge
13	Teaching skills
14	Instructor feedback
15	Cosmic radiation
16	Transport of radioactive materials
17	RI Production and use
18	Nuclear safety law
19	Gamma ray nuclide analysis
20	Radiation prevention
21	Education method
22	Satisfaction with training facilities
23	Facilitator service

The tool used for analysis after data collection was the R program, an open source statistical software, version 4.2.3. In this study, R packages such as dplyr, ggplot2, and caret were used to compare the mean of satisfaction with expectations, to analyze the mean of educational satisfaction by item, and to analyze and graph the difference in satisfaction by work experience [6].

All variables were treated as continuous variables and missing values were corrected using the mean substitution method [6].

2.4 Comparing Means of Expectations and Satisfaction

In this study, R was used to compare the means of expectations and overall satisfaction with continuing education for RI/SRI licensees. The variables were Course_Expectation for educational expectations and Overall_Satisfaction for educational satisfaction, and a bar graph was created using the ggplot2 package based on the means of each.

2.5 Analyzing Training Satisfaction by Item Mean

In this study, we analyzed the mean by item for the RI/SRI licensee training satisfaction scores. However, we limited the total of 23 items to 12 items, excluding satisfaction with subject matter, and created a bar graph using the ggplot2 package and sorted them in ascending order by mean score.

2.6 Comparative Analysis of Educational Satisfaction by Work Experience

To analyze the differences in educational satisfaction by work experience, we used the BoxPlot visualization technique. BoxPlot provides an intuitive representation of the distribution of data and facilitates comparisons between groups by including medians, quartiles, and outliers [7, 8].

In this study, we analyzed training satisfaction by dividing the groups into 0-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years, 26-30 years, and 31+ years of experience.

3. Results

3.1 Comparison of Expectations and Satisfaction Means

This study compared the means of expectations and satisfaction with RI/SRI licensee continuing education. Comparing the means of expectations and satisfaction with continuing education is important to determine the performance of the continuing education program and the subjective evaluation level of the participants.

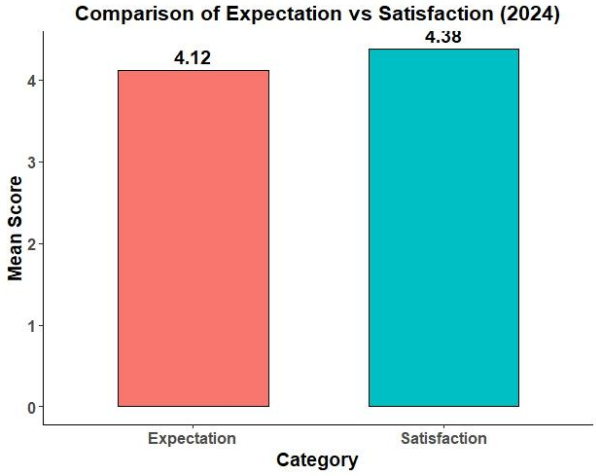

Fig. 1. Training expectations vs. satisfaction results

Fig. 1 shows the visualization of training expectation and satisfaction based on the average values of Expectation and Satisfaction, respectively. Expectation refers to the level of expectation participants had for the training before the training, and Satisfaction refers to

the level of satisfaction they actually felt after the training. This is an important measure of the effectiveness of the training and the need for improvement.

Expectations averaged 4.12 out of 5, while satisfaction averaged 4.38. This means that participants were actually more satisfied with the training than they expected.

This finding suggests that overall satisfaction with the retention training is good and confirms that the quality of the training program meets the expectations of the participants.

However, the fact that the difference between expectations and satisfaction is not large and satisfaction is relatively high suggests that future course designs should reflect participants' expectations. The lack of difference between expectations and satisfaction means that the goals of the course were well aligned with the needs of the participants, but the high level of expectations suggests that the participants may have had specific requirements for the training. Therefore, it is necessary to reflect specific needs through pre-surveys or needs analysis when planning future courses.

3.2 Training Satisfaction Average Breakdown

The average satisfaction with RI/SRI licensee training by detailed item is shown in Fig. 2.

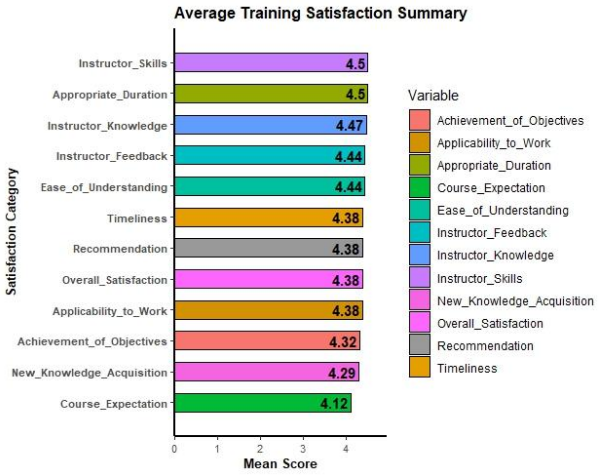

Fig. 2. Average Breakdown by Training Satisfaction Item

When analyzing the mean of training satisfaction by item, Instructor_Skills and Appropriate_Duration had the highest mean of 4.50 out of 5. This indicates that instructor skills and appropriate training duration are the main factors that increase training satisfaction.

Instructor Knowledge (Instructor_Knowledge), Instructor Feedback (Instructor_Feedback), and Ease_of_Understanding (Ease_of_Understanding) were also highly rated, with mean scores of 4.47 and 4.44, respectively. On the other hand, Course_Expectation was the lowest, with an average score of 4.12, which may be due to the fact that initial expectations were relatively low since refresher training is mandatory every three years.

3.3 Analysis of Training Satisfaction by Work Experience

In this study, box plots were used to analyze the differences in training satisfaction by work experience. Box plots are a useful tool to visualize the distribution and outliers of data and to clearly show the difference in mean or median between groups [7, 8].

In particular, box plots are well suited for analyzing differences in training satisfaction by years of experience because they can effectively visualize medians, interquartile ranges (IQRs), and outliers in satisfaction[7, 8].

Differences in continuing education satisfaction among RI/SRI licensees by years of practice are shown in Figure 3.

In this study, seven groups were categorized by years of practice, and those with 0~5 years, 6~10 years, and 11~15 years of practice showed relatively high satisfaction, while those with 21~25 years, 26~30 years, and 31+ years of practice tended to be somewhat less satisfied.

For ease of interpretation, the seven groups were reclassified into three categories: early career, mid-career, and senior career.

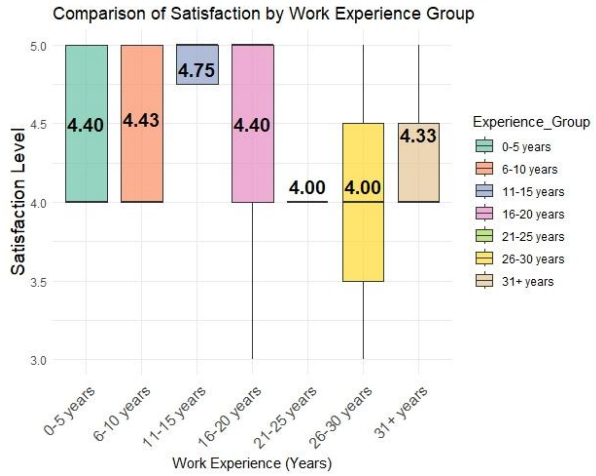

Fig. 3. Comparative Analysis of Training Satisfaction by Years of Experience

In Fig. 3, the early career group, 0-10 years, tends to have relatively high satisfaction ratings. This may be because participants with less experience are more likely to be positive about the knowledge and skills they acquire through training.

In the mid-career groups of 11-15 years and 16-20 years, satisfaction tends to be higher overall. This is likely due to the fact that practitioners in this age group are more experienced in handling radiation, but still

benefit from continuing education to keep up with the latest technological changes and regulatory revisions.

Satisfaction tended to be slightly lower in the more experienced group (21+ years of experience). This may be because the educational content overlapped with their existing knowledge and experience, or because their expectations for new information and skills were not fully met.

Box plots provide an intuitive way to compare differences in distributions within groups. In particular, in this study, the differences between the interquartile range (IQR) and median in the box plots clearly show differences in satisfaction between groups. For example, the 11-15 year experience group has the highest mean, averaging 4.75 out of 5, and the distribution of satisfaction is not very skewed. The 26-30 year experience group, on the other hand, has a relatively low mean and a wide range of variation, indicating less consistency in satisfaction.

These findings suggest that for early-career practitioners, training programs should be similar to existing curricula, but expanded to include basic radiation handling and safety procedures as well as the latest knowledge and skills. For mid-career practitioners, training programs should be expanded to include the latest regulatory and procedural changes that are immediately applicable to their practice. For more experienced practitioners, training should focus on more advanced topics such as practice improvement strategies and case-based learning.

4. Conclusions

This study analyzed the expectations and satisfaction of RI/SRI licensees with continuing education and examined differences in satisfaction by years of practice. Based on the results of the study, the following conclusions can be drawn: RI/SRI licensee expectations and satisfaction with continuing education averaged 4.12 and 4.38 out of 5, respectively. This means that the quality of the training met participants' expectations, indicating that the content and teaching methods were effective overall. In particular, the fact that both the expectation and satisfaction scores are above 4.0, despite the small difference between them, suggests that the overall quality of the training program was high.

However, the fact that both expectation and satisfaction scores were high but not significantly different suggests that the training program was delivered with participants' expectations already high. Therefore, in future courses, it is necessary to take into account the specific needs of the participants and to introduce customized training programs that are differentiated by profession. In particular, it is necessary to identify specific needs through pre-surveys and feedback and to improve the program based on these needs.

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When analyzing the average by training satisfaction, Instructor Skills and Appropriate Duration were the highest with an average of 4.5 and Course Expectations was the lowest with an average of 4.12. This means that the instructor's teaching skills and the appropriateness of the course duration had a positive impact on students.

In particular, instructor feedback scored a high 4.44, indicating that the instructor's interaction and ability to deliver the course content was good. However, the relatively low average score of 4.29 for New Knowledge Acquisition suggests that further improvements are needed to increase the applicability of the training in practice.

When analyzing training satisfaction by work experience, the 11-15 year experience group had the highest satisfaction with an average score of 4.75, while the 21-25 and 26-30 year experience groups had the lowest satisfaction with an average score of 4.00. This suggests that training needs may vary according to experience. In particular, the clear difference in satisfaction by work experience suggests that the current training program is being delivered in a one-size-fits-all format. Therefore, it is necessary to divide the training into beginner, intermediate, and advanced courses by work experience and provide customized training to maximize training performance.

Based on the results of the study, RI/SRI licensees are generally satisfied with the continuing education program, but the following specific improvements are needed.

First, introduce career-specific training programs.

It is necessary to specify the training needs of each career, categorize them into beginner, intermediate and advanced courses, and strengthen advanced courses focusing on the latest technology trends and field applications.

Second, strengthen the acquisition and application of new knowledge.

To improve the quality of training programs, it is necessary to increase the proportion of practical applications and exercises related to the handling of radioisotopes.

Third, strengthen the competence of trainers.

In this study, instructor competence was the most important factor in training satisfaction, so it is necessary to update instructor competence and course materials.

Fourth, strengthen the pre-need survey and feedback system.

In order to improve the quality of compensation training, it is necessary to reflect the demand for training through pre- and post-training surveys. After the training, it is necessary to improve the curriculum by collecting individual feedback and reflecting program improvements.

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