

Development of Computer-Aided Learning Programs on Nuclear Nonproliferation and Control

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1. Introduction

The fulfillment of international norms for nuclear nonproliferation is indispensable to the promotion of nuclear energy. The education and training for personnel and managers related to the nuclear material are one of crucial factors to avoid unintended non-compliance to international norms. Korea Institute of Nuclear Nonproliferation and Control (KINAC) has been providing education and training on nuclear control as its legal duty. One of the legally mandatory educations is “nuclear control education” performed since 2006 for the observation of the international norms on nuclear nonproliferation and the spread of the nuclear control culture. The other is “physical protection education” performed since 2010 for maintaining the national physical protection regime effectively and the spread of the nuclear security culture.

The 2010 Nuclear Security Summit was held in Washington, DC to enhance international cooperation to prevent nuclear terrorism. During the Summit, the South Korea was chosen to host the second Nuclear Summit in 2012. South Korean President announced that South Korea would share its expertise and support the Summit’s mission by setting up an international education and training center on nuclear security in 2014. KINAC is making a full effort to set up the center successfully. An important function of the center is education and training in the subjects of nuclear nonproliferation, nuclear safeguards, nuclear security, and nuclear export/import control.

With increasing importance of education and training education on nuclear nonproliferation and control, KINAC has been developing computer-aided learning programs on nuclear nonproliferation and control to overcome the weaknesses in classroom educations. This paper shows two learning programs. One is an e-learning system on the nuclear nonproliferation and control and the other is a virtual reality program for training nuclear material accountancy inspection of light water reactor power plants.

2. Computer-Aided Learning Programs

2.1. E-Learning System

The e-learning development consists of the development of e-learning content and the establishment of e-learning system. The e-learning content is developed based on the presentation

materials used in the classroom education. The text of international treaties/agreements and domestic laws and the dictionary are also provided as supplements. The e-learning content consists of seven topics and nineteen units, as shown in Table I. The topics are overview of nuclear nonproliferation, overview of nuclear control, overview of safeguards, reporting on internationally controlled materials, nuclear material accountancy inspection, overview of nuclear export/import control, and overview of physical protection. Using the e-learning content, seven e-learning courses were prepared, as shown in Table II.

Table I : Outline of the e-learning content (* For 2 units, one in Korea and the other in English)

Subject	Topic	Unit
Nuclear Nonproliferation and Control	Overview of Nuclear Nonproliferation	Concept of Nuclear Nonproliferation (2 units*)
		International Nuclear Nonproliferation Regime (2 units*)
	Overview of Nuclear Control	Nuclear Control Regime in South Korea
Safeguards	Overview of Safeguards	Concept of Safeguards and IAEA Safeguards System (2 units*)
		Safeguards System in South Korea
	Reporting on Internationally Controlled Materials	Overview of the Reporting
		Nuclear Material Accounting Reporting
	Nuclear Material Accountancy Inspection	Overview of the Inspection
Inspection of LWRs		
Nuclear Export/Import Control	Overview of Nuclear Export/Import Control	Concept of Nuclear Export/Import Control and Its International Regime (2 units*)
		Nuclear Export/Import Control System in South Korea (I)
		Nuclear Export/Import

		Control System in South Korea (II)
Physical Protection	Overview of Physical Protection	Concept of Physical Protection and Its International Regime (2 units*)
		Physical Protection System in South Korea

Whole body counting room	- Whole body counting
Power plant's main gate	- Exchange ID card
Power plant unit's main gate	- Exchange a pass - Security check
Site office	- Receive a dosimeter - Audit the books - Make a sampling plan
Dressing room	- Change clothes
Inspection site	- Verify spent fuel - Verify fresh fuel - Seal-related activities - Verify design information
... <omitted>	

Table II : E-learning courses prepared

Target	Course	Duration
General Public	Nuclear Control (in Korean)	1 hrs 30 mins
	International Nuclear Nonproliferation (in Korean)	2 hrs
	International Nuclear Nonproliferation (in English)	2 hrs
Nuclear Personnel	Nuclear Facility Operators	7 hrs
	Nuclear Fuel cycle Researchers (in Korean)	6 hrs
	Nuclear Export/Import Trader (in Korean)	3 hrs
Nuclear Inspectors	International Controlled Material Inspectors (in Korean)	7 hrs 30 mins

2.2. Virtual Reality Program

The developed virtual reality program is to train nuclear material accountancy inspection of light water reactor power plants. In the program, the mouse and keyboard devices are used to control movement of a game character in a three-dimensional virtual space and perform virtual inspection activities. A program screen consists of four regions, as shown in Fig. 1 as an example. The first region shows the virtual reality space and the game character. The second region shows the information on the position where the character is located. The third region shows a list of activities to be performed. The fourth region has two buttons; one for popping up the hint window upon clicking it and the other for exiting the program. The sequence of virtual inspection activities to be performed follows the chronological order of the inspection procedure, starting from preparations at the headquarter office. The activities in the nuclear power plants include a whole body counting, the book audit, fuel verifications, and so on. The list of activities to be performed is listed in Table III.

Table III : The list of activities to be performed

Location	Activities
Headquarter office	- Notify/brief the inspection plan - Apply for access to the power plant - Prepare access document and inspection equipments

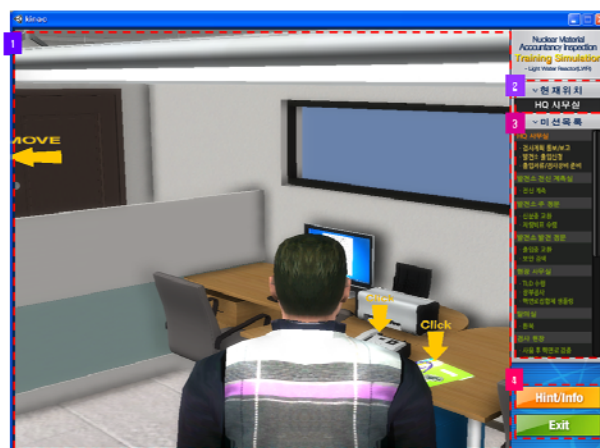


Fig. 1. The screen captured during the program execution

3. Conclusions

Two computer-aided learning programs on nuclear nonproliferation and control have been developed. Our e-learning courses were prepared for a wide range of targets divided into three groups: general public, nuclear personnel, nuclear inspectors. We are planning to provide e-learning courses to the public through the website next year and expecting it to draw more interest on the nuclear nonproliferation and control from the public. The virtual reality program for training nuclear material accountancy inspection could be utilized as both trainee's study and trainer's demonstration. We expect that the efficiency and the effectiveness of training program for nuclear inspectors would be greatly enhanced.