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DEVELOPMENT IN TRAINING DELIVERY

DISTANCE TEACHING - AN EXPERIENCE FROM PETRUS (EDUCATION IN GEOLOGICAL DISPOSAL OF RADIOACTIVE WASTES)

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ABSTRACT

One of the key objectives of the PETRUS initiative dedicated to the Education and Training in geological disposal is to investigate how distance teaching techniques can be used to deliver courses, and how the use of such technology impacts students' perception of learning.
This paper presents the outcomes of tests carried out by four PETRUS partner universities to evaluate the performances of the "face to face remote teaching methodology". Four teaching sessions have been organised with the participation of a representative sample of Master's degree students. A questionnaire filled at the end of each session allows getting perspective from students' willingness to be involved in this new learning process.
The paper also addresses problems linked with the technical quality and reliability of this technology and proposes a set of recommendations to overcome the challenges associated with shifting from the conventional pedagogical model to an online teaching and learning paradigm.

1. Introduction

Renewing and reinforcing competences in the field of geological disposal of radioactive waste are the overall goals of the PETRUS group which considers the development of the academic education as a key instrument. Producing professionals that can address divers issues related to the radioactive waste disposal requires a unified effort at European level since the very large diversity of the job profiles in this field is constrained by the very small size of the radioactive waste community which has been estimated in all less than 4000 specialists. As the demands for new recruitments are rather modest, generating the right number of graduates necessitate an innovative approach. The main idea is to develop a common educational programme at the European level by sharing the best academic resources and pedagogic materials available in each university. A cost-effective way to succeed in this challenge is to make use of the synchronous 2-way audio and visual Internet capability for broadcasting live lectures at multiple distance sites.
The works undertaken by the PETRUS group to experiment this teaching method that we call "face to face remote teaching" are presented hereafter. These works encompass technical activities for implementing the system as well as four pedagogic tests with the participation of

a representative sample of Master degree students in Geosciences which allows getting perspective on the performance and relevance of the teaching methodology.

2. Technical materials

Our experiment corresponds to the model defined in literature as *Virtual classroom.* Virtual classrooms have been located at UPM in Madrid (ES), TUC in Clausthal (DE), UTC in Prague (CZ) and INPL in Nancy (FR). In all of these locations the classrooms are equipped with broadcasting material that can function in synchronous way. Electronic communication between sites is enabled by high-speed transmission lines.
Prior to broadcast lectures, two high-performance commercial multipoint Room-based videoconferencing systems (i.e. Adobe Acrobat Connect Professional and Marratech) and their associated software have been tested in order to choose the best product regarding the quality of the audio and video transmitted/received signals. In particular the resolution of the compressed interactive video has been examined through the quality of the PowerPoint presentations (PPT) received at the distant classrooms. As a conclusion of these tests, the individual quality of the both products has been judged as insufficient to fulfil the whole expected performances.
To overcome this problem, the technical staffs proposed a new solution consisting in the use of two server stations, one for managing the video and audio transmission through the Adobe Acrobat system, the other one for managing the whiteboard and Power Point presentations using Marratech system. The diagram below presents the simplified connection scheme.

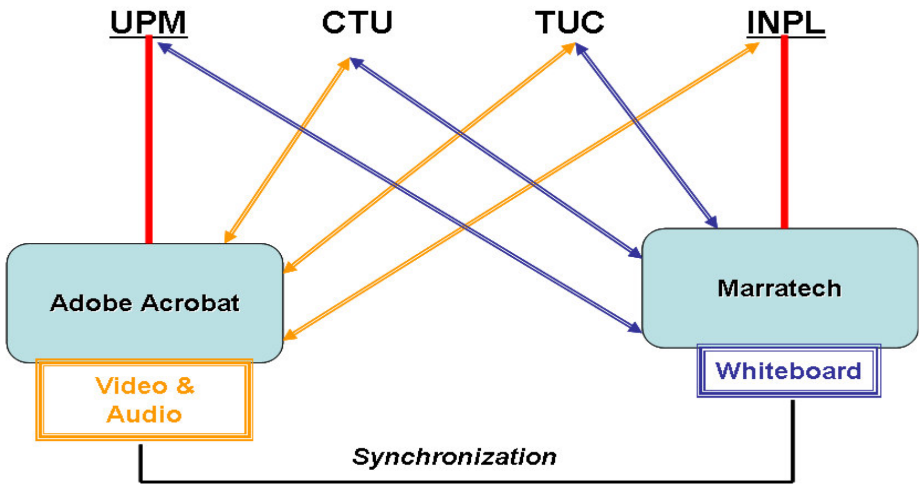

Fig.1: Simplified connection scheme

Thanks to this combination high quality sound and image have been obtained in all virtual classrooms.
At each lecture podium, the teacher has at his disposal a control panel, a computer, a document camera and a digital whiteboard. Each classroom is equipped with video cameras, television monitors, and microphones. The control panel allows the professor and/or technician to adjust the video cameras, mute or un-mute the local microphones, and alternate images from the computer, document camera and digital whiteboard. The video cameras can be adjusted to focus on different areas of the classroom or to zoom in on the professor or students. Television monitor located in the distant classroom allows viewing the professor as well as the other connected distant classrooms in incrustation mode, while the large screen enables viewing interactive images like the PPT presentations. There is also a television monitor in front of the lecture podium that enables the professor to viewing students at the distant sites. As an example, the figure below shows the INPL classroom reception equipment.

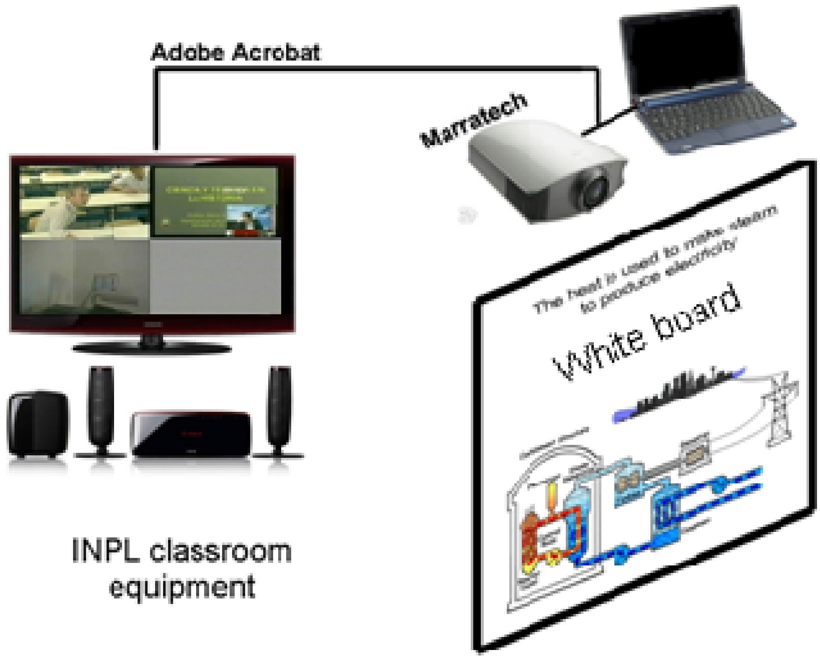

Fig.2: Reception equipment at INPL

One important issue regarding the use of such technology is the security of the data transmitted. We have adopted the end-to-end encryption ensuring security for the entire net meeting including voice, video and documents.

3. Pedagogical tests

Four teaching sessions have been organised; each one designed and led by one of the participant university. Lectures have been taught in English, each one lasting roughly an hour. In total, 37 students have followed the lectures. No major technical problem has been found during the transmissions except random link disconnections with one of the three distant classrooms during the first test. This problem has been solved before starting the second session by improving the material performance (i.e. increasing memory and processor speed).

Measuring how the students behave when confronted with the remote teaching methodology has been the main objective of these tests. All the students have been asked to give feedback on the lectures that they attend by filling a questionnaire. The goal was to get perspective from each individual student in his own experience rather than a collective opinion. The questionnaire containing 30 questions was distributed at the end of each session. In order to avoid any emotional or group reaction, students have been requested to complete the questionnaire at home and the results were collected two or three days after the end of the session.

Several questions required a written comment. These questions help to confirm or to correct the score ticked off by the student for an almost similar question which appears somewhere else in the questionnaire. For instance, the written comment on “What did you learn from the lecture?” restrains the weight of the “learning outcomes” score that may range from 1 (learned nothing) to 6 (learned a lot). The evaluation was completed by several individual interviews few weeks after the end of the lectures.

The results presented below are obtained from the analysis of the total number of responses received, irrespective of sessions. Answers are grouped in four categories: i) Learning outcomes ii) Efficiency of the remote teaching method iii) Quality perceived and iv) Teacher performances.

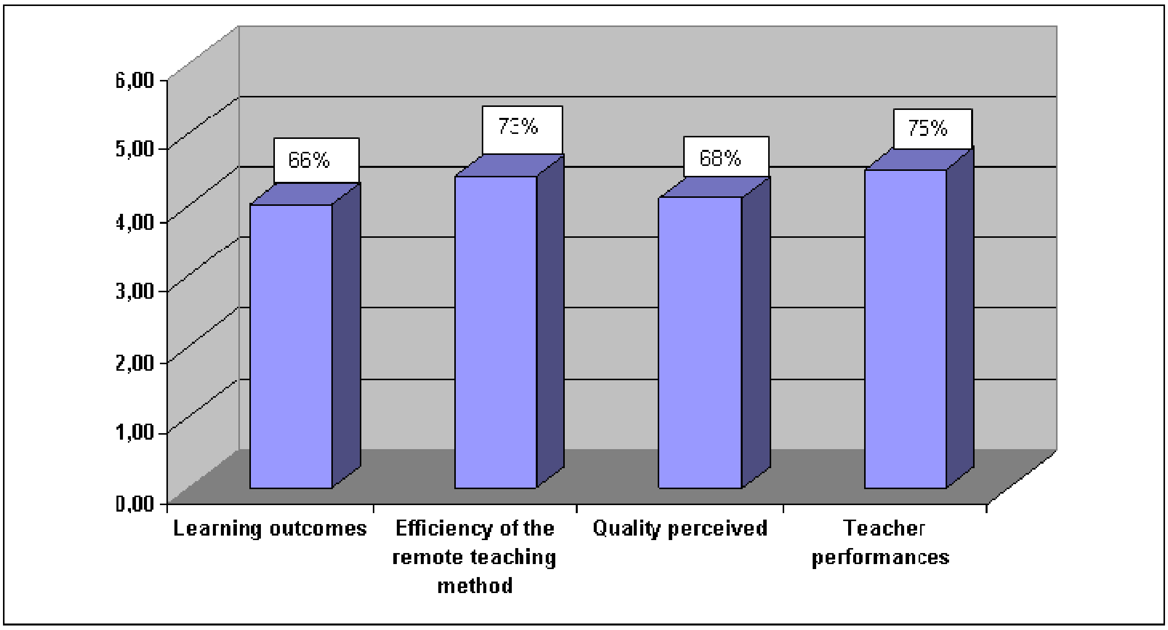

Fig.3: Statistical results of the pedagogical tests

Although global results are rather positive, the assessment has been deepened by performing more detailed analysis of the students' feedback based on the potential difficulties reported in the literature relative to virtual classrooms.

4. Detailed analysis

Problems encountered by distant teaching users have been reported by several authors [1, 2, 3]. However, most of the difficulties pointed out by these authors, notably concerning the following items, have not been observed during our tests:

- ***Lack of students' willingness to participate in class.*** This difficulty is often reported as a consequence of the depersonalization of the distant professor and the fact that students can not see the teachers in "live." In our case the novelty of the concept was probably the reason for the high degree of students' participation. Indeed they have not previous experience with the remote instruction and therefore this new method has inspired some curiosity in them. On the other hand the involvement was based on the voluntary participation thus only motivated students have followed the tests.
- ***Language barrier.*** Within Europe, there is growing evidence that English has become the biggest scientific lingua franca. However, no matter how much students are competent in English, there is always a certain level of difficulties associated with the use of no native language in the learning process. In our case, English was not the native language, neither of students, nor of professors. Paradoxically, this situation has better focused the students' attention since they had to make additional effort for following the lecture and understanding different English accents.
- ***Students' anxieties*** when they have to interact with the distance professor and when they see themselves projected onto a large screen. In our case this was to a great extent mitigated by the presence of local professors (and technical staff) in the distant classrooms:

Despite of the above differences with the cases reported in the literature, the analysis of the students' feedback has drawn our attention to several points that need serious improvement; some of them include modifying teaching strategies and revising the content and the design of the lectures.

- Compared with the "standard" teaching method, the amount and quality of interactions between the professor and (distant) students but also among different virtual class rooms must be increased in order to strengthen the collaborative learning environment.

- Advance preparation of the technical materials (i.e. establishment and tests of the electronic connections) is a matter of great importance. Impoverishment of the image quality during a lecture or even unexpected delay in audio transmission would be a source of frustration for both teacher and students.
- Students must receive a paper copy of the lectures (texts and power point presentations) before the delivery of the courses. By providing pedagogic materials to students in advance, the students' fear of missing information is alleviated. This is particularly important when the lectures are not taught in the students' working language.
- Finally, the most important difficulty concerns students' attention spans and their concentration for long period of time. Indeed, several surveys (e.g. [4]) have shown a drastic drop of the "attention curve", typically after 15 minutes, when an individual watches a screen passively (fig. 4). Thereby, it is important to avoid too long monolithic lectures and manage periodic short discussion breaks.

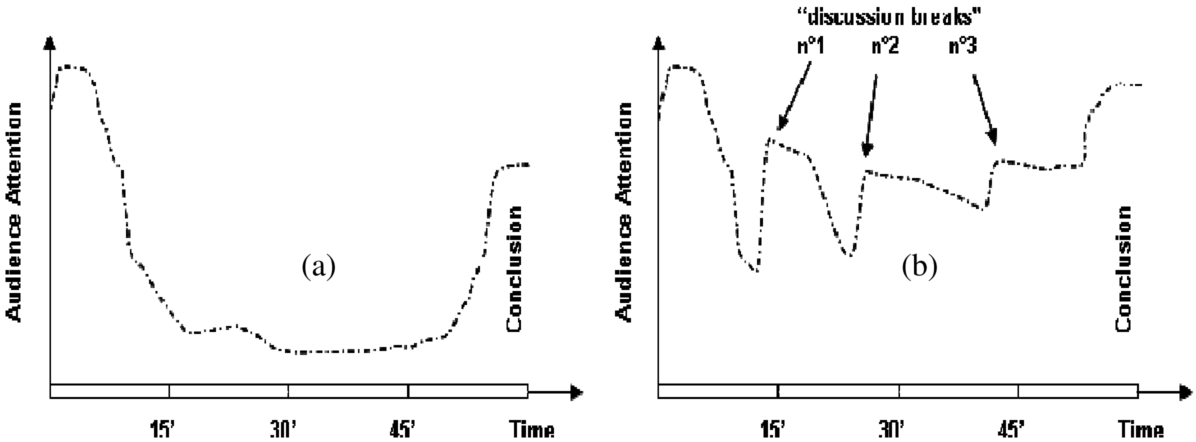

Fig.4 Typical attention of the audience pays to a lecture: a) monolithic presentation b) improvement by introducing discussion breaks.

5. Conclusion

The "face to face remote teaching" tests conducted in the frame of the PETRUS initiative with the involvement of four European universities have shown rather positive results related to the pedagogical process that encourages further developments and improvements. Technical problems have been easily mastered resulting in high quality audio and video transmission better than initially expected. The analysis of the students' feedback allowed collecting several elements for better fitting the teaching practice to the virtual classroom requirements.

However, this experience has also put to the fore an unforeseen difficulty at the organisation level. Indeed, finding common dates for running the tests have been by far the major obstacle since internal organisation of the academic year (teaching plans and timeframes, period of holidays …) are very different in the four universities. This could be a real cause of concern when the organisation of common courses encompassing several tens of lectures is targeted.

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Acknowledgement

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DEVELOPMENT OF A γ-RAY SPECTROSCOPY SYSTEM USING CsI(TI)-PIN DIODE DETECTOR FOR EDUCATIONAL PURPOSES

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ABSTRACT

At the Korean Atomic Energy Research Institute (KAERI), a prototype γ-ray spectroscopy system was developed and fabricated that is rugged, compact, reliable and relatively inexpensive. Laboratory evaluation shows its resolution and efficiency are good, and it is safe to operate and easy to use, making it quite suitable for educational purposes at secondary-school level and beyond. The system consists of a CsI(TI)-PIN diode detector, integrated electronics, and a multi-channel-analyzer. The capability of the system was checked using Cs-137 and Co-60 sources. Resolutions are 7.9% and 4.9%, respectively, for the 660- and 1,332- keV lines, and the efficiency is sufficient to accumulate a quality spectrum in a few minutes by using weak, encapsulated commercial sources. The results obtained from the γ-ray spectroscopy system show this system is eminently suitable for educational purposes.

1. Introduction

Radiation is all around us, and its applications in our daily lives are common and wide spread. Yet public awareness of this fact is lacking, especially to students at elementary-level and up. A simple demonstration of radiation to the youngsters would go a long way to promoting wider awareness.

Better perception and understanding of nuclear radiation by the public is even more necessary now than before, especially with wide spread use of radiation in such practical applications as medicine, pharmaceutical, appliances, etc.

Among the nuclear radiation, perhaps the public is most familiar with γ-ray (and x-ray), and hands-on experiments involving this form of radiation at schools, elementary and up, would be an effective way to broaden the public awareness. Quality γ-ray detection systems are not cheap nor simple and safe to operate by a layman; they are generally fragile and require high voltage or cooling. A simpler, cheaper, and safer γ-ray detector would be a boon to disseminating nuclear knowledge.

We at KAERI developed a γ-ray spectroscopy system that can be readily deployed for the ab ove mentioned demonstration. R. M. Anjos, et al,[1] earlier pointed out the role a simple γ-ray detector can play in education.

2. Materials and methods

2.1. CsI(Tl)/PIN diode detector[2]

CsI(Tl)-PIN diode detectors were fabricated for the application in various radiation fields by Kim H.S. et al.[2]. The density of the CsI(Tl) scintillator is 4.51g/cm^2 and hardness is 2Mohs. Although the crystal is slightly hygroscopic, no special packaging is necessary. A CsI(Tl) ingot was cut into 10 (W) × 10 (L) × 20 (H) mm^2 using a diamond string saw and optically coupled to the same size, 10mm^2, PIN diode (Hamamatsu 3590-08). The maximum emission spectrum of CsI(Tl) scintillator, 550nm, overlaps well with Si absorption spectrum resulting in high quantum efficiency. Optical grease and PTFE tapes were used to assemble the CsI(Tl) scintillator. Fig. 1 shows the detectors.

Fig. 1. CsI(Tl)/PIN diode detectors

2.2. Design of the γ-ray detector system

Fig. 2 shows the components of the system. Owing to the use of PIN diode, rather than photo tube, we were able to mount the whole system in a small metal chassis.

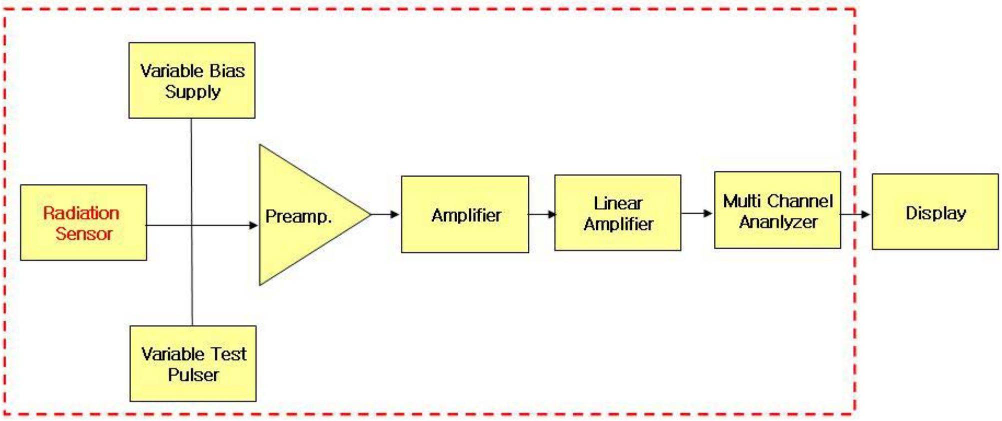

Fig. 2. Component layout of the spectroscopy system

2.3. Fabrication of the prototype of the γ-ray spectroscopy system

Fig 3 shows a working prototype of the system consisting of a CsI(TI)-PIN diode detector, integrated electronics, and a multi-channel-analyzer. The detector is rugged and quite compact, as is the rest. The chassis lid opens easily, and this makes accessibility to the components quite simple.

A Cremat CR-110 and CR-200 hybrid chips were used as preamplifier and shaping amplifier and an Amptek ADMCA is used as MCA. Fig. 3(a) shows the chassis with the lid closed and open. The diagram of of the pulse amplification chain is displayed on the chassis lid for teaching.

Fig. 3. Prototype of the spectroscopy system with the lid open and closed

3. Results and Discussion

The energy spectra were measured using Cs-137 and Co-60 sources. They are shown in Fig 4. The energy resolutions for 660 and 1,330keV were 7.9% and 4.9%, respectively. The noise contribution to the resolution is considerable, and as a result, the relative resolution is worse for the lower energy peak. The efficiencies are sufficient to accumulate a quality spectrum in a few minutes using weak, encapsulated commercial sources. γ-ray energy was calibrated using three lines from these sources.

A calibrated detector system was used to illustrate how characteristic γ rays are used to identify specific isotopes to the science teachers at the training courses, and then the technique was used to identify materials, mostly very heavy metals, probably from the surface glaze, present in a piece of pottery to the delight of the audience. Fig. 5 shows the spectrum of a pottery piece measured by the developed γ spectroscopy system. The radiation from the pottery sample was counted for 20 minutes. Apparently, there are significant peaks of the heavy metals in the pottery piece in the spectrum.

The ruggedness, simplicity and safety in operation, inexpensiveness, and convenient portability makes the present spectrometer suitable for such routine measurements as i) ambient background radiation observation, ii) monitoring the intensity of selected radioactivity iii) γ -ray attenuation in absorbers and similar γ -ray singles experiments. The new system can replace Geiger-Muller counters in many traditional basic experiments for example. With the pulse-height selectivity the new system brings, these experiments can be done not only more easily and safely but also with more detail and provide higher quality data.

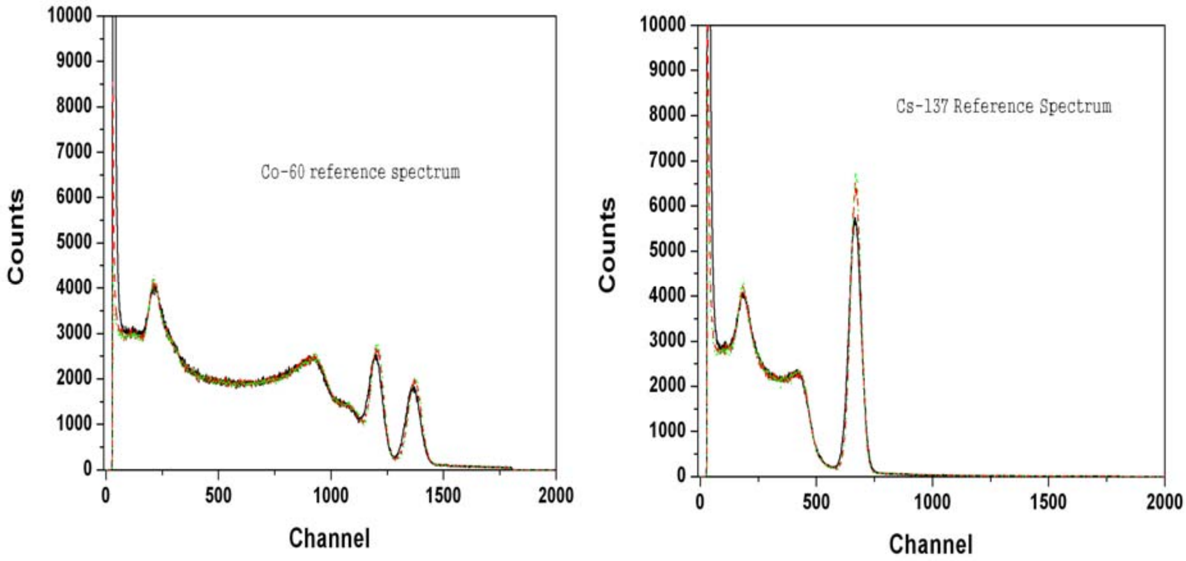

Fig. 4 Co-60 spectrum (right), Cs-137 spectrum (left)

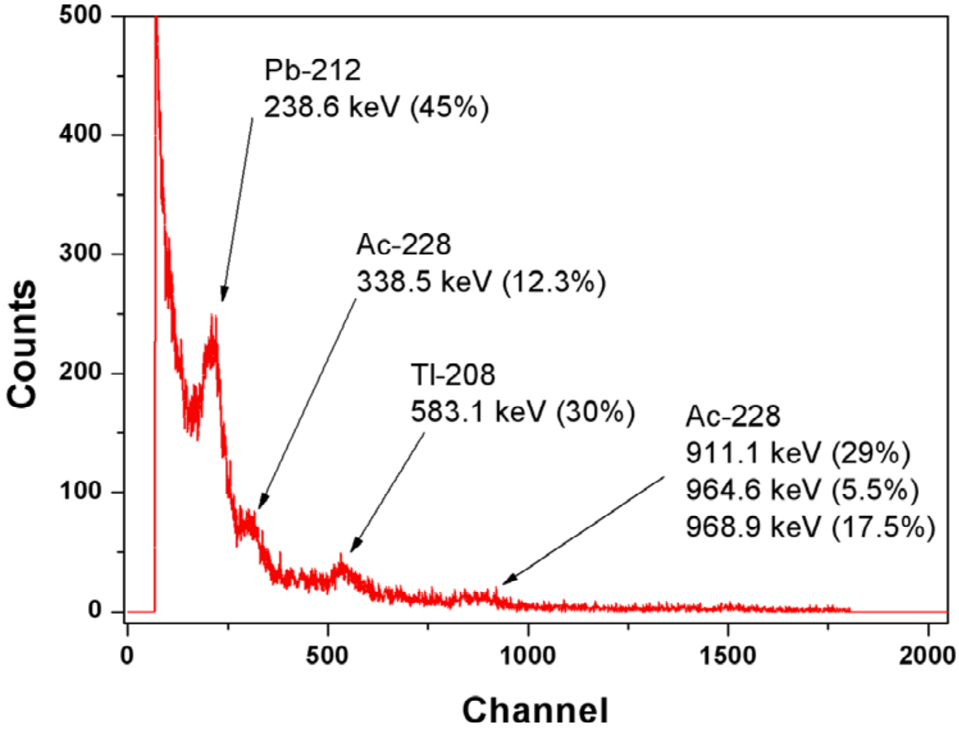

Fig. 5. Spectrum of a pottery piece

4. Conclusions

The γ-ray spectroscopy system that is rugged, compact, reliable, and relatively inexpensive has been developed, fabricated and tested.

Measured resolution is 4.9% at 1,332 keV, 7.9% at 660 keV, respectively. The efficiency is sufficient to accumulate quality spectrum in few minutes using weak, encapsulated sources. This results measured from the prototype show that its resolution and efficiency are good, making it quite suitable for educational purposes at secondary school level and beyond. The γ-ray spectrum measurements using this system may be very useful at school experiments, especially the simple application to the pottery.

We expect to manufacture a detector system based on this prototype with high hopes that they would be widely adopted for education and even for more sophisticated and higher level investigations.

5. References

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FIFTY-YEAR EXPERIENCE OF NUCLEAR&RADIATION EDUCATION AT NuTEC/JAEA
- MAINLY ON RADIATION BASIC COURSE AND NEW DISTANCE LEARNING SYSTEM -

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ABSTRACT

Human resources development (HRD) in the nuclear and radiation field is one of the main missions of Japan Atomic Energy Agency (JAEA). Nuclear Education and Technology Center (NuTEC) of JAEA has been playing a main role for HRD through 50 years of its history in Japan. NuTEC has developed and conducted a variety of training courses to meet the domestic and international needs to educate useful and competent human resources in the nuclear and radiation field. Among these training courses, Radiation Basic Course was inaugurated in 1958 as the first and principal course at NuTEC, and is still continued, sending more than 8,000 human resources, many of whom became experts and kept influential in the nuclear/radiation field of Japan. This training course has been putting emphasis on experiments, in addition to lectures, using radioisotopes and many kinds of advanced nuclear/radiation apparatuses and facilities. Recently, we have started a new distance learning system named Japan Nuclear Education Network (JNEN) for the nuclear/radiation education, connecting several Japanese universities through multi-directional, simultaneous communication Internet lines. The above two topics are mainly discussed, along with overall introduction of the education and trainings having been conducted at NuTEC/JAEA, referring also to its future plans.

1. Introduction

1.1 History of JAEA and NuTEC

Japan Atomic Energy Agency (JAEA) was established in 2005 by integrating two precedent organizations, that is; Japan Atomic Energy Research Institute (JAERI), and Japan Nuclear Cycle Development Institute (JNC). JAERI was founded in 1956 as a center for basic research on nuclear science and technology. JNC also dates back to 1956 for its first precedent organization, Nuclear Fuel Corporation, which reorganized in 1967 into Power Reactor and Nuclear Fuel Development Corporation (PNC), then into JNC in 1998. JAEA has a variety of R&D subjects such as basic physics, chemistry and biology, utilization of radioisotopes and radiations, nuclear safety, nuclear fuel cycle, nuclear fusion, neutron science, accelerator science and rad-waste management.

Nuclear Education and Technology Center (NuTEC) was originally founded in Tokyo as the Radioisotope School (RS) in 1957. Then in 1958 Nuclear Reactor Training Center (NRTC) was independently founded at Tokai site for the education mainly for nuclear reactor operators. The two centers were organisationally unified in 1975 though operated separately at the two sites. In 2002 RS moved to Tokai site, then in 2005, together with the establishment of JAEA, the two centers were unified into NuTEC.

The Radiation Basic Course was held as the first training course of NuTEC in 1958. It was originally a 4-week course with a maximum capacity of 32 participants, held 7-8 times a year in the beginning years, conducted with eminent teachers and instructors in the nuclear field of Japan at that time. In 1958 the first international training course on radioisotopes and radiations was held in cooperation with UNESCO, followed by another international training course in cooperation with IAEA in 1959..

1.2 HRD activities at NuTEC

NuTEC/JAEA has been playing a pivotal role in Japan for human resources development (HRD) in the nuclear and radiation field through 50 years of its history and still today. In its history, NuTEC has developed and conducted a variety of training courses to meet the domestic and international requirements to educate useful and competent human resources in the nuclear and radiation field. The total number of the graduates from these training courses has increased gradually through its history as shown in Fig.1, up to over 100,000 domestic trainees until today, in addition to about 3000 international trainees.

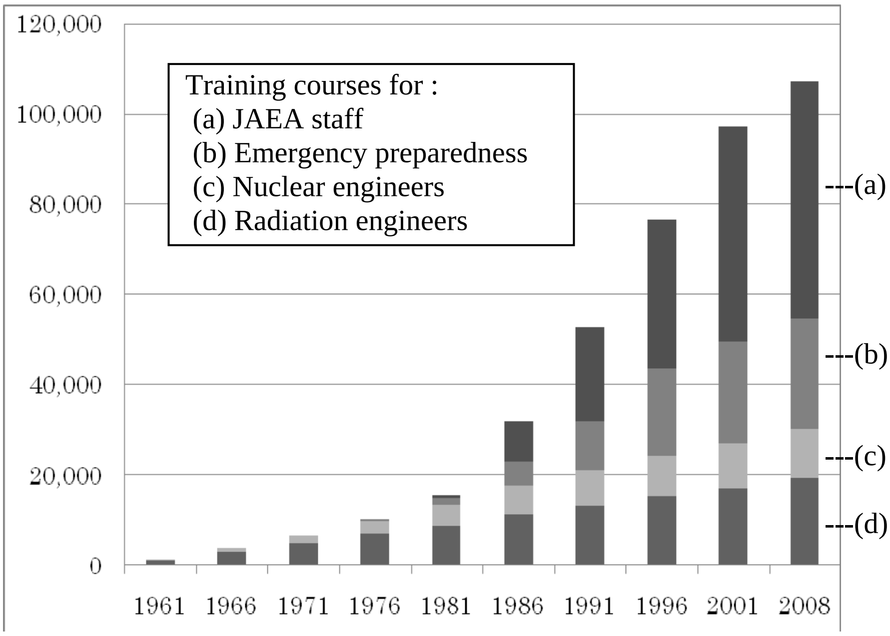

Fig. 1: Increase of the total number of trainees in the NuTEC domestic training courses

There have been many kinds of training courses, some of which still exists such as the Radiation Basic Course, while some of which were terminated such as, for example, Radiation Chemistry Course or Autoradiography Course.

Currently the HRD activity at NuTEC/JAEA can be classified into three categories, that is; 1) education and training for domestic nuclear engineers and scientists, 2) collaboration with universities, and 3) international cooperation.

The training courses in the category 1) are listed in Table 1. We also have training courses for JAEA staff in addition to the courses listed there. The Radiation Basic Course is the first one conducted at NuTEC (RS) in 1958. Except for several courses which are given only by lectures, most of the training courses of NuTEC put emphasis on the laboratory experiments and exercises using well-equipped and advanced facilities of JAEA, including research reactors and accelerators such as JRR-4. Many courses include in the curricula technical visits to advanced large facilities of JAEA such as TANDEM, JT-60 and J-PARC. A variety of subjects are possible in the training curricula because of holding a variety of experienced and leading-edge researchers in the nuclear and radiation fields in JAEA.

Table 1: Training courses at NuTEC for domestic nuclear engineers and scientists

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Training Courses for Radioisotope and Radiation Engineers

1. Radiation Basic Course (15 days, once/year)
2. Radiation Safety Management Course (14 days, once/year)
3. Radiation Protection Basic Course (4 weeks, once/year)
4. 1st Class Radiation Protection Supervisor Course (5 days, 8 times/year)
5. 3rd Class Radiation Protection Supervisor Course (2 days, 3 times/year), since JFY. 2006
6. 1st Class Working Environment Expert Course (3 days, 2 times/year), until JFY. 2008

Training Courses for Nuclear Reactor Engineers

1. Nuclear Beginners Course (4 weeks, once/year)
2. Reactor Engineering Course (6 months, once/year)
3. Introductory Neutron Experiment Course (3 days, once/year)

In the category 2), we cooperate in the nuclear and radiation education with domestic universities based on the collaboration agreements. Especially, NuTEC/JAEA has a close cooperation with the nuclear professional school of the University of Tokyo, which is located close to JAEA Tokai Research Center. As of 2009, JAEA, through NuTEC, has collaboration agreements with 17 universities, mainly of graduate school. In the fiscal year 2009 JAEA despatched totally 53 visiting professors to the universities/college and accepted 16 students allowing them to conduct their research works using JAEA facilities. NuTEC/JAEA has also supported universities in the nuclear/radiation education based on the Nuclear Human Resources Development Program sponsored by MEXT and METI (the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Economy, Trade and Industry) of the Japanese government.

As the international cooperation, in the category 3), there are such activities as; training for Asian countries, international cooperation under the scheme of FNCA (Forum for Nuclear Cooperation in Asia) and IAEA, and cooperation with ENEN (European Nuclear Education Network) and CEA/INSTN.

2. Radiation Basic Course

Since 1958, Radiation Basic Course has been continuously conducted over a half century for the nuclear/radiation scientists and engineers to offer basic knowledge and skills in handling and studying radioisotopes and radiations safely and effectively. This course has reached the 283rd in 2009, sending about 8,300 graduates so far. Although we have Radiation Protection Basic Course as listed in Table 1, the Radiation Basic Course has also played a role to provide nuclear/radiation engineers and scientists with safe and protective handling skills for radiation and radioisotopes through its long history since the dawn of nuclear age of Japan.

As listed in Table 2, the curriculum of this course consists of lectures, exercises, experiments and others. The lectures effectively and concisely cover the basic fields of radiation, with some application subjects given by the specialists of these fields. It is noted that the exercises and experiments occupy more than half of the curriculum. This is because we believe and have tried to offer the opportunity to have direct experience of handling actual radioisotopes and of operating basic and/or advanced apparatuses such as gamma-ray spectrometers and liquid scintillation counters.

This training course provides the trainees with sufficient knowledge and skills to take the Radiation Protection Supervisor licence (1st class) of Japan.

Among all the training courses at NuTEC/JAEA, the Radiation Basic Course has continuously provided the trainee with useful and valuable opportunity to learn the basics of radiation and radioisotope. We will further continue this training course, with some necessary modifications to meet the new demands of the future.

Table 2: Curriculum of the radiation basic course

Lecture (totally 29 units)

1. Nuclear Physics (3 units)
2. Interaction of Radiation with Matter (2)
3. Radiochemistry (3)
4. Radiation Chemistry (2)
5. Radiation Biology (3)
6. Radiation Measurement (3)
7. Measurement of Radiation Dose (1)
8. Gamma-ray Spectrometry (1)
9. Liquid Scintillation Counting (1)
10. Safe Handling or Radiation and Radioisotopes (1)
11. Control of Radiation Exposure (2)
12. Radiation Monitoring (1)
13. Decontamination and Waste Management (1)
14. Application of Radioisotope and Radiation to Agriculture and Biology (1)
15. Application of Radioisotope and Radiation to Medicine (1)
16. Application of Radioisotope and Radiation to Industry and Environmental Study (1)
17. Radiation Protection Law (2)

Exercise (totally 7 units)

1. Physics (1)
2. Chemistry (1)
3. Biology (1)
4. Law (1)
5. Radiation Monitoring Techniques (2)
6. General (1)

Experiment (totally 32 units)

1. Guidance of Safe Handling of Unsealed Radioisotopes (1)
2. Radiation Dose Measurement (3)
3. Gamma-ray Spectrometry (5)
4. Liquid Scintillation Counting (5)
5. Compton Scattering (3)
6. Milking with ^{99}Mo/^{99m}Tc Generator (5)
7. Neutron Activation Analysis (5)
8. Radiation Monitoring (5)

Others (totally 4 units)

1. Orientation (2)
2. Technical Tour (2)

(70 min/unit)

3. Japan Nuclear Education Network (JNEN)

JAEA has collaboration agreements with domestic universities, totally with 17 universities and colleges in 2009. These are basically the bilateral cooperation between a university/college and JAEA.

In addition to the above-mentioned agreements, JAEA and three universities launched a new multi-directional distance learning system for the nuclear/radiation education in 2007, named the Japan Nuclear Education Network (JNEN) [2]. The concept of JNEN is a multi-directional education system connecting the remote sites of the participating universities and JAEA through Internet. Many kinds of lectures are available through the system at real time. There are two semesters for JNEN. These two semesters are for 1); radiation-related subjects and for 2); rad-waste management subjects, consisting of 15 lectures each. JNEN was expanded to include 6 universities in 2009, that is; Tokyo Institute of Technology, Fukui University, Kanazawa University, Okayama University, Ibaraki University, and Osaka University, in addition to JAEA. The conceptual structure of JNEN is illustrated in Fig. 2.

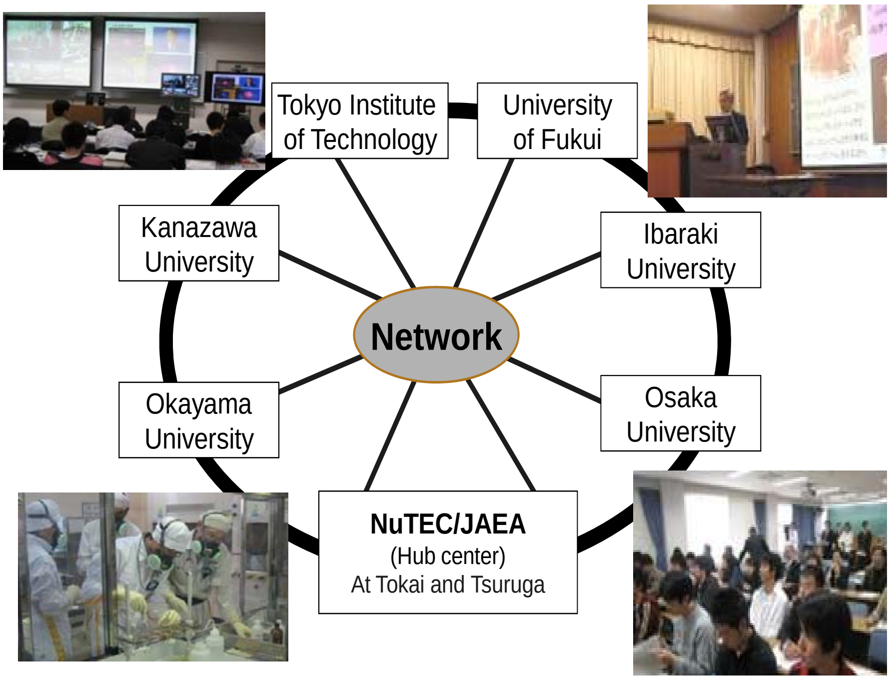

Fig. 2: Illustration of JNEN system

Through JNEN, students of a university can take lectures of the professors belonging to other universities. The professors and students of various universities can make Q&A and discussions on the topic of interest through wide monitors multi-directionally on the real time. The students can also review the lessons by the e-learning system after the lectures.

In addition to the lectures, some experimental courses, for one week or less, are organized in the summer and/or winter vacation season on the handling of nuclear materials, radioisotopes and glove boxes, using JAEA facilities such as Nuclear Fuel Cycle Engineering Laboratories.

We plan to expand this network to some more universities of Japan, as well as with foreign universities, possibly in collaboration with ENEN, in the future.

4. References

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