

Radiation protection culture at school: feedback experience and perspective

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Abstract

The radiation protection culture corresponds to the set of knowledge and know-how allowing people to be informed, to behave and to make decision accordingly with regard to exposure situations involving ionizing radiation. In this perspective, the aim of the development of this culture is to provide people the means to understand the risk associated with exposure to ionizing radiation, as well as the origin and the localisation of the radioactivity in the different places. It also aims at providing the means for appraising the efficiency of the different protective measures already implemented or to be implemented. The development of this corpus of knowledge and know-how at school is based on the practical experience instead of a purely theoretical approach, and has to favour the cooperation between teachers and radiation protection experts in relation with the local contexts concerning exposure to ionizing radiation.

Experiences with schools have been developed first in the context of the post-accidental situation in Belarus and more recently in France to deal with exposures associated with radon or discharges of nuclear installations, as well as in the medical sector. The success of the first experiences clearly relies on the willingness of the teachers and the students to experiment the development of the radiation protection culture, mainly out of the traditional school programme. It also relies on the flexibility and the dynamics of the work performed with the young students. It allows them at the same time to address scientific topics related to their own context in cooperation with experts and to challenge the relationship between science and society in addressing social, economic or philosophical dimensions according the teachers involved.

Furthermore, the relationship developed with professionals for scientific mediation (Pavillon des Sciences) was crucial to favour the development of knowledge and know-how instead of theoretical approaches of radiation protection. The place of radiation protection experts is also essential: this is a real challenge for us to present to a young public what is at stake in radiation protection in terms of public health, research, protection and surveillance of the environment. There is a need to find the good wording, the meaningful experiences and the limited set of useful knowledge to deal with the radiation protection issues with young people.

In the perspective of enlarging the experiences already developed, it could be useful to:

- Develop pedagogical documents describing the approaches implemented together by teachers and radiation protection experts;
- Favour local initiatives in establishing relationship between school teachers, scientific mediation professionals and radiation protection experts;
- Organise the sharing of these experiments at the national and international levels, notably through Radiation Protection Societies and IRPA.

Introduction

The radiation protection culture corresponds to the set of knowledge and know-how allowing people to be informed, to behave and to make decision accordingly with regard to exposure situations involving ionizing radiation. In this perspective, the aim of the development of this culture is to provide people the means to understand the risk associated with exposure to ionizing radiation, as well as the origin and the localisation of the radioactivity in the different places. It also aims at providing the means for appraising the efficiency of the different protective measures already implemented or to be implemented. The development of this corpus of knowledge and know-how at school is based on the practical experience instead of a purely theoretical approach, and has to favour the cooperation between teachers and radiation protection experts, as much as possible, local expertise, in relation with the local contexts concerning exposure to ionizing radiation.

The aim of this paper is first to analyse the meaning of the radiation protection culture and its role in the application of the radiological protection system. In a second part, it draws some lessons from different experiences to develop radiation protection culture at school in different contexts. The third part of this paper puts specific emphasize on the need to develop partnership with professionals for scientific mediation and also points out the role of RP professionals in the development of the radiation protection culture. In conclusion, the perspective for the development of the radiation protection culture is discussed.

Definition of culture

To better define the meaning of actions in the field of radiation protection culture, it is interesting to come back to the meaning and dynamics of development of culture in general and especially in science. It is first interesting to note the definition for Culture adopted by UNESCO in its Mexico City Declaration in 1982¹:

"... in its widest sense, culture may now be said to be the whole complex of distinctive spiritual, material, intellectual and emotional features that characterize a society or social group. It includes not only the arts and letters, but also modes of life, the fundamental rights of the human being, value systems, traditions and beliefs;

that it is culture that gives man the ability to reflect upon himself. It is culture that makes us specifically human, rational beings, endowed with a critical judgement and a sense of moral commitment. It is through culture that we discern values and make choices. It is through culture that man expresses himself, becomes aware of himself, recognizes his incompleteness, questions his own achievements, seeks untiringly for new meanings and creates works through which he transcends his limitations."

¹ Mexico City Declaration on Cultural Policies, World Conference on Cultural Policies, Mexico City, 26 July - 6 August 1982, UNESCO

It should be emphasized that culture brings together the knowledge enabling the individual to acquire a sense of critical analysis, to form his judgment and to help him argue. The relationship of culture with education, and science is also quoted in the UNESCO Mexico City Declaration:

"The overall development of society calls for complementary policies in the fields of culture, education, science and communication with a view to the establishment of a harmonious balance between technological progress and the intellectual and moral advancement of mankind.

Education is ideally suited to the transmission of national and universal cultural values and should foster the assimilation of scientific and technological knowledge without detriment to each people's capacities and values.

At the present time, integral, innovative education is required that not only informs and transmits, but also trains and renews; that helps students to become aware of the realities of their times and of their environment, that assists in the full development of the personality; that provides training in selfdiscipline, respect for others, and social and international solidarity; that equips people for organization and productivity and for the production of truly necessary goods and services; and finally, that encourages renovation and stimulates creativity."

Defining radiation protection culture

Radiation protection culture can be defined as the knowledge and skills enabling citizens to make choices and behave wisely in situations involving potential or actual exposure to ionizing radiation. It must contribute to knowledge-being of individuals and communities to questions posed by radioactivity and the implementation of protective actions. It is also worth noting that this set is based on currently available knowledge and should therefore take into account the evolution of knowledge over time.

Based on the questions of the public related to radioactivity in various exposure situations, it is possible to formulate the expectations of individuals and communities from this culture that is to say:

- Orient themselves in relation to risk associated with exposure to radioactivity in their environment;
- Assess, by measuring the levels and patterns of exposure and the radioactivity in the environment, in workplace, in the medical field;
- Update their knowledge and understanding of risks associated with exposure to the radioactivity in the environment or in the medical field and identify protective actions to implement in order to maintain their own exposure as low as reasonably achievable;
- Be able to "appreciate" and to evaluate the usefulness of protective actions to be implemented.

It is important that individuals have access to the base of available knowledge and know-how enabling them to better understand the issues of various exposure situations, facilitating their participation in the evaluation process and decision on protective actions.

The development of the radiation protection culture is generally associated with the local context, for example:

- The proximity of facilities (nuclear power plant, old mines, storage centre, a hospital, a research centre ...)
- The presence of radioactivity in the environment (radon, contaminated land),
- The existence of a social issue (consequences of a nuclear accident, nuclear waste management, building a new nuclear power plant, ...)

It has to be noticed that the Fukushima accident clearly highlighted a need to develop the radiation protection culture in various fields to enable a dialogue with the public on issues related to radiation exposure. In this perspective, it is necessary to take care on the language used for addressing radiation protection issues among the general public.

In addition, experiences developed in recent years with the exhibition "*La robe et le nuage*"² showed the interest of artistic approaches for addressing the issue of radiation protection with a wide audience. In this context, the role of expertise is very different from the classic actions of development of scientific culture.

Approach adopted with high schools

In 2007, the Institute of radiation protection and nuclear safety (IRSN), Nuclear Protection Evaluation Centre (CEPN) and the "Pavillon des Sciences de Franche-Comte" (a centre for scientific and technical culture) decided to initiate a pilot programme with some high schools (lycee) in France. The programme is based on cooperation between school professors and radiation protection experts from different institutions: national institutes of radiation protection, CEPN, universities, hospital, nuclear installations or environmental NGO.

In order to develop multidisciplinary approach, professors teaching biology, physics, philosophy, arts ... are involved. School students, from 15 to about 19 years old, participate, on voluntary basis, in small group(s) up to 20 students in each high school.

Each school year, the programme includes two parts: the first one concerns practical experiments performed by school students with their teachers, in cooperation with radiation protection experts, and the second one consists in the organisation of an international workshop, involving all the schools, held each year, in Spring. Different topics are studied: biological effects of radiation, cancer epidemiology in exposed population, radiation detection, radon exposure, radioactivity in the environment, medical use of radiation, ethics... Each high school chooses topics, according to regional or personal interest.

Practical experiments

For each topic, a radiation protection expert is identified on voluntary basis to accompany professor and students. As much as possible a local expert is favouring because of his knowledge of the stakes and specificities of his territorial context. Experiments are designed for the students to cope with radiation protection bases

² This exhibition was developed by the "Pavillon des Sciences" in 2007.

through practice and to identify the issues for the management of radiation protection at stake in specific situations (mining residues areas, environmental surveillance around nuclear installations, radon management in dwelling, radiation protection at hospital,...). Protocols for experiment are defined in order to avoid any risks for participants.

The Figure 1 summarizes the approach adopted for developing a radiation protection culture at school.

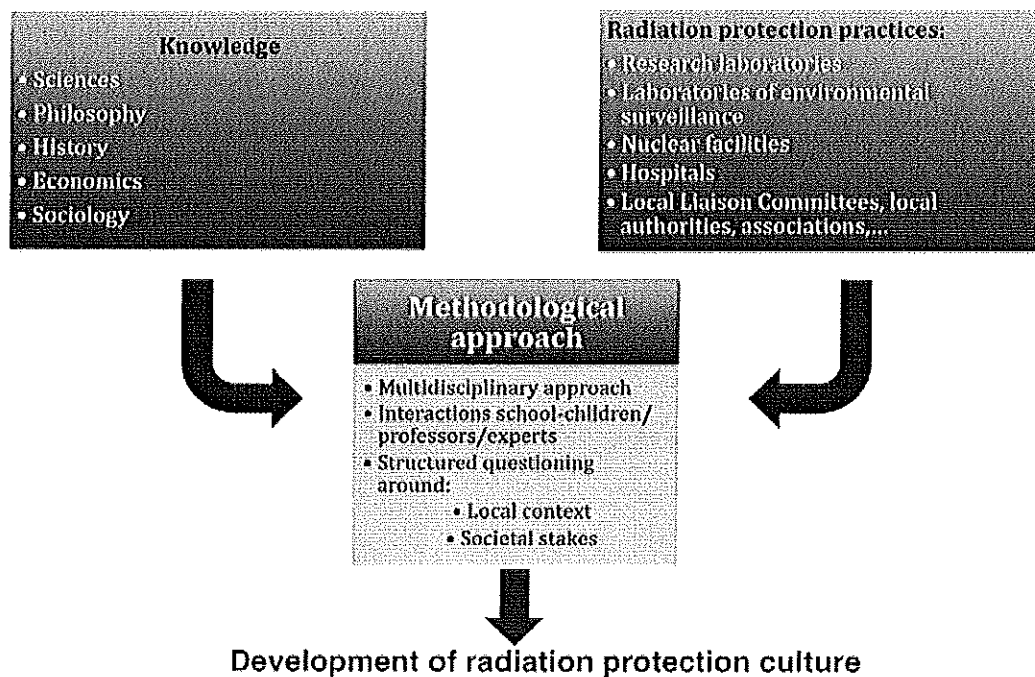


Fig. 1. Approach adopted with schools

International Workshop

Each year, an international Workshop is organised, giving the opportunity for students to present their work and exchange with other students, but also with experts. It includes topical sessions with oral presentations by students, as well as some lectures by experts on special topics. The Workshop programme also includes technical visits and entertainments.

Feedback experience with schools

From practical experiments, students learned about physical, biological, regulatory... bases in radiation protection. For example, a project was focused on environmental monitoring around nuclear facilities and population exposure to ionizing radiation. Initially, teachers and an expert in radiation protection have presented the basics of radioactivity and radiation protection principles to familiarize students with this new theme. To implement these concepts, a field experiment was conducted in the Nord-Cotentin Region near the La Hague reprocessing plant. These visits were an opportunity for students to meet leaders of environmental monitoring sites and to participate to sampling campaigns (sediment, seafood, ...) with experts from IRSN and NGO. In a second step, discussions were conducted both on the assessment of internal contamination by ingestion and epidemiological aspects in interaction with the IRSN and the CEPN. Students have a committed dose calculated from the data of contamination of

food (seafood) measured on the field. Concerning the projects dealing with radon exposure, students exposed radon dosimeters in various conditions: basement, living rooms, caves... Then they are involved in the analysis of the results and they discussed the associated risk of lung cancer. They also analysed the different protective actions to be implemented.

It is important to note that the multidisciplinary approach together with the interaction with different experts and stakeholders give the opportunity to engage a reflection on the societal issues associated with different radiation protection practices. Inquiries have been performed by students around nuclear installations for example on the type of information available for the population. A measurement campaign has been organised with an environmental NGO in addition to the visit performed in a nuclear installation. Students living in territories contaminated by the Chernobyl accident in Belarus and Ukraine worked on the memory of the accident and the current consequences in the day-to-day life. Students also addressed, with the help of their professor of philosophy, the ethical issues associated with radioactivity and especially the precautionary principle and the decision-making process under uncertainty.

Partnerships and role of RP professionals

The experiences developed since several years have pointed out the importance of the different partnerships allowing the development of the radiation protection culture at school:

- A network of school professors:

It is essential to set up a network of professors who are volunteers to experiment new topics and approaches with their students, generally out of the official programme. A real cooperation with the professors allows to co-construct the programme and to identify the relevant approaches for developing the radiation protection culture. In addition, the professors themselves are in position to motivate their colleagues and also to exchange with them their experiences.

- Professionals for scientific mediation:

The relationship developed with professionals for scientific mediation (i.e. Pavillon des Sciences) is crucial to favour the development of knowledge and know-how instead of theoretical approaches of radiation protection. It is to note that the mission of these types of structure is to promote exchanges between the scientific community and the public, by collecting and making available a set of information that can contribute to a better approach to the dissemination of scientific knowledge and techniques. This favours the development of new approaches to deal with radiation protection.

- Radiation protection experts:

The place of radiation protection experts is also essential. This is a real challenge for RP experts to present to a young public what is at stake in radiation protection in terms of public health, research, protection and surveillance of the environment. There is a need to find the good wording, the meaningful experiences and the limited set of useful knowledge to deal with the radiation protection issues with young people.

Conclusion - Perspective

There is an increasing trend to involve stakeholders in radiation protection management. Some issues will be of particular importance in next years: radioactive waste management remains a sensitive issue, discharges from nuclear installations, medical exposure increases drastically, management of radon exposure needs to be improved, learning lessons from post-accidental situation (Chernobyl and Fukushima)... However, members of civil society need basic knowledge in radiation protection together with practical experimentation to be able to improve their level of protection regarding radiation exposures, to express their concerns and expectations on these issues and to play a role in the related decision making processes. In this perspective, the development of the radiation protection culture at school can significantly contribute to open the debate and to improve the awareness of young generations on these different issues.

For enlarging the experiences already developed, it could be useful to:

- Develop pedagogical documents describing the approaches implemented together by teachers and radiation protection experts;
- Favour local initiatives in establishing relationship between school teachers, scientific mediation professionals and radiation protection experts, notably local ones
- Organise the sharing of these experiments at the national and international levels, notably through Radiation Protection Societies and IRPA.