Teaching about biological effects of ionizing radiation, a sensitive societal issue related to radiation protection.

Marie-Hélène Hengé-Napoli
Institut National des Sciences et Techniques Nucléaires (France)

Nicolas Lechopier
Département Sciences et Société ENS Lyon – (France)
LEARNERS

It is the employer who must meet the legal requirement to have trained personnel at the workplace.

- **Occupational training**: mandatory training to be allowed to work in nuclear facilities
- **Training for lifelong learning**
- **Students** involved in University degree courses

The objective is to move them from the non-informed person position to a first level of expertise
TEACHING THE BIOLOGICAL EFFECTS OF IONISING RADIATIONS

- Training in radiation protection always includes an introduction of the basis of the biological effects of ionizing radiation.

- Trainees often encounter difficulties to appropriate the level of radiation doses associated to an observed biological effect.
Learning process

Jean PIAGET

Learners are not as *tabula rasa*.

The content of knowledge is not neutral with regard to learning process.

Pierre PASTRE

human development at the work place
Say « I can » before saying « I know »

the concept of « epistemological obstacle »
History of radioactivity is build on series of accidents and disasters
KNOWLEDGE

At the beginning of the training

- Try to help learners to become aware of these existing representations in their mind, their preconceived ideas

- Use these preexisting elements to construct the different concepts of dose, determinist effects and stochastic effects
RISK: A POLYSEMIC WORD

- risk = an *unwanted event* which may or may not occur.
- risk = the *cause* of an unwanted event which may or may not occur.
- risk = the *probability* of an unwanted event which may or may not occur.
- risk = the statistical *expectation value* of unwanted events which may or may not occur.
- risk = the fact that a decision is made under conditions of *known probabilities* (“decision under risk”)
how to judge and assess the severity or the acceptability of risks?

they are taken, run, or imposed

Sven Ove Hansson
Royal Institute of Technology,
Stockholm
Perception of risk is shaped by the features of the perceiving person.

- LEVEL OF EXPERTISE

- PERSONAL CULTURE: history, values, belief, professional experience

- TARGET OF THE RISK: the person himself, somebody else...

- Is the person subjected to the risk or is he volunteer

- SOCIAL VARIABLE: level of the person in the hierarchical scale, implication in organisation, social environment

- SOCIAL RULES: behaviour of other neighboring people

- PERCEPTION OF OWN SKILLS AND DECISION-MAKING POWER
PERCEPTION OF RISK

Perception of risk is shaped by the risk itself

- Is the risk familiar
- Controllable
- Natural or technological hazard
- Occurrence of the risk (frequent or not)
- Immediate or delayed consequences
- Number of persons potentially concerned
- Mediatization
Heuristic refers to experience-based techniques for problem solving, learning, and discovery that give a solution which is not guaranteed to be optimal. Heuristic methods are used to speed up the process of finding a satisfactory solution via mental shortcuts to ease the cognitive load of making a decision.

- **Heuristic of representativity**: similar situation already encountered

- **Heuristic of disponibility**: disponibility of information coming first to mind (media role)

- **Anchoring heuristic**: people allow more confidence to information confirming pre-existing beliefs

  Expert approach simpler: severity and frequency
Make the risk acceptable for the learner

- Explain the figures
- Explain the statistical construction of the risks level
- Move the learner from the subjective field to the objective field
The controversy

- Low level doses exposure defined by
  - Metrology and the sensitivity of tools
  - Effect of the exposure (NOAEL – LOAEL) (Choice of the observed effect)
  - Difference with the public exposure level
  - ....

  For epidemiologist, low level dose is associated to low risk

- Threshold: no scientific consensus

- Individual sensitivity

Make the learners become aware of the scientific and societal controversy
THE TEACHER HAS TO

- Know exact and agreed data
- Use and explain exact and agreed data
- Explain the meaning of the figures
- Show that comparables risks have already been accepted in previous situations
- Show the positive aspects of the stake
- Guide the learner towards an active partner position
CONCLUSION

- Training is mandatory: It is the employer who must meet the legal requirement to have trained personnel at the workplace.

- Identify the difficulties encountered by learners
  - Psychological dimension of risk
  - Burden of the history of radioactivity
  - The controversy

- Give the learners time to help them to become aware of their preconceived ideas and conceptions

- Present the ethical values supporting the three pillars of radiation protection

  - Trust in Radiation Protection policy is not a matter of opinion
THANK YOU FOR ATTENTION