# New Approaches in Radiation Protection Education (P-S11-40)

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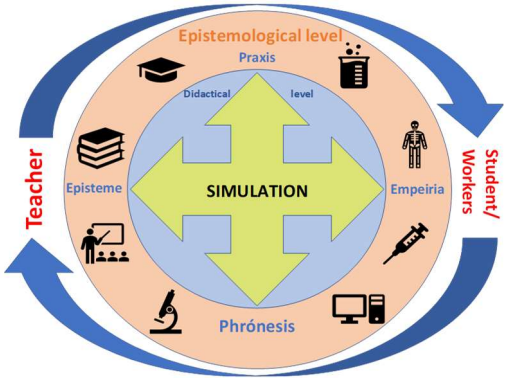
## 1. Background and Goal of the present work

In Occupational Radiation Protection (ORP) education, the following teaching sequence has traditionally been used: Theory, Problems, Laboratory and Supervised Practices, the relationship between them varying according to the educational level of the target audience and the objective of the training. Our aim is to postulate a new epistemological basis for ORP teaching based on the concept of phronesis or "practical wisdom, prudence or precaution" (1) applied to the optimisation of processes and procedures with ionising radiation (2). Our particular objective is to show its didactic implementation through the presentation of an advanced simulator prototype which has been designed to be used in Higher education, Vocational training and Continuing education in activities that involve open sources of radioisotopes, such as Health, Mining or Industry (3). As it has been widely demonstrated in the transport industry, simulation-based training (SBT) is an exemplary solution for developing professional skills. SBT is presented as a superior option to traditional didactic models in terms of speed of learning, amount of information retained and problem-solving ability in work practice (4; 5; 6).



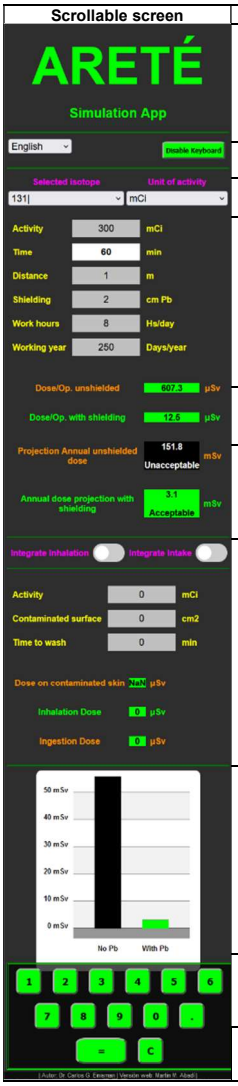

| | |
|---|---|
| **Episteme**: | - It is aimed at the knowledge of various situations; |
| | - It is based on scientific research; |
| | - It uses general concepts; |
| | - It is conceptual: it helps us understand various situations. |
| **Phronesis:** | - It is aimed at concrete action, in a specific; |
| | - It is based on one's own experiences; |
| | - It focuses on specific aspects of the situation (certain "clues"); |
| | - It is perceptual: it shapes our perception of specific situations. |

Radiological risks are only one more risk in different activities together with chemical, biological, socio-environmental, etc. and it is necessary to rethink their teaching following a Promotion, Prevention and Protection approach. We propose changing the epistemological and ethical basis of ORP teaching from a universal "must be" - compliance based on obedience - to a culture of safety and care based on the ability of students and workers to think and develop awareness of themselves in their work context. For this, it is necessary to scaffold the construction of knowledge which can be translated into context-specific know-how.

In the handling of open sources of radiation, the factors that determine occupational dose are more related to the way in which each operation is performed than to the length of the working day or the number of practices performed (7). The systematic use of Personal protective equipment (PPE) and, in particular, appropriate shielding during the handling, fractionation, transfer and application of radioactive material will maximise ORP against external irradiation. Also, the systematic use of disposable gloves during handling, preparation and/or administration of radioactive material prevents contamination. These are simple measures, but they only work if they are applied systematically in all daily operations. **Maximising protection in every operation is the only way to minimise risks.**

## 2. Exposure simulator for Occupational Radiation Protection education

Simulation allows visualisation, experimentation, surprise, feedback and it answers to the need to test and demonstrate. The ultimate goal is that interaction with the simulator leads to the conclusion that optimisation integrates multiple levels: fixed and mobile facilities, protection and control devices, systematic operating procedures, and continuous education and training. However, simulator interaction alone does not change professional practices. To this end, it is necessary to integrate it using different supports to present the theory; the analysis of situations with dynamic visualisation and projections of annual doses, the simulation of situations with PPE in various work scenarios (Nuclear Medicine, Oil, etc.), and supervised practical work. We have developed a numerical simulator prototype for smartphones called "Areté", scalable to a virtual or augmented reality simulator. In preliminary tests, the system has proven to be more accessible and effective than traditional ORP teaching methods.

| Scrollable screen | Features |
|---|---|
|  | **ARETÉ (Αρετή) means in old Greek "virtue, excellence"**<br>**Multilingual: English; Spanish; French and Portuguese.**<br>**← Dropdown menu for activity unit and Isotope: $^{99m}Tc$;$^{131}I$;$^{18}F$.**<br>**Data input**<br>**Numerical output on dynamic colour bar**<br>**← Dose by operation**<br>**← Annual projection dose**<br>**Inhalation Ingestion Skin contamination**<br>**← Internal contamination module:**<br>**Real time dynamic visualization of shielded and unshielded dose**<br>**←Selectable keyboard** |



| Variable | Range [min; max] | Unit |
|---|---|---|
| Activity | [0; 1000] | mCi |
| | [0; 37000] | MBq |
| Time | [0; 480] | min |
| Distance | [0,01; 20] | m |
| Shielding (Pb) | [0; 20] | cm |
| Work hours | [0; 8] | h/day |
| Working year | [0; 250] | days/year |

| Concept | By year value | Calification |
|---|---|---|
| Individual limit (50mSv/1y) | 50 mSv | Unacceptable |
| Individual limit mean (100mSv/5y) | 20 mSv | Unacceptable |
| Dose restriction (6mSv/1y@8hs) | 6 mSv | Tolerable |
| | | Acceptable |
| Optimization | ≈0 mSv | Optimized |

Scan here for free test!

## 3. Conclusions

Simulator-based training induces the user to construct and critically analyse the relationships between the physical, environmental and occupational factors specific to each activity. The proposed system allows trainees to evaluate the decisions taken in terms of their effects on the radiation dose received in each operation and the projected annual dose. Thus, the user can conclude personally and experientially - not only theoretically - that maximising protection in each operation is the only way to minimise risks. In this way, the synergy between epistemology, didactics and technology promotes greater awareness of care among students and workers, reducing occupational dose throughout working life.

## 4. References

1. Muñoz, F. A., Martínez, C, y Jiménez, J. M. (2012). "Phrónesis, prudentia y praxis. Teorías y prácticas de la paz". En: VV. AA. *La praxis de la paz y los Derechos Humanos* (pp. 31-58). Granada: Universidad de Granada.
2. González, A.J. (2010). "The Argentine Approach to Radiation Safety: Its Ethical Basis". *Science and Technology of Nuclear Installations*. Manuscript Number 910718.v2
3. Einisman, C.G. (2021). "Simulación en la enseñanza de la Protección Radiológica" (2021). *Revista En Clave Didáctica*, Año 2, Nº 2. Centro de Estudios en Didácticas Específicas. Escuela de Humanidades. UNSAM. ISSN 2718-7322.
4. Bilotta, F.F., Werner, S.M., Bergese, S.D. y Rosa, G. (2013). "Impacto e implementación de entrenamiento basado en simulación para seguridad". *The Scientific World Journal*, 2013, 652956.
5. Issenberg, S.B., McGaghie, W.C., Petrusa, E.R., Lee Gordon, D. & Scalese, R.J. (2005). "Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review", *Medical Teacher*, 27:1, 10-28.
6. Einisman, C.G. (2018). "Simuladores: Un aporte de la simulación a la seguridad de los sistemas". Colección Seguridad, *Hojitas de conocimiento*, p. 213-214. IDAES, CNEA.
7. Einisman, C.G. (2013). "Indicadores para la optimización procedimental en Medicina Nuclear". [Tesis]. Escuela de Ciencia y Tecnología, Universidad Nacional de San Martín (UNSAM).

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