IPEN

MODELO DE PROVA DE PRODUÇÃO ESCRITA EM LÍNGUA INGLESA

Read the text "Pre-university students' conceptions regarding radiation and radioactivity in a medical context" and answer the question below. Write your answer in English between 80 – 90 words.

How do the conceptions and knowledge about radiation and radioactivity among pre-university students in Brazil compare to those in other countries, especially in a medical context? Are there specific cultural or educational factors that may influence the differences or similarities in students' understanding of radiation and radioactivity in Brazil compared to students in other parts of the world? What implications might these differences have for physics education and the effective teaching of radiation-related topics in Brazilian schools?

Pre-university students' conceptions regarding radiation and radioactivity in a medical context

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An X-ray at the dentist, radiation therapy at the hospital, a malfunctioning nuclear power plant–in one way or another, nowadays nearly everyone is confronted with radiation and radioactivity. However, radiation and radioactivity are difficult to understand because we cannot feel them with our senses. We develop our own conceptions of radiation and reasons based on our experiences and the information that we receive from others, be they parents, the media, or peers. Probably because everyone is confronted with radiation and radioactivity and they thus play an important role in modern society, this has become a compulsory topic in physics education worldwide.

To be able to teach the topic of radiation and radioactivity, teachers need to know not only the physics but also the pedagogical difficulties of teaching about radiation and radioactivity. It was only in the second half of the twentieth century that radiation and radioactivity became a topic in educational research. The first educational research paper about radioactivity was published by Riesch and Westphal (1975). They studied how students adjusted **their** mental images of matter to incorporate the existence of ionizing radiation. After the nuclear disaster at Chernobyl in 1986, radiation and radioactivity received more attention in educational research. Three prominent examples of investigations carried out in the aftermath of this disaster were: Lijnse et al. (1990) studied students' ideas about radioactivity as it is addressed in mass media; Boyes and Stanisstreet (1994) research covered children's conceptual knowledge of the sources and the perceived dangers of radiation and radioactivity; and Eijkelhof et al.'s (1990a) investigation of the influence of mass media on students' ideas about radiation and radioactivity.

The overarching research question in this research was: 'What do students know, or think they know about radiation and radioactivity?'. The aim of the research presented here was to find out what conceptions students have about radiation and radioactivity. The focus of this article is on all student's beliefs and conceptions that differ from scientific theory. Our first step was to develop an overview of what is already known about the difficulties students have with respect to radiation and radioactivity. We researched student conceptions, conceptions that do not correspond with prevailing scientific theories, that have been found in research about radiation and radioactivity among upper-level secondary school students.

Our first research question thus was: 'What conceptions are upper-level secondary students known to have about radiation and radioactivity?' Students' conceptions are influenced by **their** experiences, just as research and education are influenced by society. The Chernobyl disaster is an example of the influence of society on research. As a result of Chernobyl, for decades public discussion about radiation and radioactivity centered around the possibilities of nuclear disasters. Educational research, likewise, focused on the same aspects of radiation and radioactivity. Compared with other subjects, significantly less research has been conducted into conceptions regarding radiation and radioactivity.

Only five of Duit's (2009) 550 articles about student conceptions referred to conceptions with regard to radiation or radioactivity. Moreover, following changes in society and in the research, high school physics curricula evolved accordingly. The first high school physics courses that included radiation and radioactivity as topics focused on the principles of radiation and radioactivity. During the cold war, the focus in school education shifted toward the dangers of radiation and radioactivity. In more recent years, the context in which radiation and radioactivity are taught in secondary schools has shifted further towards benign applications, for example, medical imaging (e.g. X-ray and CT scanning) and medical treatments (e.g. radiation therapy and positron therapy). Little educational research has been done to investigate students' conceptions of radiation and radioactivity with regard to a medical context.

None of the five publications about students' prior knowledge of radiation and radioactivity investigated the medical context. As conceptions depend on the context, it is important to look into students' existing conceptions about radiation and radioactivity

within the context in which radiation and radioactivity are taught, and this context has recently changed. For example, in the USA, the Next Generation Science Standards (Council, 2012; States, 2013), proposes the teaching of the principles of wave behavior and wave interactions with matter in the context of medical imaging. In the UK, a significant proportion of the physics curriculum focuses on the medical, industrial, and commercial use of these principles. In the Netherlands radiation and radioactivity concepts are now taught in the context of medical applications.

There are multiple views on the nature of student conceptions and how to deal with student conceptions, to achieve conceptual correctness. The similarity between these views is that teachers need to know what existing student knowledge is because the development of knowledge is a process during which students assimilate new, scientific information into prior knowledge, which can cause hybrid conceptions or misconceptions. For teaching radiation and radioactivity effectively, it is important to know which conceptions appeal most to students. The teacher then can anticipate potential conceptual problems and hybrid ideas.

We did not find research in this literature search that focused on student conceptions in a medical context in secondary schools. Conceptions related to medical applications of radiation and radioactivity were investigated to some extent with other types of students. Mubeen et al. (2008) studied medical students' knowledge of ionizing and non-ionizing radiation, and Freudenbergand & Beyer (2011) studied the perceptions of radiation risk held by medical students and non-radiologic physicians. This research revealed conceptions about X-ray radiation: that gamma rays are less hazardous than X-rays; X-rays stay for hours in the air in an X-ray department; and, after completing X-ray examinations, objects in the room emit radiation. Along with these conceptions, patients informed about and treated with, radioactive medicine also showed a high level of distrust in radioactivity (Freudenberg & Beyer, 2011; Mubeen et al., 2008) and are ill-informed about the risk involved (Ricketts et al., 2013; Sin et al., 2013). However, none of these studies involved secondary school students. **Therefore**, we looked into the differences in conceptions between secondary school students and medical students, as well as patients who have had experience with medical treatments.

Many of the conceptions of secondary school students were not found in research with medical students or patients. Moreover, only one of the conceptions found with medical students was already known from research outside the medical context. It is not clear whether medical students do not have the most common conceptions because of their higher levels of education, or that the conceptions were not found because the studies in which medical students were involved focused on conceptions related to medical applications.