

# Digital feedback to students to enhance strategic knowledge in medical physics

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Radiation and radioactivity are topics about which numerous preconceptions exist as we cannot, by any of our senses, feel radiation. An overview will be presented of preconceptions found among high school students. Based on these preconceptions a web-based environment for learning about radioactivity in the context of medical physics was developed in which students receive feedback during and after working on assignments. The feedback is directed at conceptual and strategic knowledge about radioactivity and aims at improving both simultaneously. Results will be shown about the use of the digital feedback and the development of students' conceptual knowledge in medical physics.

## ***1 Introduction***

An X-ray at the dentist, radiation therapy at the hospital, a malfunctioning nuclear power plant, everyone in one way or another is confronted with radiation and radioactivity. These topics have been included in the physics courses of secondary schools world-wide. Knowledge of radiation and radioactivity is important because we cannot, by any of our senses, feel radiation. That is why we develop our own mental images of radiation and our own reasoning if and why radioactivity is dangerous.

These mental images in the context of medical imaging have been studied in literature and during semi-structured interviews. Such mental images play a role when solving problems related to radiation and radioactivity. In our study we aim to support students' learning and problem solving by providing digital feedback during the problem solving process. We study how students use such digital feedback and whether conceptual and strategic knowledge of the students can be enhanced using this feedback.

## ***2 Preconceptions of radiation and radioactivity***

Radiation or radioactivity are known concepts to high school students. A great number of research has been done to investigate preconceptions in the field of for example mechanics or optics [1]. In the field of radiation and radioactivity also several preconceptions occur which can interfere with learning. First because radiation is not visible [2], second because of the stochastic nature of radioactivity [3] and lastly because of language difficulties due to differences in professional language and everyday language [4].

In this presentation an overview of all preconceptions about radiation and radioactivity found in the literature will be presented and be compared with the preconceptions we found by means of semi-structured interviews in the Netherlands in 2017.

## ***3 Preconceptions about radiation in medical contexts***

As preconceptions are dependent on the context [5] it is important to look at preconceptions that arise within a medical context. No research was carried out into

preconceptions in a medical context in high schools, with the exception of a study by Eijkelhof's PhD [6] research. Two preconceptions stood out during the analysis of the results of the semi structured interviews with high school students: students trusted the authority of medical professionals; and second, radiation was seen as independent of the source of the radiation.

#### ***4 Digital feedback to enhance conceptual and strategic knowledge***

A web-based environment was developed in which high school students receive feedback while working their assignments about radiation and radioactivity. The tool provides feedback at multiple levels. The first level of *hints* provides feedback at a conceptual level. The second level of feedback gives them the opportunity to learn from worked examples and the third feedback level focuses the attention of students towards one of the known preconceptions.

The first level of feedback is available for students during problem solving. It consists of hints which students can choose to use if they feel their conceptual knowledge falls short. A second type of feedback gives assistance in developing problem solving schemes. It is available after students have answered their assignment. Students have to compare their answer with a worked example and indicate which part of the assignment they made was correct and what type of mistakes they made.

Finally, the last level of feedback is a multiple choice question. Students have to answer one multiple choice question related to the assignment. This question aims to focus the student to the crucial point of the assignment: one of the known preconceptions.

The enhancements in both conceptual and strategic knowledge is analysed using pre- and post-tests. The use of the feedback is measured by capturing all mouse-clicks of the students and by a survey, asking the students about the use of the software.

#### ***5 Preliminary results***

During the presentation an overview of the preconceptions, found in both literature and during semi-structured interviews, will be given. The web-based environment will be presented and the first results of a study using this web-based environment will be shown. This study focuses on how the students use the offered feedback and how their conceptual knowledge improves as a result of the use of the digital environment.

#### **References**

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