

"Physics In Medical Diagnosis" A New Physics Unit for High Schools Development, Implementation and Evaluation

Thesis for the Degree DOCTOR of PHILOSOPHY

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Abstract

The project described here consisted the of development, implementation and evaluation of a new teaching unit: "Physics in Medical Diagnosis."

This unit is offered as an optional topic for high school students who major in physics.

The unit presents the principles of three medical imaging techniques as examples of non-destructive testing, applied in the realm of medical diagnosis. The methods presented have one guiding principle: the distribution of energy after interaction with the object one needs to "see". The three methods employ transmission (x-rays), tracing (radioactive tracers) and reflection (ultrasound.)

The unit also deals with the limitations of each method, while treating the physical restrictions imposed on the various methods, technological drawbacks and safety considerations.

A special chapter is devoted to the topic of biological effects of ionizing radiation.

During their study, students participated in a guided visit to a hospital.

A teacher's guide was prepared and in-service teacher courses were held to train teachers in teaching the new unit.

The unit was tried out in 15 12th grade classes during a period of three academic years (1983-1985). The unit was evaluated, using a variety of measurements, both cognitive and affective. Whenever relevant, the experimental group was compared with a corresponding control group which did not study the unit.

The results of the evaluation revealed that the new unit was implemented successfully, and was integrated well into the existing physics program – both in depth and in scope. Students achievements in the unit and in the part of the matriculation examination on Medical Physics were relatively high, and in correlation with their achievements in other topics in physics.

The textbook was found to be adequate for students who choose the scientific stream, and the teaching aids developed for the unit were found to be helpful.

The teacher's guide was evaluated by the teachers as clear and sufficient.

The visit to the hospital helped to demonstrate and clarify the subjects taught in the classroom and contributed to the special emphasis of this unit on practical applications.

This new unit was evaluated by the students as the most interesting topic taught in their physics program. Students attributed this interest to the relevance of the subject to everyday life.

The study of the biological aspects of ionizing radiation left a particularly high impression, and many students mentioned this subject as valuable information which they can share with their acquaintances.

A pre/post study shows that learning the unit led to significant changes in the way students perceived the energetic phenomena dealt with in the unit. Such changes occurred in two dimensions: the perception of the utility of the phenomena, and the danger attributed to them. After the study, the phenomena were regarded as more useful than before. With regard to danger attributed to ionizing radiation, we found that extreme opinions were moderated and the range of opinions was diversified.

Students who studied the unit were able to apply a non-destructive testing method, dealt with the unit, to a practical problem outside the realm of medicine, and to adjust the method so it would correspond to the new problem they encountered.

In view of students' high interest in the subject, and the variety of research findings, we recommend that applied interdisciplinary subjects with relevance to everyday life will be integrated into the teaching sequence at all stages of high school physics.