Boekbespreking

Radiation and risk in physics education

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Paradigmatic research

There is certainly no risk involved in studying this book. The approach of harnessing multiple empirical studies to investigate key aspects of curriculum work on radioactivity, radiation and risk assessment is paradigmatic. A study of this paradigmatic research is a must for people who intend to design curricula in the field of radioactivity and it is also most valuable for curriculum developers in other fields. The empirical findings on radiation and risk will also be a valuable starting point for curriculum work in cultural contexts which are different from the Dutch context on which the presented findings rest. For those who are not interested in the specific topic of radiation the research methods and the way they are employed to investigate a multiplicity of important facets may be a model for their work. In the field of radiation and risk the work of the group at the Centre for Mathematics and Science Education of the University of Utrecht as presented in the book discussed here is unique. In general, the number of studies investigating a comparable variety of factors which are important in curriculum development is rather small.

The research studies discussed here are a follow up of a curriculum unit of the Dutch Physics Curriculum Project PLON on "Ioniserende Straling" (PLON, 1984). This unit has received much attention and interest and is undoubtedly one of the key units of the young STS (Science-Technology-Society) movement in science and technology education. That the studies provide empirical props for the many good ideas and the high amount of commitment in the field of STS speaks in their favor. Further, they bring together two of the main fields of research and development activities in contemporary science education, namely

the above mentioned STS movement and research on students' (alternative) conceptions.

A brief sketch of the studies presented

It is, of course, beyond the scope of this report to provide a critical overview of research methods and results in a comprehensive manner. In the following I shall therefore restrict myself to some remarks which will hopefully encourage interested people to study it.

Delphi study among radiation experts. 55 radiation experts were approached to establish a list of themes for a curriculum on radioactivity, radiation and risk assessment and the context in which these themes should be dealt with. The resulting list is in my view a strong indication of the value of this method.

Lay ideas about radioactivity, radiation and risk. Newspapers mirror lay ideas and they undoubtedly also deeply influence and form them. An analysis of the way in which newspapers report on topics dealt with in science education has often been a valuable source of background knowledge for curriculum development. Information gained from an analysis of the press's treatment of the issue of radiation and risk and from an analysis of students' preinstructional conceptions in this field (as reported in literature) was summarized and presented to the radiation experts of the afore mentioned delphi study to comment on. In my view this is an interesting and valuable way of using the framework a delphi study provides.

Students' ideas and conceptions. A questionnaire was given to some 300 students about six month after the Chernobyl catastrophe. As the students had had no formal schooling about the topic of radioactivity and risk they mainly employed "lay ideas" to make sense of Chernobyl issues to the exclusion of scientifically sound ones. Interviews carried out about a year later also investigated students' conceptions on radioactivity and risk beyond the Chernobyl context, i.e. in contexts like medical applications and radioactive waste. It is interesting to see both ideas which appear to be very context bound and ideas of a broader scope which are employed independent of contexts. It is also notable that many students' responses are of a "commonsense" and not of a "scientific reasoning type". A study on the persistence of "lay ideas" was also carried out. Students who followed the mentioned PLON unit and more traditional curricula

were compared. It is noteworthy that the persistence of lay ideas is a very prevalent aspect. Many studies in many other fields of science have also led to this "sad" conclusion. Where differences between PLON students and non-PLON students are concerned the results are not very convincing. There are some differences but in the main they are neither statistically nor pedagogically significant. Reasons discussed by the author are somewhat speculative. More research on this would be most valuable, but it is only fair to say that there is a considerable number of studies available now where the results are also not significantly in favor of new approaches specifically designed e.g. to promote conceptual change in a certain field.

Schoolbook analysis. Two results of this study appear to be of general interest. Firstly, in the text-books analysed some lay ideas "survived", but their number is rather small. Nevertheless, this finding indicates that even school-book authors are not always able to completely free themselves from the ideas of public culture as presented, for instance, in the mass media. Secondly, the definitions given in the text-books e.g. for radio-activity and half-life-time were substantially different. Five different definitions for the concept of half-life-time which appears to be a well defined science concept, for instance, were given. It would be most interesting to carry out similar studies aimed at other concepts. If the results were similar to those presented in the study discussed here, there would be another piece of firm empirical evidence to confirm science educators' doubts concerning the value of definitions given in science classes.

Evaluation of the PLON unit. Seven teachers who taught the PLON unit on ionizing radiation were interviewed about their experiences in classroom practice and one teacher's series of lessons was observed and videotaped. A critical examination of the unit resulted which will be of help when designing a new version.

Concluding remarks

Naturally, nothing is perfect. The methods employed in the studies do have their limitations, but the author discusses most of these limitations in very great detail. Where aspects beyond what has been investigated are concerned it would be worth-

while to integrate students' interests and attitudes in a more formal way.

As the book discussed here is a doctoral thesis and hence must meet academic standards, it appears to be well suited to science educators, i.e. to researchers and curriculum developers. Interested teachers may also acquire background knowledge which will help them when teaching about the subject f radio-activity. The author states that the research carried out will result in a new version of a curriculum unit on radioactivity and risk assessment. We look forward both to another paradigmatic unit and to a summary of the research presented in the book discussed which is also accessible to the teachers who do not have the time and energy to deal with more formal research reports such as the one discussed here.

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