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ANTTI LAHERTO, 2012

Nanoscience education for scientific literacy: Opportunities and challenges in secondary school and in out-of-school settings

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Abstract

A need for education in the emerging fields of nanoscience and nanotechnology (NST) has been recognized throughout the world not only at the academic level but also in terms of citizens' abilities to deal with personal, social and global issues related to NST. This doctoral dissertation lays research-based groundwork for the future development of learning environments on NST. The aim was to map the educational needs, possibilities and challenges of bringing the topics of NST to secondary schools and out-of-school settings. To this end, the methodological framework of the Model of Educational Reconstruction and a pragmatist multi-method approach was employed to scrutinize NST from diverse educational viewpoints.

The role of NST in scientific literacy was first explored through a theoretical-analytical study on the content structure, the nature and the implications of NST. Next, a group of secondary school teachers who had attended a course on NST was invited to evaluate the educational significance of the field's contents and their appropriateness for the curriculum. Another survey addressed Finnish teachers' views on barriers that hinder incorporating NST into the curriculum, and facilitators for overcoming these barriers. Specific challenges in learning and communicating NST were investigated through a literature review that was subsequently complemented with an interview study on science centre visitors' perspectives on NST.

Both theoretical and empirical analyses identified several content areas as well as social and epistemological aspects of NST that render the field educationally interesting and relevant to scientific literacy. The results imply that, by addressing NST, science education could stimulate dialogue on important contemporary issues in the intersection of science, technology and society, and provide up-to-date views on the nature of science. However, the teachers also pointed out a number of difficulties in arranging instruction on NST in practice. It is concluded that NST would be best incorporated in the curriculum as a transdisciplinary theme. The field has, in addition, a potential to integrate traditional science subjects and approaches by shifting the focus to the scale of natural phenomena. In any case, including NST in science classes also requires in-service teacher training and new resources for materials and equipment.

Some of the identified barriers for teaching NST may be circumvented by out-of-school methods. This dissertation suggests research-based models for the development of two specific learning environments: exhibitions in science museums and school group visits to industrial sites. The models strive to bridge the notorious gap between academic research and the development of educational practice. Their applications to NST education are discussed. Furthermore, some methodological issues are raised because this research also explored the potential of the Model of Educational Reconstruction in informal and out-of-school contexts.

Language: English

Report Series in Physics HU-P-D194 (ISSN 0356-0961)

ISBN 978-952-10-7090-7 (printed version), ISBN 978-952-10-7091-4 (pdf version)

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Download: <http://urn.fi/URN:ISBN:978-952-10-7091-4>