Science Education in a Nordic Welfare State

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Abstract. The problems related to science education in a small Welfare State such as Denmark are of a very different character and of a very different scope than those faced by many developing countries. In this paper I will try to describe the current situation for science education in Denmark based on my reading of different articles in educational magazines and material presented to the Danish parliament by the Danish ministry of Education. Science education in Denmark suffers not from the lack of funding, but from the lack of students seeking technical and scientific studies.

1. Introduction

The history of science in Denmark is long and interesting and astronomy is no exception. In the 16th century the Danish Astronomer Tycho Brahe was the first to see a supernova (stella nova) in the Galaxy since the supernova seen by the chinese in 1054. More importantly he performed the very precise astrometric observations of the planets that later allowed his coworker Johannes Kepler to derive his famous three laws for the movements of the planets. Later in the 17th century another Danish astronomer, Ole Rømer from Århus, was the first to measure the speed of light by observing how Io, the largest moon of Jupiter, appears 22 minutes later when the earth and Jupiter are at their maximal distance than when they to are at their minimal distance. He called this 'the hesitation of light'. In the first half of this century Danish astronomy was put on the map by Ejnar Hertzsprung and Bengt Strömgren who both did very important work in stellar astronomy and astrophysics.

I will not elaborate further on the past, but only notice that already at the time of Tycho Brahe, astronomy was a highly international science that required commitment and sacrifice. At the age of 16 he went to university in Leipzig, at the age of 19 to Wittenberg and Rostock, and to Basel at the age of 22. However later, when he was established as a royal astronomer with tenure, he was very fortunate to receive about 2% of the gross national product for his astronomical research.

2. The current situation in Science Education in Denmark

Unlike the problems presented in many of the papers presented in these proceedings the problems in Denmark are not mainly related to limited funds. Still the current situation of Science Education in Denmark must be described as a *crisis*. The problem in Denmark, as in several other countries in the so called western world, is not the lack of funding, but rather the lack of new students choosing physics in high school and later the technical or scientific studies at university. Physics has limited prestige.

Before I describe the problems in more detail I will very briefly describe the educational system in Denmark. Children start in primary school at the age of 6 and go to primary school for 10 years. After that there is an optional 11th year. Physics and chemistry was up till recently taught from the 7th grade. After primary school students can either study at technical schools, technical gymnasiums or gymnasiums for 3–4 years. In gymnasium students can attend courses at three levels A, B and C. Finally students can obtain bachelor degrees (3 years), master degrees (5 years) or PhDs (8 years) at universities.

2.1. What is the problem?

The following will mainly be based on a report presented to the Danish parliament by the ministry of education in 1996 entitled : "The failing search for the technical and natural sciences" (my translation) (reference I). Since the mid eighties the number of students choosing physics in gymnasium has dropped steadily. During the 16 years from 1980 to 1995 the number of students studying mathematics at A-level in gymnasium has increased from 5000 in 1980 to 8200 in 1996. However, the number of students studying physics at A-level has dropped from 5000 in 1980 to a little less than 1900 in 1996. The number of students beginning a physics/chemistry study at university has dropped the last 5 years by more than 25% even though the number of students starting university studies has increased in the same period. In the natural sciences as a whole, the number of new students has been fairly stable, and for the "soft" natural sciences such as biology the number of students has even increased. Only the "hard" natural sciences such as physics have a problem. A perhaps related problem is the very low percentage of women in physics. Personally I do not believe that this has anything to do with subtle barriers or discrimination. The female percentage in biology is 50% for all practical purposes. More likely the low female percentage in physics is related to the general low prestige that physics suffers from at the moment. There tend to be fewer female "nerds" than male ones.

2.2. What is the reason behind the problem?

The speculations about the possible reasons behind the lack of interest in physics are numerous. The January 1996 version of the Danish educational magazine 'Uddannelse' (Education, reference II) was dedicated to this debate. The headline of the issue was 'The two Cultures - Natural Science in Education' (my translation) and the field of the authors range from linguistics to physics. Several of the authors refer to the book by C.P. Snow : "The Two Cultures and the Scientific Revolution' that counterposes the humanist and the natural sciences. According to Snow the humanist sciences tend to look backwards into the past, whereas, the natural sciences look forward into the future. Furthermore the humanist sciences are seen as 'soft' and irrational, whereas, the natural sciences are seen as 'hard' and rational. There is no doubt that these stereotypes are valid to some extent, and for some reason todays student prefers the humanist culture to the natural science one. A main issue must be to break down these stereotypes. A linguist suggests that the current lack of interest in physics derives from a general distrust in man's interference with nature, which steams from the mainly humanistic revolt in 1968. The natural sciences were seen as the cause of the ecological crisis and the alienation of man from nature. Other authors find either science teaching in primary schools too abstract and unappealling to children, or, that the language used by scientists is unneccesarily difficult to understand and hence a barrier for the stimulation of interest. The truth is likely to be a combination of all these problems.

2.3. What is being done to solve the problem?

Several projects have been initiated to stimulate more interest in the natural sciences. A new course called 'Nature and Technique' has been introduced in Primary Schools from grades 1 to 6. In this course the pupils are introduced to nature and techniques in a few areas that are intended to be closely related to thier everyday lives. In high school a project called 'Physics in Perspective' has been started, in which scientists produce teaching material about their own research. Furthermore many internet-pages and CD-ROMs with information for high school students have been produced at universities. Finally, the general structure of the natural scientific studies at university has been subject to a study and a new special 3-year bachelor degree in science teaching has been opened.

3. Final Remarks

Physiscs (and astronomy) in Denmark suffers not from the lack of funds, but from failing interest. The situation has gradually become worse during the last 15 years, and recently different projects have been put forward to stimulate further interest. The effects of these projects remain to be seen.

The bottomline, I think is, that we as scientists (students, post-docs, with tenure or whitout) need to engage ourselves in the public debate. We need to be visual in society and take active part in defining what is culture. We have to make clear to the public and to ourselves why we still have to study the skies and more broadly to study nature in the search for knowledge about the universe we are part of, otherwise we will not only lose the main source for new ideas and insights, namely new young scientists, but also not be truly man, but like the mute creations without culture. I finish with a few lines from 'Metamorphoses', where Ovid beautifully describes the nature of man (reference III) :

Thus, while the mute creation downward bend
Their sight, and to their earthly mother tend,
Man looks aloft; and with erected eyes
Beholds his own hereditary skies.
From such rude principles our form began;
And earth was metamorphos'd into Man.

References

I) 'Den svigtende søgning til tekniske og naturvidenskabelige fag', Review presented to the Danish parliament by the ministry of Education (1997) (available at http://www.uvm.dk/gammel/udd1-96.htm)

II) 'Uddannelse', January 1996, published by the Danish ministry of Education (available at http://www.uvm.dk/gammel/svigt.htm)

III) Ovid's 'Metamorphoses', the last six verses from the 1. book : 'The Creation of the World'