Physics in Context

Alf Olme, a teacher at the Peder Skrivares Gymnasium in Varberg, Sweden, concludes that is unclear who will decide the amount of physics in context which should be taught in secondary schools. His remarks, based on a survey of trends in Denmark, England, Wales, Finland, Hungary, Norway, Sweden, and The Netherlands, were presented during the symposium *Physics and Education* at the *10th EPS General Conference*. They are thought to reflect the situation in most of Europe. A detailed survey will be carried out in the framework of the European Union-funded European Physics Education Network that got underway during meetings held in conjunction with the conference.

Several major trends have affected secondary schools recently. For instance:
- Many countries have reconstructed their school systems during the last decade.
- A growing number of young people are spending more time in school.
- Students are offered the opportunity to choose the subjects they want to study.
- Mathematics and science are not always the most attractive subjects for students. This is a problem in many countries since the best opportunities for jobs are in these areas.
- Politicians often say that a high level of mathematics and science education supports economic growth.
- More girls are needed in science education otherwise the unemployment among young women will exceed the corresponding number for men.

Whose Curriculum is It ?

Insofar as physics curricula are concerned, it has often been said that more girls would be attracted to science if curricula were changed and that physics would benefit from the influence or girls. Moreover, there are common trends in physics curricula since the demands are the same throughout Europe and all of us now live much closer together in our "Internet world".

A school curriculum was once essentially a description of the content of a course (the syllabus). Curricula today give much more attention to how physics is studied, the scientific method, connections to every day life, the contribution to the development of the student's view of the world, experimental skills, scientific literacy, communication skills, *etc.* For example, in Hungary [1]:

"The aim of physics teaching in high schools is to contribute to the development of the student's personality and to the formation of a world view by helping a student understand the basic laws of motion and by activities during the learning process. To realize this objective, physics teaching must fulfil the following goals:
- *to reveal and offer practical work in the basic methods of physical cognition, to develop theoretical and practical skills, thereby contributing to establishing general scientific literacy;*
- *to assist the cognition of the basic structure of matter and its properties in relation to structure;*
- *to enable the students to orientate themselves in the physical and technical environment, to understand and interpret physical and technical phenomena, to apply consciously the physical principles manifested in them, to acquire further technical knowledge;*
- *to demonstrate the economic and social significance of physics and the sciences in general through examples of practical application;*
- *to assist education in citizenry, mainly by demonstrating the progress of understanding in the history of physics, by introducing the institutions of national and international significance;*
- *to develop interest in further independent studies in physics, science and technology;*
- *to offer a firm foundation to students to continue their studies in higher education."*

In some countries educational authorities have even reached the point of saying that the curriculum does not need any syllabus content ! For instance, the Finnish curriculum [2] states that:

"School-based curriculum work is the main instrument for developing education in municipalities. The teacher is increasingly a developer of his/her work. The school community has a main role in utilizing its own strengths. The teachers personal involvement in the construction of curricula is the main instrument for any real change and development."

The Finnish curriculum for physics comprises eight different courses and only the first course *Physics as Natural Science* is obligatory. The various courses are described very briefly in the curriculum. In the study of electricity, for instance, the teacher is guided by the following:

"Electricity: Students strengthen their knowledge of phenomena, concepts and the technology connected with electricity. They study different electric circuits, measurement techniques and safety regulations."

As a contrast here is part of a syllabus description of gases and heat from The Netherlands (it is also described in words in the syllabus):

$p = m/V$ $\qquad p = F/A$

$T = t + 273$ (t in °C) $\qquad pV/T = nR$

Most curricula appear to describe the syllabus. The reason for this is obvious. It is a guarantee that the students have a common foundation for their studies in higher education. There are of course other ways to establish a common syllabus. It could be done by national exams, formula sheets and old tests, but these do not represent an official curriculum and cannot be trusted.

Opinions differ about the teacher's freedom to interpret the curriculum. It seems to be a Scandinavian trend not to be too precise, and there have been instructions to curriculum writers in this direction. By contrast, the National Institute for Curriculum Development (SLO) in The Netherlands states that [3]:

"To support the introduction of the new curriculum the SLO coordinates the writing of the curriculum documents in which the results of educational research are written up for textbook writers, teacher trainers and teachers ..... It is hoped that in this way results from the field of science education research will be incorporated in text-

Alf Olme, on the left, speaking during the *Physics and Education* symposium at EPS-10. John Lewis, the EPS Treasurer, is seen on the right demonstrating a chain reaction using arrays of matchsticks.

books, teacher training and teaching."

So the questions that need addressing today are: What is the best way to reform physics teaching ? Whose curriculum is going to be taught – that of the teacher or that of the National Board of Education?

Time for Physics in Context

It is an obvious trend in all curricula to emphasize the teaching of physics in context, namely the situations to which the physics should be related. In the Danish curriculum, this is expressed by means of dimensions like "everyday life", "world view", "physics in history and philosophy", and "technology and society". No one objects to this trend. If there is a problem it is a problem of time. Discussing physics in context and exercising communication skills takes time. Where will we find this time? It could perhaps be found by diminishing the numerical solutions of theoretical problems – an activity which has a strong tradition in physics teaching. Maybe, like the proverb says, *"It's easier to adapt new ideas than to abandon old ones".*

Teachers need help and ideas if we are to realize the intentions of the new curricula. In The Netherlands, a new magazine called *Exaktueel* which offers physics exercises related to newspaper articles has been very popular among teachers. The proportions of physics in context and "science physics" in the curricula are often reviewed. Henry Nielsen from the University of Aarhus has described the discussion as a cruise between the greedy, scientific Scylla and the diffuse, general Charybdis [4].

More generally, teachers are finding it difficult to meet the demands of the new curricula. We need well-educated and devoted teachers, requirements that might be hard to meet because the image of the teaching profession has suffered during the last decade. There are many job opportunities outside education for physics graduates and teachers' salaries are not competitive. We have good physics curricula in most countries but one has to be pessimistic about the supply of secondary school teachers.

References

[1] I. Wakwaku, *Proc. Japanese – Hungarian Physics Teacher Meeting* (1992).
[2] *Framework curriculum for the secondary school*, National Board of Education, Finland (1994).
[3] H. Eijkelhof, *Phys. Education* **27** (1992) 315.
[4] *Undervisning i fysik – den konstruktivistiske idé*; Gyldendal, Denmark (1992).