

## Physics education in the European Physical Society

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### Introduction

My task today is to give you an account of the activities in physics education of the European Physical Society (EPS), mainly through the Division on Education and its two sections, University and Pre-university.

The present structure of EPS concerning education is of rather recent origin. The other nine EPS Divisions are specialized in various branches of physics research: Astrophysics, Atomic & Molecular Physics, Condensed Matter, High Energy & Particle Physics, etc. In addition to the Divisions there are six so-called Interdivisional groups with a more general character; some examples are Accelerators, Computational Physics, History of Physics and Physics for Development. From the beginning, less than 10 years ago, physics education was assigned to an Interdivisional group in EPS. However, it was considered a step forward for the topic, to bring education issues more into focus, when our activities were allowed to constitute a Division of its own. This happened in the year 2000.

From the beginning it was decided to split the Division into two sections, one for University and one for Pre-university, or school, physics education. The structure also contained so-called Presidential representatives, to be appointed by the Presidents of each of the 38 National physical societies belonging to EPS. The thought was to have efficient contacts for communication in physics education issues between the two section boards and the National societies. However, it must be said in all honesty that, so far, it has been quite difficult to establish these contacts for reasons which are not well understood.

### University section

The section dealing with university physics education is chaired by Professor Urbaan Titulaer from Johannes Kepler University Linz, Austria. During the few years this section has existed, perhaps the most important activity has been an inquiry among physics education experts in different countries. The results were published by one of the board members, Michael Vollmer from Brandenburg, Germany, under the title *Physics teacher training and research in physics education: results of an inquiry by the European Physical Society* [1]. The investigation concerned both teacher training and physics education research across Europe. In the chapter Discussion (pp. 140-143) an excellent summary of the findings is given.

One rather discouraging result of the analysis is the very low interest in physics education research as expressed by the involved persons. The different possible reasons for this indifference are very well described in the above-mentioned Discussion chapter. One could be the fact that physicists working in the field of education have many diverse duties, making it difficult for them to concentrate on their area of expertise. When they publish they often do so in domestic journals which become known to a limited group of readers. Another reason is that it is often difficult to obtain research grants for educational issues. The applications concerning physics education always seem to be placed in lower priority than those of colleagues working in basic or applied physics research. The above-mentioned publishing policy might be one of the reasons for this.

A consequence of this situation could be the observation made by Vollmer that the contacts between ordinary physics researchers, in basic or applied fields, and physics education representatives are poor

or even non-existent. There is a mistrust in the sense that the former group has little knowledge of what the latter are doing, and, in particular, of the usefulness of their work.

This particular feature was also evident from the results of an evaluation of several European physics departments. The report of this evaluation was published in 2001 by the ZEvA agency under the title *Cross Border Quality Assessment in Physics* [2]. Not only did we find academic physics teachers little aware of the activities in the field of education research, but they were also uncertain about the value of such work. In fact, in this evaluation the gap was very visible between representatives of research, teaching and didactic work in physics. The EPS inquiry corroborated this finding as well as the results of one of the early working groups of EUPEN on physics education research [3].

It seems that "ordinary" physics researchers/teachers think of education researchers more as colleagues who might advise and serve them with hints of how to improve the efficiency of teaching, not as researchers in a field of their own. The common feeling given to us in the evaluation group was that if you are a good researcher you are automatically also a good teacher. Another belief was that if you had been the student of somebody who was known as a good teacher you would not need any more knowledge about teaching in your later life as a university teacher. There is definitely an unnecessary gap between the different categories, physics researchers, teachers and physics education researchers. A lot of efforts must go into bridging this gap!

A series of workshops *Multimedia in Physics Teaching and Learning* has been another concern for the University Section.

The series was started by one of the members of the Section board, professor Jodl from Kaiserslautern, Germany. The 7th workshop in the series will take place in September of this year in Prague, Czech Republic. Evidently the issue for discussion here is a very important one, also for your own considerations. Research in this area has been going on for some time already.

In a recent article [4] Peter Gustafsson, from Mälardalen University in Sweden, reports on some general results of a study of *Physics teaching at a distance*. His conclusions may be surprising: even in a subject like physics where experimentation is an integral part of the student's work, distance teaching seems to be reasonable, as long as the student is willing to do some experimental work at home. If you look at it from another point of view one might argue that the sharing of excellency in teaching would be made much easier using multimedia -a first class course given anywhere in the world can easily be transferred to other lecture rooms, or even to the student's living quarter.

## **Pre-university section**

In a sense the Pre-university section is a forerunner of the whole EPS Division on Education. Together with EUPEN, the European Physics Education Network, and EMSPS, the European Mobility Scheme for Physics Students, a unit called EPS Forum on Education was established in the mid 1990s. Those three units made up what was then called the Interdivisional Group on Education during the years before the Division was formed [5]. The Forum, like the present Pre-university section, mostly dealt with school physics. The other two units were rather soon separated from EPS in the administrative sense.

In the first year of its existence the Forum made an inventory concerning the percentage of teachers in the National physical societies [6]. It turned out that there were huge differences. Whereas the French Physical Society had less than one percent teachers, the Portuguese percentage was close to 70! It is clear that this would have a great influence on the interest in school physics issues in the different national societies.

The end of the Forum and the birth of the Division are firmly connected with a very important meeting, organised by the physics education Nestor and former treasurer of EPS, John Lewis, at Malvern, England, in September 1999. The title of this meeting, *Securing the future of physics*, was a brave one, and the ambitions were high [7]. Over two thirds of the European National physical societies were represented by their presidents. Five working groups were set up among the 70 delegates. They tackled various issues, among them physics education. As background it was stated that "in many European countries there is a need to update the physics curriculum in schools, that there is a serious shortage of physics teachers, and fewer young people are enrolling for physics and

engineering courses in higher education". This sounds like the description of a crisis which may still exist!

The five working groups had the following themes:

- a) Physics and the human condition,
- b) The case for research -physics and wealth creation,
- c) Public awareness of physics,
- d) Physics education, and
- e) Teacher training.

In the Physics education working group recommendations were made concerning the curricula for different ages up to the last year before the university. For the lower grades the concept "*Wonder and Delight*" should be emphasized in an integrated science curriculum. Only in the last three or four years should one diversify and if possible also include some "modern" physics at the expense of more traditional elements. In addition the importance of "key skills, such as communication, information technology literacy and team work" were mentioned as very relevant.

As one of the initiators of the Forum I became the chairman of the Pre-university section. A year ago I represented the section in a new meeting called "*Physics Education: a European Confrontation*". Jacques Treiner of the French Physical Society was the main organiser. Delegates from 23 European countries attended.

One result of this meeting was a decision to survey European school systems with regard to physics curricula. We do not expect to find great differences but it is hoped that we could learn from each other with respect to the contents and also the order in which different elements come in. Do we have to wait so long with introducing "modern" physics that there is almost no school time left? Could it be done earlier, and at which expense? How do we establish contact with research institutions in order to prepare the pupils adequately? How do we give all pupils some knowledge of physics, so that they are able to understand various problems in society and participate in their solution?

The Pre-university section has endorsed several other activities pertaining to school physics. Some examples will be given here.

1) Biographical posters of famous physicists to be distributed in schools have been produced in the United Kingdom, on the initiative of a former EPS President, Sir Arnold Wolfendale. More information can be found on the web [8]. In our section we encourage the National physical societies to translate the texts into the domestic languages, if necessary, and distribute the posters in schools.

2) Our division participates in an advisory and supporting role in the event Physics on Stage, a physics teacher oriented annual activity sponsored by the large research organisations, comprising the administrative unit EIROFORUM. The third manifestation of this type will take place this year at Noordwijk, The Netherlands. Participating European countries normally have web pages to describe their different involvement. One suggestion, from the German delegation, has been to stage a performance of a phase of the physics competition, International Young Physicists' Tournament described below, at the next Physics on Stage event.

3) Physics competitions have a long history, worldwide. The best known event, the Physics Olympiad, is an individual competition where many physicists have participated during their school years. In 2003 the 34th Olympiad will be held in Taipei, Taiwan. Another physics competition which I know much more about is called IYPT, International Young Physicists' Tournament [9]. In this event teams of five pupils, normally from the last pre-university grade, compete by reporting on their solutions to 17 "open" physics problems which have been published about six months in advance. This year the 16th IYPT was organised in Uppsala, Sweden during the first week of July. There were 23 teams from 22 countries present. New in the competition for this year were teams from Indonesia, New Zealand and the United Kingdom.

In each of five qualifying rounds three teams compete in the following way. One of the teams reports on their solution to a problem challenged by an opponent team. After having presented the solution the reporter enters into a discussion with the opponent who will bring up the appropriateness of the solution, possible flaws etc. The third team comments on the action of the other two. The teams change roles during a round so that, after one qualifying competition, they have assumed all three positions. All performances are judged by an internationally composed jury. After the five qualifying rounds the three top teams go to a final round. In Uppsala the final saw the victory of the German team with Korea and Poland as runners up. Next year the 17th IYPT will be held in Australia.

4) Teacher exchanges between different countries have been tried in a pilot project involving Swedish and British school teachers. This would be another way for teachers of getting to know the school systems of other countries. However, it has turned out to be difficult to find suitable exchange partners for a continued project.

For the moment the Pre-university section is collaborating with its sister section in planning for a seminar *Quality development in teacher education and training*, to be held in Udine during the first week of September, 2003. Some outstanding representatives of the field of Physics education research will be present.

## Final remarks

In conclusion I should like to mention a few other international organisations working in the field of physics education. You have already heard about EUPEN, the thematic network financed in part by the European Commission. In ESERA, European Science Education Research Association, not only physics but all natural sciences are represented. It differs from the EPS Division on Education and EUPEN in the sense that for ESERA research is also on the agenda. The same is true for GIREP, Groupe internationale de recherche sur l'enseignement de la physique, or, in English: International Research Group on Physics Teaching. This is the main organiser of the above-mentioned Udine seminar.

I should also like to mention ICPE, the International Commission on Physics Education, one of the commissions of IUPAP, the International Union on Pure and Applied Physics. ICPE has 13 ordinary members from 13 different countries and three associate members. The Commission will meet next time in the Netherlands in August, just after an ESERA conference there. ICPE sponsors conferences on physics education, like the one in July of this year: *Inter-American Conference on Physics Education*, held in Cuba, or the one mentioned on teacher training in Udine in September 2003. Next year ICPE is involved in a conference in Durban, South Africa, with a theme having to do directly with the choice of curricula for physics education: *What physics should we teach?*

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