



EPS Physics Education Division Position Paper on Physics Education

V - July 2012

Effective and inspiring education in all subjects and at all levels – school, university and lifelong – is important to the future of European culture, commerce and industry as well as to scientific research. In this context the Physics Education Division of European Physical Society (EPS PED) has identified effective physics education, as vital to ensuring adequate knowledge and skills for every citizen aspiring to active participation in democratic society, as well as to the supply, training and updating of a wide range of scientists and engineers.

Despite the generally acknowledged importance of physics education, and the special attention paid to it in several European countries, there are a number of points of specific concern that the EPS PED wishes to highlight and draw to general attention.

First, with regard to physics education in schools: EPS PED is concerned that students in all European nations should be engaged in an accurate and useful introduction to physics, as a distinct discipline, by motivated and well-trained teachers. There are divergent views across Europe about the desirability of teaching the different scientific disciplines separately or together as a combined subject. However there is general agreement that it is important for students to properly appreciate the differences in method that characterise the various sciences, particularly at the upper level. The solving of real-world scientific problems often requires a multidisciplinary approach but the strength of that approach frequently arises from the differences between the separate disciplines rather than their similarities. It is for this reason that all those engaged in the teaching of physics, whatever their individual backgrounds, should display a robust understanding of physics knowledge that is broadly-based, authoritative and up-to-date. In particular, school students should appreciate that physics is not a disjoint collection of facts, rules and laws but rather a coherent approach to making sense of the physical world, utilising its resources and solving problems that range from the purely academic to the most pressingly practical. For this to be the case, it is vital that programmes for both the initial and the continuing education of teachers should be capable of attracting students of the highest quality, that they should fully reflect the latest developments in physics education research, educational technology and pedagogical methodology, and that they should be informed by the most recent advances and applications of physics. This emphasis on rigorous evidence, coherence, modernity and relevance should, of course, also be reflected in school curricula, syllabi and teaching specifications, which need constant attention and purposeful refreshment.

Second, with regard to universities: despite the currently buoyant situation regarding the recruitment of physics students, the proportion of students entering and continuing with university-level physics studies had previously been declining for almost two decades. Such a decline threatens the flow of physicists into industry, academic research and teaching, and thereby challenges future technological innovation and science-based economic development. Ensuring that such a decline does not recur calls for a range of ongoing measures but an important element is certain to be an improvement in educational physics. Against this background, EPS PED is concerned to note the relative lack of specialised university-level physics education research groups in Europe and the corresponding absence of a clear career path for those primarily interested in the evidence-based improvement of undergraduate and post-graduate physics education. This situation now puts Europe in sharp contrast to the US, where decades of unbroken support for university-level physics education research by the National Science Foundation and other bodies has produced a highly active university-level physics education research community with clear routes of progression from graduate student to post-doctoral researcher to tenured faculty position, and equally clear impacts on the university curriculum and the methods used in university teaching. EPS PED urges that throughout Europe steps

should be taken by those responsible for the funding of scientific research to ensure that opportunities are created for the establishment and support of high quality university-level physics education research groups with a mission to contribute to evidence-based innovation in the course structures and resources available for physics learning as well as the broader understanding of the nature and role of physics teaching and learning. This is a field of applied physics research in which Europe has demonstrated strength but will need additional programmes of targeted research funding and increased flexibility on the part of many more university physics departments if it is to compete successfully in the international research arena.

Third, with regard to lifelong learning and public outreach; EPS PED is convinced that a proper understanding of physics, including the opportunity to gain insight into the nature and significance of the latest developments and their impacts on society and scientific culture, is a cornerstone of effective European citizenship, an important element of social inclusion, and crucial to meaningful participation in public discourse and decision making. EPS PED encourages those with the knowledge and talent to promote the public understanding of science to do so. It also encourages institutions to support that effort and to help remove whatever barriers stand in its way. Proactive public engagement is essential if informed public support for physics is to be sought and achieved. The EPS PED is particularly aware that many efforts to promote public understanding are limited in their impact by linguistic considerations. Consequently, EPS PED urges the harnessing of resources to enable the best and most effective outreach activities to be publicised throughout Europe and made available to the widest possible part of the European populace. Good ideas can transcend national boundaries even when good words cannot.

In all these concerns, the importance of evidence gathering and interpretation has been stressed. In the domain of primary and secondary education, where much work of this kind is already carried out, the investigative studies by the Programme for International Student Assessment (PISA, Ref 1) may be taken as exemplary. Also worthy of note are the efforts of the Eurydice Network and particularly its Eurypedia (Ref 2) which aims to make available the kind of information on European educational systems and policies that researchers need. At higher levels, initiatives such as the E.C. flagships 'Youth on the Move' (Ref 3) and 'Innovation Union' (Ref 4) provide examples of thoughtful policy development with a potential to promote lasting action with positive educational impact. The EPS PED has had a direct involvement in this domain through the European Mobility Scheme for Physics Students, which started in the 1990s, and continue with its current efforts to support student and staff mobility. Complementing these are the EPS-backed investigations into the implementation and impact of the ongoing Bologna process on physics studies at the Bachelor, Master and Doctoral levels, and the corresponding 'EPS Specifications of University Level Physics Programmes' at the three levels (Ref 5). In relation to outreach and public engagement, the EPS PED is again putting its principles into practice through its Forum Physics and Society, as evidenced by reports such as 'Science Journalism and Scientific Communication' (Ref 6). Recently gathered evidence relating to a range of issues in educational physics may be found in the book 'Teaching Physics in Europe' (Ref 7) produced by the EU funded STEPS TWO project, which, like the EUPEN network that preceded it, has been consistently supported by the EPS. Welcome as this work is, its chief significance may actually be the indication it provides of the vast amount that remains to be done in developing, analysing and utilising a comprehensive, representative and up-to-date account of physics education on a European scale.

Improving the quality of physics education at all levels is vital to the future of Europe; such activity sustains our ability to identify and address problems analytically and to develop solutions through the application of rigorous methodology. The initial and in-service education of teachers is an important part of this, as is the improvement of school curricula and the development and evaluation of new teaching methods. Also important is the improvement of university physics teaching, lifelong learning and outreach to the general public. Underpinning all this is the development of research in physics education, particularly that carried out in physics departments. EPS PED supports all these

efforts and is especially active in helping to promote regular contacts between physics educators at all levels and those working at the frontiers of physics. It encourages others to recognize the importance of its efforts to improve European physics education and invites them to participate in achieving this goal.

References

- 1 Programme for International Student Assessment (PISA): see <http://www.pisa.oecd.org>
- 2 Eurydice: see http://eacea.ec.europa.eu/education/eurydice/index_en.php and follow the link to the Eurypedia
- 3 Youth on the Move: see <http://ec.europa.eu/youthonthemove/>
- 4 Innovation Union: see <http://ec.europa.eu/research/innovation-union>
- 5 EPS Specifications for University Level Physics Studies: see the EPS website http://www.eps.org/?page=studies_reports
- 6 Science Journalism and Scientific Communication: see http://www.eps.org/resource/resmgr/activities/eps_fps_2010_communication.pdf
- 7 Teaching Physics in Europe: Edited by L. Tugulea *et al*, Ars Docendi Press, 2011 ISBN 978-973-558-595-2 and available to download from <http://www.stepstwo.eu> .