Section A “About Physics”

Introduction

Matilde Vicentini, Elena Sassi

Usually in Physics courses at University level, the main attention is generally paid to the communication about concepts, models and theories agreed upon in the scientific community with scarce emphasis about reflecting on the structure of the discipline. It is true that many textbooks have an introductory chapter devoted to the presentation of what science is, sometimes with a synthetic description of the scientific or experimental method, but these aspects are rarely discussed with the students and usually are not taken into account as important ones in the evaluation procedures.

It is also true that students are required to follow some laboratory courses but the proposed rationale focuses more on using already prepared apparatuses and on collecting data to “verify” already studied physics laws. Therefore a person with a degree in Physics has an approximate (and personal) picture of what is an experimental science and has difficulties in connecting the real world phenomena with the concepts, models and theories s/he is supposed to learn, in understanding the role of experimental work and of models in the organization of scientific knowledge.

Today Physics Education Research (PER) is paying particular attention to the students' ideas about the explanation of phenomena and to their “image of science”. It has become urgent and imperative that a correct image of science should be communicated to and discussed with the students in order to frame the disciplinary conceptual aspects in a knowledge net which is not fragmented and which is able to place different information in a meaningful context (as E. Morin has proposed several years ago[1]). Teachers should then be stimulated to reflect on what science is, its role and meaning nowadays, in particular for what concerns the relation between theoretical and experimental aspects, the role of technology in the development of scientific ideas, the possibility of connecting the disciplines in a unified frame, the role of mathematical language.

The very title of this section “About Physics” indicates that its three contributions suggest some reflections on these issues. These papers obviously cannot discuss all facets of such a complex area, but they address key points that sometimes are also not completely agreed upon.

The first essay “Science and commonsense” by Jon Ogborn compares scientific and commonsense knowledge, their differences and similarities. Examples are given in various disciplines (physics, biology. chemistry). The presentation interlaces nature and reasoning of scientific knowledge with those of commonsense knowledge; role and importance of science in the construction of rational ways of thinking; some pitfalls that should be avoided. Finally

[1] Edgar Morin Les sept savoirs nécessaires à l’éducation du futur. Organisation des Nations Unies pour l’éducation, la science et la culture. © UNESCO 1999 http://www.agora21.org/unesco/7savoirs/. Retrieved on 2008, July 18th.
Edgar Morin (2000). Les sept savoirs de l'éducation nécessaires à l'éducation du futur. Paris : Seuil

some implications for the teaching of science are offered as procedural tools to teachers and operators in this field.

The second essay "Mathematics as a structural language of physical thought" by Mauricio Pietrocola takes again as a starting point the comparison between scientific and commonsense knowledge in order to focus on the different languages they use and to point out the importance of Mathematics in the formalization of Physics. Some problems related to the teaching of Mathematics and Physics courses, at University level, are discussed. An historical account of the interplay between the two disciplines is presented, with example viewpoints. A detailed discussion of mathematics as a structural language of Physics offers hints for reflection about regular, scientific, interpretative and formal languages. Some didactical implications are finally presented in order to avoid common pitfalls, as for instance the presentation of Mathematics as a collection of tools useful for learning Physics.

The third essay “Overcoming the Oblivion of Technology in Physics Education” by D. Gil Perez, A. Vilches and C. Ferreira-Gauchia addresses the lack or scarcity of attention paid to technology in the teaching of physics. Technology, in fact, is perceived and lived very differently with respect to Mathematics in the scientific and commonsense culture, in real life and in school activities. In everyday life we are immersed in a world populated by natural and technological objects besides people. We are supposed and sometimes forced to use technological artifacts without the knowledge of the underlying mathematical tools (but, of course, the logic of input-output connections is a must). In the teaching of physics usually few technological artifacts are presented (an example are the refrigerators, still called thermal engines in some textbooks), while the students are asked to immerse in an ocean of mathematical formalism. The essay firstly discusses the misconception and pitfalls of “Technology as applied science” and later the main features of scientific activity. Finally some implications for the teaching of science and physics education, calling attention on the UN resolution on “Decade of Education for Sustainable Development (2005-20014)”.