

Teaching modern physics in secondary school

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The physics of the last century is now included in all EU curricula and in the last 10 years appear in all secondary textbooks, even if in not organic way. Although there are very different position as concern its introduction: conceptual knots in classical physics are quoted to argue the exclusion of modern physics in secondary school. Discussions are on goals, rationale, contents, instruments and methods, target students. The different proposals are relative to different goals: the culture of citizens, popularization, guidance, education. As concern what is considered useful to treat are considered: fundament, technologies and applications. Methods are: story telling of the main results, argumentation of crucial problems, integrated or as a complementary part in the curriculum. Modern physics in secondary school is a challenge which involves the possibility to transfer to the future generations a culture in which physics is an integrated part, not a marginal one involves curriculum innovation, teacher education and physics education research in a way that allows the students to manage them in moments of organized analysis, in everyday life, in social decisions. This innovation of curriculum outlines the request for new formative modalities, requires a school in which modern physics is presented as a cultural object that the teacher offers to the students not so much for them to be reproduced, but most of all, for them to be used in a creative way to face the interpretative problems as a competence in many contexts. For this scope it is necessary to undertake a revision of the contents and methods in school activities. Disciplinary knowledge should NOT be seen as static and definite, but in a progressive and continuous evolution, without split the product from its process, with a tight correlation between the many dimensions of knowledge. Disciplines have to become “maps”: conceptual ones for understanding and organizational ones for a guidance in the interpretation of experience. In this perspective modern physics is an integrated content in curricula. Our research focus is the building of formal thinking on 3 directions: 1) Learning processes and role of reasoning in operative hands-on and minds-on to interpret phenomena; 2) object - models as tools to bridge common sense to physics ideas and ICT contribution focusing on real time labs and modelling; 3) building theoretical way of thinking: a path inspired of Dirac approach to quantum mechanics. From our research in physics education some different proposals for the modern physics are: 1) The physics in modern research analysis technics: Resistivity and Hall Effect, Rutherford Backscattering Spectroscopy, Time Resolved Resistivity; 2) Explorative approach to superconductivity (a coherent paths), 3) Discussion of some crucial / transversal concepts both in classical physics and modern physics: state, measure, cross section, 4) Foundation of theoretical thinking: quantum mechanics.

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