Research in Didactics of the Sciences

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Małgorzata Nodzyńska
Jan Rajmund Paśko

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Report on the International Science Education Studies in Europe

Józefina Turło

Institute of Physics, Nicolaus Copernicus University, Toruń, PL

jturlo@fizyka.umk.pl

Abstract

The students' interest in science and technical subjects decreased dramatically in whole Europe during the recent years. Why is this? To answer this question the Nuffield Foundation decided to examine the actual state of arts in science education in Europe and appointed for that a special Committee consisting of representatives from different European countries, dealing with science education and teachers training, under the supervision of Prof. Jonathan Osborne and Dr. Justin Dillon from King's College, London. A Report to the Nuffield Foundation on: Science Education in Europe: Critical Reflections has been published. The main messages of this report are: There are shortcomings in curriculum, pedagogy, assessment and teachers' competencies and there is evidence, that education is also failing in providing a route into science for future scientists. So, in this paper some recommendations and conclusions elaborated by the experienced European team of science educators are described and discussed from the Polish education point of view.

Keywords: Science education, Nuffield Foundation, diagnosis, Europe, recommendations

Introduction

It is well known that students' interest in science and technical subjects is decreasing dramatically in whole Europe nowadays [1-3]. Anyone can ask: Why is this? To explore this question the Nuffield Foundation organised two seminars in London in 2006 involving 19 science educators, representatives of different European institutions and EC from nine European countries, namely: Prof. Costas Constantinou (Cyprus), Prof. Jens Dolin (Denmark), Prof.Harrie Eijkelhof (The Netherland), Prof. Maria Pilar Jimenez Aleixandre (Spain), Prof. Doris Jorde (Norvay), Prof. Robin Millar (UK), Dr. Andrew Moore (European Molecular Biology Organisation), Ms Laura Lausilito (EC DG Research), Prof. María Sáez Brezmes (Spain), Mrs Ana Serrodor (EC DG Research), Dr. Camilla Schreiner (Norvay), Prof. Svein Sjoberg (Norvay), Prof. Andrée Tiberghien (France), Mr Anthony Tomei (UK), Dr. Józefina Turlo (Poland), Dr. Jan Van Driel (The Netherland), Prof. Claudia von Aufschnaiter (Germany). The team was working under the supervision of Prof. Jonathan Osborne and Dr. Justin Dillon, the most experienced researches from King's College, London (UK). The seminars investigated the extent to which the issues concerned with education are common across Europe, the similarities and differences between countries, and some attempted solutions and remedies.

As the result in 2008 a Report to the Nuffield Foundation on: Science Education in Europe: Critical Reflections has been published [4]. The foreword to the report has been written by Mr Anthony Tomei - the Director of Nuffield Foundation. He started with the question: Why study science? *Science is an important component of our European cultural heritage. It provides the most important explanations we have of the material world. In addition, some understanding of the practices and processes of science is essential to engage with many of the issues confronting contemporary society.* But, as science is so important, why still less students seem to be interested in science and technical subjects? *Does the problem lie in wider socio-cultural changes, and the ways in which young people in developed countries now live and wish to shape their lives? Or is it due to failings within science education itself?* To answer these questions the Nuffield Foundation took a decision to examine the actual state of arts in science education in Europe and to put some important recommendation directed to the National Ministers of Education, scientists, politicians and People responsible for education in EU countries. But, the results of these studies were first presented and discussed during the International ESERA Conference in 2007 in Sweden.

The main messages of the report are: There are shortcomings in curriculum, pedagogy, assessment and science teacher competencies, and there is evidence, that education is also failing in providing a route into science for future scientists. J.Osborne and J. Dillon are saying: *In such a context, to do nothing is not an option!* [4].

Thus, in this paper some recommendations and conclusions elaborated by the experienced European team of science educators are described, discussed and commented from the Polish education system point of view, as also in Poland the number of students willing to study science, especially physics is decreasing instantly.

Remarks on current education system in Poland

In September 2005 Polish Ministry of Education published the document: *Education and competencies – National Plan of Development for 2007-2013*, in which some strong and weak factors of our education system were described. Among strong points there are listed among others: Compulsory schooling up to 18, differentiated structure of education system, external examinations, high percent of educated people, large offer of school curricula and textbooks, two-subject model of teacher training, system of financial help for students, high school autonomy, establishment of *Education Information System*, increased number of computers at schools, possibility to use the financial grants from EU. But there is even more weak points, eg: Low achievements of pupils in PISA investigations concerned with scientific skills, too low number of Information Technology and Foreign language teachers, small number of school hours devoted to science teaching, too big number of students in the classroom, too low number of science and mathematics students finishing higher education, not enough developed system of "long life" and distance learning, very low outlay for one pupil/ University student, very high unemployment, too low prestige and salary of teacher profession, slow development of scientific carriers, etc. The above statements are also

valid in the area of science education, but I am aware, that this list is still far to be complete.

Some report's findings and recommendations

As it was already said, the report message is clear – there are shortcomings in curriculum, pedagogy, assessment and in science teacher training [5-7]. School science education, has never provided a satisfactory education for the majority. Now it is also failing in its original purpose, to prepare a future scientists. The challenge therefore, is to re-imagine science education; to consider how it can be made fit for the modern world and how it can meet the needs of all students; those who will go on to work in scientific and technical subjects, and those who will not. The report suggests how this re-imagining might be achieved. Many countries are experiencing significant problems with engaging students with the advanced study of physical sciences [8,9]. Where this is the case, it is a source of significant concern. However, this pattern is not universal across Europe and appears to be strongly correlated with the level of economic advancement in any given country.

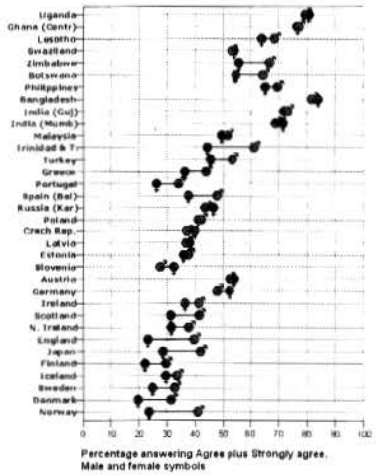

Fig. 1. Data from the ROSE study showing students responses on: *I like school science better than most other school subjects*

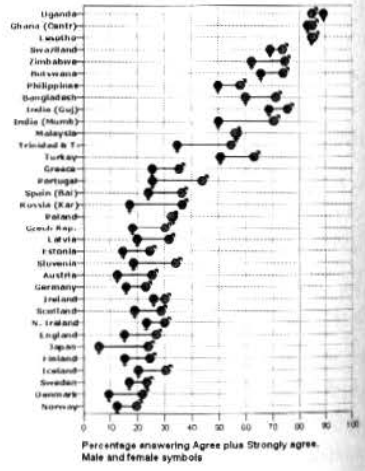

Fig. 2. Data from ROSE study showing students responses on: *I would like to become a scientist*

The ROSE study of students' attitudes to science in more than 20 countries [10] has found that students' response to the statement I like school science better than other subjects is increasingly negative the more developed the country (Fig. 1) and answer to the question I would like to become a scientist just opposite – is much more positive for undeveloped countries (Fig. 2). Furthermore, the differences in the attitude between male and female are the smallest in the undeveloped and post- socialistic countries, including Poland.

Recommendation 1

The primary goal of science education across the EU should be to educate students both about the major explanations of the material world that science offers and about the way science works. Science courses whose basic aim is to provide a foundational education for future scientists and engineers should be optional.

Whilst science and technology are often seen as interesting to youngsters, such interest is not reflected in students' engagement with school science that fails to appeal to too many students (eg. in Poland- more than 30 students in the classroom). Girls, in particular, are less interested in school science (Table1), and only a minority of girls (especially in rich countries) choose careers in physical science and engineering.

Tab. 1. The top 5 items boys would like to learn about in science and the top 5 for girls [5]

Boys	Girls
Explosive chemicals; How it feels to be weightless in space; How the atom bomb functions; Biological and chemical weapons and what they do to the human body; Black holes, supernovae and other spectacular objects in outer space;	Why we dream when we are sleeping and what the dreams might mean; Cancer – what we know and how we can treat it; How to perform first aid and use basic medical equipment; How to exercise the body to keep fit and strong; Sexually transmitted diseases and how to be protected against them;

Recommendation 2

More attempts at innovative curricula and ways of organising the teaching of science that address the issue of low student motivation are required. These innovations need to be evaluated. In particular, a physical science curriculum that specifically focuses on developing an understanding of science in contexts that are known to interest girls should be developed and trialled within the EU.

Recommendation 3

EU countries need to invest in improving the human and physical resources available to schools for informing students, both about careers in science – where the emphasis should be on why working in science is an important cultural and humanitarian activity – and careers from science where the emphasis should be on the extensive range of potential careers that the study of science affords.

Student engagement or interest in science is largely formed by the age of 14. This situation has implications both for the formal curriculum and for opportunities to engage with science outside the classroom.

Recommendation 4

EU countries should ensure that:

- *teachers of science of the highest quality are provided for students in primary and lower secondary school;*

- *the emphasis in science education before 14 should be on engaging students with science and scientific phenomena. Evidence suggests that this is best achieved through opportunities for extended investigative work and 'hands-on' experimentation and not through a stress on the acquisition of canonical concepts.*

Recommendation 5

Developing and extending the ways in which science is taught is essential for improving student engagement. Transforming teacher practice across the EU is a long-term project and will require significant and sustained investment in continuous professional development.

Recommendation 6

EU governments should invest significantly in research and development work on assessment in science education. The aim should be to develop items and methods that assess the skills, knowledge and competencies expected of a scientifically literate citizen.

Recommendation 7

Good quality teachers, with up-to-date knowledge and skills, are the foundation of any system of formal science education. Systems to ensure the recruitment, retention and continuous professional training of such individuals must be a policy priority in Europe.

The authors of the described report are convinced, that the above *recommendations are important and timely and deserve careful consideration by educators, policy makers and scientists alike*. At the end I also would like to remind you ancient Chinese saying: *If you think that education is not important or too expensive, you have not try ignorance yet*.

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