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SCIENCE AND TECHNOLOGY IN EDUCATION

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Abstract

Our societies are dominated and even 'driven' by ideas and products from science and technology (S&T) and it is very likely that the influence of science and technology on our lives will continue to increase in the years to come. In short, modern societies need people with scientific and technological qualifications at the highest level as well as a general public which has a broad understanding of the contents and methods of science and technology, coupled with an insight into their role as social forces that shape the future. While science and technology are obviously important for economic well-being, they must also see from the perspective of a broadly based. A falling enrolment seems to suggest a decline in interest in science and technology. This, however, is the case only if enrolment in science and technology education is taken as the sole indicator of interest in these fields. Popular science and technology magazines have also retained their popularity in many countries, and television programmes about science, the environment and technology continue to attract large audiences.

Keywords: *Modern Societies, Environment, Euro Barometer, Knowledge.*

Introduction

Our societies are dominated and even 'driven' by ideas and products from science and technology (S&T) and it is very likely that the influence of science and technology on our lives will continue to increase in the years to come. Scientific and technological knowledge, skills and artefacts 'invade' all realms of life in modern society: the workplace and the public sphere are increasingly dependent on new as well as upon more established technologies. In short, modern societies need people with scientific and technological qualifications at the highest level as well as a general public which has a broad understanding of the contents and methods of science and technology, coupled with an insight into their role as social forces that shape the future. While science and technology are obviously important for economic well-being, they must also see from the perspective of a broadly based.

Scientific and Technological Illiteracy and the Public Understanding of Science

Projects like TIMSS and PISA describe the levels of achievement of children of school age. However, there is a comparable political concern about how the general public relates to science. The concern has many dimensions. These include the nature and level of public scientific and technological knowledge, attitudes and interests, and, of course, the degree of public support for scientific and technological research and the community that undertakes it. Acronyms like PUST (Public Understanding of Science and Technology) have

become indicators of growing unease about the situation. Academic journals are devoted to the relevant issues (e.g., Public Understanding of Science) and several research institutions study the challenges involved in promoting the public understanding of science. Phrases like 'scientific illiteracy' are also used, more or less fruitfully, to describe the situation. There is a rich literature in the field, and this is marked by the many, and often conflicting, meanings of some of the terms used. Statistical data and most surveys, however, do not shed much light on the underlying causes of many of the present educational concerns. Why have science and technology apparently lost their attraction for many young people, and what might be done to remedy this situation? Without some answers to these questions, intervention programmes designed to increase interest in science and technology are unlikely to succeed.

Contradictory Trends

A falling enrolment seems to suggest a decline in interest in science and technology. This, however, is the case only if enrolment in science and technology education is taken as the sole indicator of interest in these fields. Other indicators give other messages. For instance, young people in many countries are more interested than ever in using many kinds of new technology. It is a paradox that the countries that have the most problems with recruitment to scientific and technological studies and careers are precisely those with the most widespread use of new technologies by young people. Examples include cellular telephones, personal computers and the Internet. There seems to be an eagerness to use the new technologies, but a reluctance to study the disciplines that underlie them.

Popular science and technology magazines have also retained their popularity in many countries, and television programmes about science, the environment and technology continue to attract large audiences. Furthermore, survey data for the member countries of the EU (often including some other countries), such as the ongoing series of Euro barometer surveys, do not give support to general claims about falling interest in, and negative attitudes towards, science and technology. Indeed, to the contrary, these studies indicate a high level of public interest in scientific and technological research and a high level of acceptance of such research as a national priority. The Euro barometer studies also document that doctors, scientists and engineers have high esteem, much above that enjoyed by lawyers, 'businessmen', journalists, and politicians.

Scientific and technological skill and knowledge are acquired and developed in many different contexts, and not simply in formal settings like schools. The media, museums of various kinds, the workplace and even 'everyday life' provide other learning contexts. Most of the impressive skills that young people have in handling personal computers, the Internet, cellular phones and all sorts of electronic devices are acquired in informal out-of-school settings. When the Euro barometer asked members of the public

where they had acquired their scientific knowledge, television, the press and the radio featured much more prominently than either schools or universities.

An International Concern…

The growing importance, but increasingly problematic, enrolment in, and status of, science and technology in many countries, provides the obvious background to a growing political concern about science and technology education in schools, higher education, media and the public.

In many countries, the situation has attracted political attention at the highest level, and, in some cases, projects and counter-measures are planned or put in operation. The Swedish NOT-project (http://www.hsv.se/NOT/) and the Portuguese Ciencia Viva (http://www.ucv.mct.pt/) are examples of large-scale national programmes. Some of these programmes have also initiated research and prompted discussion and other efforts directed at improving understanding of the dimensions of the problem.

From the available studies in the field, it also seems premature to claim that the public understanding of science and technology is deteriorating, although such claims are often voiced from interests groups on behalf of the scientific and technological establishment. One could, however, argue that the public understanding of science and technology needs to be much better than it is, given the crucial role they play in contemporary society. General claims about falling standards, however, do not seem to be justified.

Who needs Science and Technology – and Why?

The problems surrounding recruitment to scientific and technological subjects can be viewed from several different perspectives. These range from industrial and governmental anxiety about national, economic competitiveness to concerns about empowerment at the grassroots level to protect and conserve the natural environment. Different conceptions of the recruitment 'crisis' point towards different solutions, and, as indicated below, there is a range of stakeholders, each with a somewhat different argument to present.

Industry needs people with a high level of qualification in science and technology. Modern industry is high-tech, and it is often referred to as a 'knowledge industry'. The need here is for highly qualified scientists and engineers for survival in a competitive global economy. While such survival is also a matter of national economic well-being, young people will not base their educational choices on what is good for the nation.

Universities and research institutions have a similar need for researchers (and teachers) to maintain research at a high international level and to train future generations of experts, researchers and teachers.

Industry, universities and other research based organisations thus need to recruit a highly skilled élite. However, the size of that élite may be quite modest, even in a highly industrialised society, and it would be a mistake to have this group principally in mind when reforming science and technology education within schools. A policy based mainly on the needs of this élite could decrease even further the proportion of young people interested in school science and technology interesting, and who wish to continue their studies in these fields:

Schools need large numbers of well-qualified teachers but many countries face a problem of both quality and quantity in recruiting to the profession. Well-qualified and enthusiastic teachers are the key to any improvement in the teaching of science and technology in schools, not least in laying the foundations for the future development of the knowledge, interests and attitudes of ordinary citizens once they have left school. Science and technology teachers are also influential in recruiting people to the science and technological sectors of employment.

The long-term effects of a shortage of good science and technology teachers can be very damaging, although they may not be as immediately evident as a comparable shortage in industry and research. Teachers of science or technology need a broad education: - a solid foundation in the relevant academic discipline(s) is important, but it is not enough. They need broader perspectives and skills in order to cope with the kinds of challenges set out earlier in this chapter. In particular, they need not only a foundation in the scientific or technological disciplines, but also an understanding that places these disciplines in their historical and social contexts. Achieving this is likely to require significant reforms in teacher training.

Science and technology education are required for participation as a citizen in a democracy. Modern society is dominated by science and technology, and citizens, acting as consumers and voters, are confronted with a range of science- and technology-related issues. As consumers, we have to take decisions about food and health, the quality and characteristics of products, the claims made in advertisements, etc. As voters, we have to take a stand and be able to judge arguments related to a wide variety of issues. Many of these political issues also have a scientific and/or technological dimension. In such cases, knowledge of the relevant science or technology has to be combined with values and political ideals. Issues relating to the environment are obviously of this nature, but so, too, are issues relating to a wide range of other matters, including energy, traffic and health policy. It is important that social and political issues should not be seen as 'technical', and thus be left in the hands of ‘experts’.

The above 'democratic argument' for scientific and technological education assumes that people have some understanding both of scientific and technological concepts and principles and of the nature of science and technology and the role they play in society. Among much else, people need to know that scientific knowledge is based on

argumentation and evidence, and that statistical considerations about risks play an important role in establishing conclusions. In short, while everyone cannot become an expert, everyone should have the intellectual tools to be able to judge which expert, and what kind of arguments, one should trust.

Science and Technology in Schools

Present curricula – the critique

Science curricula are key factors in developing and sustaining pupils' interest in science. There seems to be a broad agreement about the shortcomings of traditional curricula that still prevail in most countries.

The implicit image of science conveyed by these curricula is that it is mainly a massive body of authoritative and unquestionable knowledge. Most curricula and textbooks are overloaded with facts and information at the expense of concentration on a few 'big ideas' and key principles. There seems to be an attempt to cover most, if not all, parts of established academic science, without any justification for teaching this material in schools that cater for the whole age cohort. Many new words and 'exotic' concepts are introduced on every page of most textbooks. Although very few pupils will pursue further studies in science, preparation for such studies seems to be a guiding curriculum principle. There is often repetition, with the same concepts and laws presented year after year. Such curricula and textbooks often lead to rote learning without any deeper understanding so that, unsurprisingly, many pupils become bored and develop a lasting aversion to science.

It should also be noted that science is often seen by students as demanding and difficult. Scientific ideas are not always easy to grasp, and their understanding sometimes requires concentration and hard work over a long period of time. Many young people today in technologically advanced countries do not readily make the commitment necessary to learn science. If they are to make that commitment, pupils will need to be strongly motivated and sense that they are learning something worthwhile, interesting and valuable to them. This does not often seem to be the case. Although science per se can be seen as difficult, the demands of school science can, of course, be adopted to suit the age of the learners.

Conclusion

The challenges facing contemporary science and technology education are multi-faceted. In addition, those challenges, and the strategies for overcoming them, are perceived differently by the different groups with a legitimate interest in science and technology education. The perspectives of industrial leaders are often different from those of environmental activists. It has also been argued in this chapter that the problems related to interest in, and attitudes towards, science and technology cannot be regarded as solely educational but need to be understood and addressed in a wider social, cultural and

political context. As a consequence, the range of possible 'solutions' may be as large and diverse as the ways in which the problem is framed.

Despite this, it is possible to recognize some degree of broad agreement about the reforms that need to be undertaken. Agreement can be reached, for example, about the need to stimulate and maintain young children's curiosity about natural phenomena and how things work. There can also be agreement that everybody would benefit from a broad knowledge of key ideas and basic principles in science and technology and an understanding and appreciation of the key roles played by science and technology in contemporary society. Knowledge and appreciation of scientific theories and ideas as major cultural products of humankind also probably also constitute an uncontroversial curriculum goal. This list could be continued, but these examples indicate that it should be possible for different groups to work together to achieve what is often called 'scientific and technological literacy'.

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