



Joint G8+ science academies' statement on Education for a Science-Based Global Development

Background

Economic growth, provision of food and progress in health – as measured by the spectacular increase in life expectancy during the 20th century and into this first decade of the 21st century – is attributable mostly to advances in science and technology and the expansion of systems of research and education. These advances have impacted our daily lives in many ways including travel, communication and access to new technologies. In the future, science and technology will continue to be key for global development, for example, to meet the need for new and sustainable sources of energy.

Education in science must be targeted not only to future scientists, engineers and other specialists in government and industry but also to the general public, from children in school to adults. This is the only way to make them partners of the scientists and hence to avoid misunderstandings and unfounded fears, and to better understand risks and uncertainties.

Science understanding and practice embody fundamental values such as rigorous reasoning, honesty and tolerance for the opinions of others. The practice of science must be accompanied by a sense of justice and a respect for all human beings.

Education for science-based global development involves three simultaneous challenges: science education for the general public, science education in school, and science education at university and at other national research bodies. This will require innovative approaches and institutions for teaching and research, many of them using modern information and communication tools. It requires also scientific assessment of the outcomes of the education system in order to ensure that the best state-of-the-art tools and educational methods are effectively used. Progress in cognitive sciences and brain research has shed new light on learning processes, especially in very early years of life.

Science education for the general public

Science literacy is essential for making adaptive judgments in a modern economy. These judgments involve many choices including, for example, choices about resource scarcity, climate change mitigation,

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food safety, health decisions, energy futures and many other individual and collective decisions. A democratic society in which only a few scientists and highly educated people understand the bases for major societal decisions is not viable. Accordingly, it is essential that greater efforts be made to disseminate scientific concepts, methods and discoveries to the public. Scientific information must be distributed widely and detailed briefing documents on topical issues must be available for decision-makers and media. Many successful interactions with society have been organised and carried by local and national governments, universities, public and private research institutes and academies. These include public lectures, 'open houses', festivals, pairing with parliamentarians and TV programmes. We must use all appropriate education tools, including those presented by rapid developments in the electronic media and help people to identify the reliability of the information presented. Finally, the outcomes of all these education practices must constantly be assessed.

Science education in school

Science is taught at school with two goals:

The first goal is to provide the basic knowledge necessary for future citizens in a globalized world. This includes the acquisition of basic knowledge in science as well as the understanding of the very nature of science, the way to pose and then challenge hypotheses. Students must develop a taste for doing experiments, analyze results, make inferences. In short, they must be "curiosity-driven". During the last decades, inquiry-based Science Education (IBSE) has been successfully implemented in developed and less developed countries as well, supported by the Global Network of Science Academies (IAP).

A basic science education for all youngsters in the world is a matter of justice, sharing the beauty of scientific discoveries and the power of scientific methods. Last but not least, learning to reason properly may help protect young minds against intolerance.

The second goal is to recognise talented youngsters and inspire them to become science teachers, researchers, engineers and medical experts. A shor-

tage of good quality mathematics and science teachers in many countries creates a vicious circle that needs to be broken. In many countries even the most developed, there are still huge social inequalities in the opportunities for students to become scientists particularly for young women and low-income groups of society.

The decline of interest in science among youngsters is a serious issue which should be addressed.

Encouragement of young talents could be organized on the basis of different level competitions in different science domains, accompanied by contacts with leading scientists.

To achieve these goals, it is essential to share experiments and pedagogical materials in innovative science education programs and to provide teachers with a significant continued education in Science. In addition, it is advisable to cooperate with the global programs of Education for Sustainable Development (ESD) promoted by UNESCO.

Science education at university

Universities throughout the world need quality faculty, infrastructure and innovative learning programmes to train and maintain human resources. Databases, electronic libraries, scientific journals and sophisticated software should be widely accessible throughout the world. Access to distant databases creates new opportunities for researchers of all countries particularly in the experimental disciplines. Databases on gene sequences and astronomical objects, for example, can potentially be accessed freely by all researchers, including those from the less-developed countries. Similarly, essential data - such as those on biodiversity - that are acquired everywhere, can now be exploited by the global community of researchers. The effectiveness of e-learning and its highly positive prospects, however, may be limited by the high cost of implementing and using modern techniques.

Although virtual universities may have considerable potential, research centres remain necessary both to conduct experimental works and to facilitate direct interaction between researchers and between faculty and students.

Academia Brasileira das Ciencias, Brazil

Deutsche Akademie der Naturforscher Leopoldina, Germany

Science Council of Japan, Japan

Académie nationale des Sciences et des Techniques, Sénégal

Royal Society, Canada

Indian National Science Academy, India

Academia Mexicana de Ciencias, Mexicana

Academy os Sciences, South Africa

National Academy os Sciences, United States of America

Académie des Sciences, France

Accademia Nazionale dei Lincei, Italy

Russian Academy of Sciences, Russia

Royal Society, United Kingdom

Conclusion

Data on the comparative effectiveness of educational strategies must be patiently acquired, analyzed and the results disseminated. Rigorous experimental approaches should help to identify which educational strategies are the best, at all levels of educational curricula. This "evidence-based education" could revolutionize the science and practice of education, as "evidence-based medicine" did, to the point that it has become, after just a few decades, the paradigm of modern medical practice.

Recommendations

The Academies of the G8+ countries strongly recommend the following action plan to their Governments:

- Establish the conditions for a true globalization of knowledge in science and technology. Encourage and help governments of developing countries, to give high priority to acquiring and maintaining the necessary infrastructure and human resources for science education, and to facilitate the return of those trained abroad.
- Support international collaboration to set up quality e-learning facilities, accessible to all, including students worldwide, and promote open access to scientific literature and databases.
- Share the growing knowledge derived from brain research, cognitive sciences and human behavioural research to improve learning programs for children, students and the general public.
- Create a network of virtual collaborative research centres at the front line of innovations in education, such as e-learning, inquiry-based and evidence-based education.
- Support and expand existing successful programs which facilitate the two-way interactions between scientists, on the one hand and the general public, media, and decision makers, on the other.

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