A Statement on Climate Change and Education

from the member academies of IAP for Science

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the interacademy partnership

Headline messages

- Education, especially science education, must play an essential role in preparing present and future generations to understand climate change and to be adequately prepared to adapt to and mitigate its impacts.
- Climate change education must consider the need to provide teachers, in developed as well as in developing countries, professional learning opportunities with up-to-date facts, new and innovative training processes, new resources for the classroom, and new tools to empower their students as 'agents of change'.
- Inquiry-based science education (IBSE), developed over the last two decades, has demonstrated an effective way to teach science at primary and secondary school levels and also to inspire higher education worldwide. It provides a firm basis to develop urgently a specific, interdisciplinary climate change education programme.
- Climate change and associated events will disproportionately impact the poorest 3 billion of the global population, whose schooling is far from adequate. Climate justice calls for supporting their schools and their teachers with specific initiatives.
- International collaboration, through the involvement of the scientific community, will greatly enhance the mobilization of educational systems. As the Intergovernmental Panel on Climate Change (IPCC) is producing periodic 'Assessment Reports', accompanied by 'Summaries for Policy Makers', the scientific community should use the material from the IPCC reports to produce 'Resources & Tools for Teachers'.

1. Science education at the forefront

Humanity faces a serious climate crisis, which will impact the whole world during the 21st century and beyond. Dealing with this crisis will depend heavily on the young people who are today in schools and could become 'agents of change'. The international legal framework to tackle climate change, i.e. the United Nations Framework Convention on Climate Change (UNFCCC, 1992) and the Paris Agreement (UN, 2015), recognize this point by stating that *"The development and implementation of education and training programmes … in particular for developing countries"* (UNFCCC, Art. 6.b.ii) and *"Parties should take measures ... to enhance climate change education"* (Paris Agreement, Art.12).

Understanding the Earth's climate, the impact of greenhouse gas emissions on the system, as well as perceiving the strategies for mitigation ('fighting against the causes') and adaptation ('coping with the effects'), from global to local levels, requires scientific knowledge and critical thinking. Climate science brings together specific issues that are currently not widely recognized by science curricula in schools and universities.

Practitioners of traditional disciplines, such as Earth sciences, physics, chemistry, life sciences, mathematics, social science and economics, etc., must collaborate in an interdisciplinary manner to address these issues across the curriculum, even at the elementary level. In addition, there is a need to understand how these complex interactions between natural and societal systems (e.g. risk management) connect local actions with global consequences – thus requiring the inclusion of social as well as health sciences and economics. Such education must also recognize

the role of solidarity, altruism and ethical values, which are not derived from scientific knowledge. A significant effort to integrate all these aspects is needed.

During the last two decades, the scientific community, and especially academies of science, have been deeply involved in proposing changes in basic science education in primary, secondary and higher schools, and have fostered pilot projects in a number of countries in both the developing and the developed world. An explicit consensus has built up around a way to teach natural sciences: inquiry-based science education (IBSE), which introduces students to science in an active way. Tens of millions of young students have benefited from IBSE and continue to do so. These efforts provide an excellent basis on which to address in schools climate change issues, which are so deeply connected with sustainable development.

2. An education problem of unprecedented magnitude

It is well recognized (5th IPCC Assessment Report) that the effects of climate change will disproportionately impact poor people, who are the 3 billion living mostly in the developing world. Children (aged below 15) represent one-quarter of the global population and one billion have poor schooling, especially in science and sustainable development. At the current rate, only 14% will have secondary-level education in 2030 ('Education for people and the planet', UNESCO, 2016). Furthermore, compared to boys, education for girls is much poorer.

Currently, even in developed countries, knowledge relating to climate change is not taught effectively: an analysis of current curricula in 78 countries shows that only 58% use the term *ecology* and 47% mention *environmental education* ('Education for people and the planet', UNESCO, 2016). Adapting to the effects of climate change (heat waves and other extreme weather events, sea level rise, changing food and water resources, pollution and health threats, etc.) will impact individual and collective behaviour in all sectors of society.

A sustained effort is needed for schools to be well connected with families and communities in order to empower young people, not only in the concerns resulting from climate change, but importantly also in the social and economic benefits offered by working, with hope in the future, towards a more sustainable world. Inter-connected areas of intervention such as safe water management, alternative energy sources, traditional knowledge, sustainable agriculture, the bioeconomy and green chemistry should be addressed.

However, climate change is a rapidly evolving problem and the situation today is worse than ever before. Holding the increase in the global average temperature below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C would require society to reach zero CO_2 emissions by 2100. The choice of an adequate energy mix is strongly debated and takes into account factors such as the protection of biodiversity, as well as ethical, social and political constraints which were originally neglected in international discussions. To predict what will be the most appropriate decisions in twenty years' time, when the current generation of young students will be decision-makers, is difficult. Hence, education today must equip them with the capability of understanding and decision making, based on evidence and critical thought, rather than letting *a priori* opinions or irrationality guide their choices in the future.

3. Accompanying teachers (primary and secondary school) and professors (universities)

Primary & Secondary. IBSE pilot projects in the Americas, Europe, Asia and Africa have provided a large database on what is required to achieve successful changes in basic science education. The most obvious conclusion is that teachers must be educated, trained and supported in order for science to be taught in an active and participative manner, which includes experiments, hypothesis testing, critical thinking and use of proper language. A similar approach with respect to climate change, which calls for the participation of research scientists, can take many forms: professional learning opportunities focused on climate science concepts; collective work using distance learning; and pedagogical resources for the classroom, adapted to the level taught (primary, secondary) and to the teachers' specific expertise and local surroundings.

Adequate teacher mobilization, education and support on one hand, and introduction of climate change education into national science curricula on the other, must be planned.

In addition, to fully prepare educators at all levels to teach confidently about climate change, its impacts and response strategies, they must be trained on how to confront climate skeptics and to rationally discuss controversial issues in their classrooms and communities.

Higher education. In institutions of higher education, professors of natural as well as social and economic sciences are connected to research. Climate issues offer them an excellent opportunity to adopt interdisciplinary and integrated approaches in order to prepare their students and future professionals to contribute with appropriate skills to the challenges of mitigation and adaptation in all areas of life. This effort must encompass the pre-service and in-service training of teachers.

As the Earth is a complex system, higher education initiatives have to directly address the following concepts, in order to make them properly understood:

- differences between global and local effects, and environmental responses;
- projections into the future and associated uncertainties;
- optimization of scenarios, depending on societies' choices for their future;
- extreme diversity of scales in space and time;
- positive and negative feedbacks;
- multi-factorial causes and random processes;
- non-linearities and phase transitions.

4. Role of scientists and engineers in education

The generation of new knowledge gives the scientists who conduct the research, and those who use it, an essential role in inspiring and constantly adapting the contents of education, in schools as well as in universities. The novelty of climate issues, the interdisciplinary challenges to address them, together with the doubts often cast on scientific conclusions, all give the scientific community a special role in contributing to the transformation of education. School teachers, who in many regions do not receive sufficient training and adequate professional development, need assistance to implement climate change education in their classrooms.

Scientists and engineers engaged in all aspects of climate change have a critical role to play in advancing and implementing climate change education as they have the knowledge that must be embedded in curricula and conveyed to teachers. Cognitive scientists and education specialists also have a role to play in advancing climate change education, bringing to the table their understanding of the learning process at all ages, effective pedagogy, and the design of robust and effective teaching materials. These groups need to support the creation of teaching resources and professional development opportunities required for teachers at all levels.

Further, scientists and engineers must speak out about the necessity of such education, both globally and within their own countries and communities, as essential advocates for the importance of climate change education, the critical role of teachers, and the required resources. For example, new multilingual initiatives may include a global service providing resources and tools to teachers; local services may create direct web-assisted interactions between scientists and teachers.

5. Conclusions and recommendations

Educating the present and future generations about climate change, and teaching them to act with a critical mind and a hopeful heart, is essential for the future of humanity. Science education must meet the challenge, especially through the use of an inquiry-based and interdisciplinary pedagogy, with the global scientific community playing an essential role in its implementation and improvement.

Academies of science, working through the InterAcademy Partnership (IAP), call on policymakers, education authorities and fellow scientists to:

1. Acknowledge that climate change education, for mitigation as well as for adaptation, must become a prime component of science education at all educational levels;
2. Develop whenever possible the use of well-demonstrated inquiry-based pedagogy;
3. Facilitate the preparation of teachers and professors – key actors in educating the present and future generations – through a number of initiatives, such as curricula changes that include interdisciplinarity, professional training sessions, making available varied and specific resources, distance learning, etc.;
4. Organize the necessary support and provide the financial resources for these initiatives, all of which require creativity and innovation by the scientific community;
5. Empower students to act with creativity and hope in their schools, families and communities, to address social and economic issues related to sustainability, and to understand how science education will help them make decisions based on evidence and critical thinking;
6. Have a special focus on vulnerable communities – especially in the developing world – exposed to floods, droughts, hurricanes, and other extreme weather events;
7. Consider actions that would be carried out in parallel with the IPCC periodic reports, in order to provide 'Resources and Tools for Teachers' at a global scale, in cooperation with local actors to make the necessary adaptations to the diversity of local situations.

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Statement on Climate Change and Education from the member academies of IAP for Science

This Statement has been endorsed by the majority of IAP for Science's 113 member academies.

The InterAcademy Partnership for Science

IAP for Science is a global network of the world's science academies. Launched in 1993, its primary goal is to help member academies work together to advise citizens and public officials on the scientific aspects of critical global issues. Its membership comprises 113 academies of science. IAP's Science Education Programme was established in 2003.

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