



## Science Education & Climate Change Authors

Science Education and Climate Change

Yves Quéré & Pierre Léna

Paris

Climate Change has an obvious relation to people's wellbeing and it would be a definite misconduct to ignore it in our educational programmes for the years to come. Children of today will be those adults directly impacted by the consequences of climate change in future decades and we have to prepare them to it, especially to the understanding – in simple terms – of the science behind those changes, but also to the action they may carry, wherever they are.

The question then arises of how to adapt a proper way of teaching science to the new and interdisciplinary theme of climate change.

### A proper way of teaching science to children

There is presently a worldwide consensus about the necessity to introduce the concept of *inquiry* in the way to teach science: children and youngsters will be required to try to solve a problem of science (physics, botany...) as if they were detectives using their sense of observation, their experimental skill, their intuition and their intelligence to find the solution to the problem. Needless to say, the help of the teacher is required, preventing them from wasting their time on wrong paths. Also needless to say, a number of scientific data (classification of plants, astronomical concepts...) can be presented to them only in a classical, directive, way. A proper balance between these two ways of teaching, *Inquiry Based Science Education* (IBSE) and *Directive Pedagogy* (DP) has to be found by the teacher (G. Charpak, P. Léna, Y. Quéré, 2005).

It is obvious – considering the time devoted to experimental work – that IBSE, as compared to DP, will allow less scientific scores to be recorded by children than DP; but altogether will enhance their understanding of what science is, how it proceeds and what can be expected from it. This is exactly what has been confirmed in the last PISA (*Programme for International Student Assessment*) 2015 Science Test.

A number of high level scientists have devoted themselves to the dissemination of IBSE, including Bruce Alberts in the US, Wei Yu in China, Nobel Laureates Georges Charpak, Leon Ledermann, Mario Molina, and Lee Yuan Tseh, not forgetting Marie Curie, building a brand new bridge between the world of scientists and that of school teachers. They essentially agree on the fact that IBSE:

- i) Stimulates both curiosity, a word (latin *cura*) related to the empathy by which we 'take care' of what is around us, a word which then carries a flavour of ecology; and imagination (that is, the faculty to create *images* of what is hidden behind the wall);
- ii) Introduces us to the difficult concept of truth in a world invaded by a spineless relativism (*Tout est relatif ! A chacun sa vérité*, etc.);
- iii) Tells us that we do not know everything, the founding sentence of science being "I do not know" (to which we have to add "...but I would like to know"), which implies a hue of modesty in our behaviour and also, possibly, for the student, a desire to search and to become a scientist;
- iv) Introduces the student – *à propos* simple objects like a pendulum – to the essential problem of the separation of parameters of a complex problem like those which he/she, as an adult, will frequently encounter (conflicts, decisions to be taken...);
- v) Finally, tends – together with mathematics – to create logic and rational thinking in our brain, and in particular in our language.

### E-learning

It is easy to foresee that all fields of education will be, in the 21st Century, more and more influenced, not to say invaded, by e-processes. This opens a mostly positive perspective in the dissemination of knowledge – and possibly culture – in large areas of the world's population. In this 'digital age', new strategies will certainly be developed which will multiply the possibilities and modify the procedures in global education.

The benefits of it will possibly be huge, but an immediate *caveat* should be introduced in the debates about future education: the risk does exist of an increased abstraction, screens replacing little by little not only the dialogue with a 'real' teacher, his/her voice, convictions, passion, empathy, sense of humour... in brief his/her human density; but also destroying the physical contact of children with the reality of nature and of man-made objects.

Natural sciences are on the battlefield of this possible conflict between the concrete nature of the world and the virtual nature of images (and discourses) supposed to represent it. Paradoxically, it might be said that the more e-learning will grow, the more science should be taught to children in a concrete way in order to counterbalance a possible, if not likely, extension of a virtual vision of nature. This means a necessity to develop as much as possible the teaching of science (at least to young students) most concretely, as this is encouraged in IBSE.

### **Climate Change and Education**

The huge problem of climate change has been more and more evoked by scientists, and concretely (and most often bitterly) experienced by populations, in the last 2 or 3 decades. In the recent past, IPCC has delivered its 5th Assessment Report, 2014, and the special Report 1.5°C, giving rise to the Paris COP 21, 2015. It prepares presently the special Reports on *Cryosphere/Hydrosphere* (2019), on *Land use* (2019), and on *Cities* (2020), before the Sixth Assessment Report (2022).

The voice of *Laudato si'* joins in the warnings of the scientists: "*Climate change is a global problem with grave implications: environmental, social, economic, political and for the distribution of goods. It represents one of the principal challenges facing humanity in our day [...]. Sadly, there is widespread indifference to such suffering, which is even now taking place throughout our world. Our lack of response to these tragedies involving our brothers and sisters points to the loss of that sense of responsibility for our fellow men and women upon which all civil society is founded*". (§ 25)

This disturbing 'lack of response' requires a reaction from us, which should first be expressed through our educational systems. Following a workshop at the PAS here, in this room, 2016, on *Children and Sustainable Development: a Challenge for Education*, the Assembly of the Academies of sciences worldwide, the IAP, issued in 2017 a *Statement on Climate Change & Education* insisting on the necessity:

To develop a *Climate Change Education*, building "a critical mind and an hopeful heart"; To act in primary, secondary and higher education; To help teachers to develop inter-disciplinarity, including social sciences and ethics; To mobilize scientists and engineers for local support.

These recommendations are highly justified considering the low level of public concern about these questions. For instance a measurement in France (ADEME, 2017) of the weight of various 'points of concern' (for adults) gave, to the item: *Environment, greenhouse effect and climate warming*, the following incredibly low and incredibly stable answers, from 2011 to 2017: in %, 7, 6, 7, 2, 4, 5, 6, as compared to *Employment*: 26, 30, 37, 35, 37, 30, 29. Contrariwise, children are much more motivated: in 2018, in France, 59% of school students and 57% of higher education graduates place environment as n° 1 of causes they would like to work for. Attending an IPCC on Climate and Cities in Edmonton, young students gathered from many countries considered (2018) that the biggest barriers to addressing Climate Change are (in order): Lack of awareness, Government, Finance, and 'Not my responsibility'. They pleaded for a proper preparation of their teachers.

### **Concrete actions**

Implementing the IAP Statement, a number of concrete initiatives have recently emerged. Let us mention:

- In California:      Universities: *Bending the curve* (V. Ramanathan)  
                             Schools: California Global Education Project  
                             State: California Blueprint for Environmental Literacy.
- In India:            *Trans-disciplinary Research-oriented Pedagogy for improving Climate Studies and Understanding* (TROPICUSU), born with ICSU.
- In France:          Creation (2018) of the *Office for Climate Education* (OCE):  
                             creation of Tools and Resources for Teachers, in phase with  
                             the IPCC Reports.

The OCE, a significant initiative, was launched in France by the *Fondation 'La main à la pâte'* with various NGOs and private partner organizations, especially in Germany, combining an Executive Secretariat, with a

small team in Paris, and a network of Partners in various parts of the world. It is funded by public and private funds essentially – but not only – from France and Germany (P. Léna and D. Wilgenbus, 2018).

The ambition of OCE is to accompany IPCC reports with the publication of resources that may help teachers and education systems to implement Climate Change Education; and to stimulate and coordinate a large network of partners to enhance their actions in this field. This must take into account both a global view considering the Earth as a whole, and more local impacts of climate change differing from place to place: desertification, glacier melting, sea level rise etc., implying local actions.

The predictable invasion, in the next decades, of e-processes in the educational systems worldwide should give rise – at least in the field of Climate Change education – to a definite counterbalance of *hands-on* and *investigation* practices in schools. The problems raised by Climate Change are of immediate and concrete influence on everyday life. Consequently they should be addressed in schools through a proper alloy of e-teaching, presenting globally to children the huge complexity of the problems raised all around the planet and their interconnection; and of IBSE-teaching by which children are induced to create and study, 'on the table', simple models of the physical, or chemical, or mechanical processes involved.

The OCE has already undertaken training sessions in South-East Asia, and is planning new ones in Benin, Tunisia and Chile. It also contributes to the organization of high-level regional conferences gathering educational authorities and scientists like the one with ISTIC in Kuala Lumpur, May 2018, on *Climate Change Education* with a large attendance from the South East region. The production of resources for teachers is continued in the format of *La main à la pâte* documents for teachers (e. g. M. Hirtzig, D. Wilgenbus, G. Zimmermann, 2015), including class activities, simulators, games, participative science and documentation. This is open to comments and proposals from teachers and schools anywhere.

### **As a conclusion**

Climate change and, more generally, the health of our Earth have become such a (highly deserved) concern for humankind that it must be included in our educational systems, with a double purpose: 1. Children should at least be informed of, and possibly understand, the main scientific concepts, results and laws governing the functioning of our planet taken as a physical system; 2. They should be ready to become actors of a drastic change of mankind behaviour concerning their planet taken as their natural common house.

### **References**

G. Charpak, P. Léna, Y. Quéré, *Les enfants et la science*, Edit. Odile Jacob, 2005.

P. Léna, D. Wilgenbus, *www.oce.global*, 2018.

M. Hirtzig, D. Wilgenbus, G. Zimmermann (2015), *L'océan, ma planète et moi*, Edit. Le Pommier (English translation also available).