



INSTITUT DE FRANCE  
Académie des sciences

# *Les traductions des* **Comptes Rendus**

---

## **Géoscience**

### *Sciences de la Planète*

#### **Climate change and education**

Full text translated by Romain Dziegielinski

Translation posted online: 2023-11-08

<https://doi.org/10.5802/crgeos.26-en>


**Abstract:** Education dealing with climate change is part of the UNFCCC Paris Agreement ratified in 2016. Education is precious to act on a broad scale on people's behavior and society choices. It is also a demand from the youth who, more than others, is facing a worrying future, but can be helped for a mobilization of energies. Numerous initiatives emerge to implement it, while its systemic and interdisciplinary character requests a significant evolution of school's curricula. The role of teachers is crucial and accompanying them essential. We therefore consider critical to propose pedagogical resources, which are based upon the best current knowledge on climate, i.e. the reports from the Intergovernmental Panel on Climate Change (IPCC).

**Keywords:** Education, Teachers, Professional Development, Support, UNESCO, Schools, Climate Transition

Original article:

Pierre Léna; David Wilgenbus, "Changement climatique et éducation". *Comptes Rendus Géoscience*, vol. 352, issue 4-5 (2020), p. 285-296. <https://doi.org/10.5802/crgeos.26>

Les traductions des *Comptes Rendus* sont mises à disposition du public dans un but d'accessibilité mais n'ont pas reçu de validation scientifique avant leur publication, seule la publication initiale engage la responsabilité de l'Académie des sciences. Le projet Traduction des *Comptes Rendus* est soutenu par le ministère de l'Enseignement supérieur et de la Recherche et par la délégation à la langue française et aux langues de France du ministère de la Culture.

 This translation is licensed under the  
CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.  
<http://creativecommons.org/licenses/by/4.0/>

The emergence of climate concerns is the result of a long process [Aykut and Dahan 2014]. It originated in the scientific community with the "Charney Report," published in 1979 by the U.S. Academy of Sciences [Charney et al. 1979] and described by climatologists as "incredibly visionary" [Bony et al. 2013]. The concern then penetrated the political arena with the following steps, marked by the establishment of the Intergovernmental Panel on Climate Change [IPCC 1988], followed by the establishment of the UN-*Framework Convention on Climate Change* (UNFCCC, ratified in 1994), which organises the annual *Conference of Parties* (COP). Alongside this slow emergence, the concept of sustainable development emerged in 1987 [Brundtland, 1987] and gradually included the climate issue.

## 1. Background

Although the concern for education was mentioned as early as 1992 in the United Nations Framework Convention on Climate Change (Article 6), until the unanimous adoption of the Paris Agreement in 2015 by 195 States that this concern was clearly expressed, with the political weight that this Agreement carries. Article 12 of the Convention states: *The Parties shall take measures to develop climate change education, training, public awareness, its participation and access to information.*

This awareness, now noticeable, proceeds from a double movement. On the one hand, it became increasingly clear that the objectives of the ecological transition, those of a society that is now described as "low carbon", implied such considerable changes in lifestyle and production that they could not be achieved without the broad support of the world's populations, at least in democratic states. This support requires a minimal understanding of climate change, its causes and impacts. On the other hand, and in many countries, public opinion or certain politicians challenge the results of scientific work, while the latter attribute, with increasing certainty, global warming to human action. These challenges highlight the need to share and make public opinion and politicians understand the rationality of these scientific analyses as well as their accuracy.

Sustainable development was defined in 1987 in the Brundtland Report (*Our Common Future*, following the Club of Rome Report of 1972) as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs.* The UN 2030 Agenda published in 2015 broadens this definition: *eradicating poverty, protecting the planet, ensuring prosperity for all.* In 2015, shortly before the adoption of the Paris Agreement, the details of the *Sustainable Development Goals* (SDGs) were published, in the form of seventeen goals [UN Agenda 2015]. Education is covered by Goal 4; the climate is explicitly covered by Goal 13 but, in fact, is widely present in the objectives relating to water, energy, economic growth, cities, the ocean and terrestrial ecosystems. Science, in almost all its disciplines, is omnipresent in these subjects [ISC 2017].

This multiplicity of objectives, as well as the systemic interactions between them all, represent an objective difficulty for education, as this can take it away from its usual disciplinary structures of organisation of knowledge. We must undoubtedly rethink education in depth in the time of the Anthropocene [Wallenhorst and Pierron 2019]. However, within primary, secondary or higher education, the place of the climate issue, based on scientific concepts, and the broader issue of the ecological transition, are easier to identify and therefore to address. This analysis focuses on this more limited issue.

As early as 2016, the scientific community addressed this issue within the network of Academies of Science (InterAcademy Partnership for Science), and at the end of 2017 published *A Statement on Climate Change and Education*, which, based on observations in some thirty countries, made a number of recommendations [InterAcademy Partnership 2017]. They highlighted, among other things: the systemic and therefore necessarily interdisciplinary nature of the required changes to school curricula; the imperative need for teacher preparation and support, throughout the world, but particularly in emerging or developing countries; the essential role of the scientific community in contributing to these profound changes; and finally the need to deploy this effort in a sustained manner, starting at primary school, given the large number of difficult concepts, attitudes and skills to be acquired by students.

Noting the importance of the “Summaries for Policymakers” published by the IPCC, in concise form and accessible for each of its reports, a specific recommendation proposed at the same time the publication of *Resources and Tools for Teachers*, under a modality to be defined, since educational issues are not part of the mandate given to the IPCC by the states that ensure its governance.

The climate outlook extends over several decades, even the century and beyond. After the Paris Agreement, these are on the way widely introduced into public and political debates. It is therefore not surprising, that young people around the world have felt primarily concerned. Its mobilisation was expressed around the world, probably culminating in 2019, at least in a symbolic way, with the young Swedish activist Greta Thunberg speaking at the United Nations Climate Summit and then at the Davos Economic Forum in 2020. This mobilisation was endorsed by exceptional media coverage.

This expression of youth takes many forms, often marked by extreme emotion, especially among the youngest: *collapse* or *apocalypse*, *end of the planet*, *death of civilisation*, *downfall of humanity*, *sixth extinction* are some of the terms used, which sometimes link climate and loss of biodiversity. The term "solastalgia" appeared to characterise this climate anxiety, or eco-anxiety. Another, more positive, expression of this sensitivity also appears in many young people, who want to be able to convey, through their professional orientation and the choice of an employer, the importance they attach to the ecological transition and environmental issues.

In a White Paper published following a meeting of young people, organised in 2015 by the IPCC and the University of Edmonton (Canada), young people express their views on education. Their conclusions, which clearly identify the educational problem, are worth quoting here:

*... our schools prepare us to be the leaders of tomorrow by teaching basic knowledge. However, they do not teach us how to adapt and to have an impact on climate change. This must be taught across each subject, involving interactive project-based activities that will assist students in developing the skills necessary to have more in-depth thinking; and therefore, more in-depth solutions.*

*However, we must acknowledge the complexities of implementing curricular reform, such as the economic and social barriers facing many schools. Creative and collaborative opportunities involving students, communities, and local governments can and will provide meaningful solutions to diminish the obstacles that prevent us from making these proposals reality. [Godwaldt and Karsgaard 2018].*

A series of surveys conducted in Europe, the United States and Australia among young people between the ages of 12 and 25, concluded that *there is a rather low level of understanding of the scientific concepts underlying climate change in this age group, as well as a tendency to underestimate the level of scientific consensus on climate change*. Remarkably, however, these surveys also conclude that the messengers that these young people trust most to provide them with information, are, on the one hand, the social networks that connect them to each other, and on the other hand, their teachers [Lee et al. 2015].

## 2. Slow emergence

The need for better informed awareness was already noted in Article 6 of the Framework Convention on Climate Change (UNFCCC), which states “*the promotion of education, training and public awareness on climate change*” [UN-FCCC, 1992]. The *United Nations Institute for Training and Research* (UNITAR), established in 1963, has been hosting the secretariat of the multilateral organisation UN CC:Learn, funded by Switzerland and involving more than 30 international partners (such as UNESCO, the World Meteorological Organization, the World Bank, etc.) since 2009. The objective of UN CC:Learn is to produce relevant tools at the global level, and to contribute locally to the implementation of climate change education. It is difficult to measure the real impact of this initiative [UN CC:Learn 2009]. In 2012, at COP18 in Doha, an 8-year programme was adopted with reference to Article 6 of the UNFCCC mentioned above. This Doha Programme includes an *Action for Climate Empowerment*. Youth focal points should be identified in all countries, alongside the IPCC national correspondents. Awareness and the expected transformations are vast: changes in education systems, the role of the media, public participation, but their effects on school education do not seem to have been established yet.

In 2016, UNESCO published a remarkable annual report on education, focusing on *creating a sustainable future for all*. The detailed assessment formulated there expresses the unpreparedness, in most of the world's education systems, to implement education for sustainable development, and more specifically, the inclusion of the seventeen goals identified by the United Nations [UNESCO 2016]. For example, a survey carried out in 70 countries is cited, showing that the terms *environment* and *climate* are largely absent from school curricula, as well as from teacher training.

Nevertheless, the challenge posed by this unpreparedness of school and university systems is gradually being addressed in many countries, with the support of the scientific community and the Academies of Science, following the IAP Statement adopted in 2017 *Climate Change and Education*. In the United States, the *Climate Literacy and Energy Awareness Network* (CLEAN), aimed at supporting primary and secondary school teachers, receives support from major scientific agencies, such as NSF, NASA, NOAA, despite the withdrawal from the Paris Agreement decided by Washington [Clean 2019]. In California, the remarkable *Bending the Curve* programme is aimed at all *undergraduate* students from the University of California's twelve campuses; it is now expanded to local state universities [Ramanathan et al. 2019]. In New Zealand, all students between the ages of 11 and 15 now have a new curriculum that introduces them to understanding climate change. Numerous initiatives are being developed to create international networks of schools, such as the ECO-schools of the *Foundation for Environmental Education* supported by UNESCO, the 12,000 schools specifically associated with UNESCO within the ASPnet network, or the *Climate Change Education Stakeholders Community* network, recognised by the UNFCCC but does not depend on it. The themes are often much broader than climate change itself. Sometimes they are more about getting young people to act on limited and local environmental goals, rather than teachers implementing a deeper understanding of mitigation and adaptation issues.

Regarding Europe, the very uneven response of education systems and extra-curricular activities appears in a first survey published in 2020 by the academic network ALLEA. Among the recommendations contained in this report is the need to better integrate ethical issues and the theme of climate change adaptation into educational projects, and to put more efforts into teacher training [Allea 2020].

In France, education for sustainable development has been advocated by ministerial bodies since the early 2000s. Nevertheless, the difficulty of integrating these very general, often little or ill-defined goals into the curricula and in a structured manner has hardly led students to have a systemic vision of them and to make the link with the disciplinary knowledge that forms the core of their learning. Furthermore, climate change, which is often perceived as a difficult topic, is rarely chosen by teachers in their education for sustainable development projects, as shown by the many surveys conducted each year by the local education authority. In the regional education authority of Créteil (Ile-de-France), for example, climate change was explicitly taught in only 7% of schools in 2018 and 2019, while two-thirds of primary and secondary schools worked on waste or biodiversity [Rectorat Créteil 2019].

In addition to these difficulties, there is a new element of context, which raises fears of a generational divide. As a consequence, the issue was raised in 2019 by the Higher Council of Programmes, which writes: *The French Ministry of National Education and Youth echoes a strong demand of youth who, recurrently, express their interest in ecological issues and constantly question the generations that preceded them on their responsibility for the degradation of the environment, and on the need to develop and disseminate the rigorous knowledge essential to the understanding of the mechanisms of these changes and the restoration of natural ecosystems. It is a matter of preventing a fracture that could arise, by overcoming the reproaches that young people would make to their elders, in order to rebuild the bond of trust necessary to build a common future* [Conseil supérieur des programmes 2019].

The profound revision of the organisation of the baccalaureate from autumn 2019 led to the creation of a common core, called "Scientific Education", i.e. two hours per week during the last two years of schooling by all students of the secondary general school [Eduscol 2020]. This attempt, which is still modestly interdisciplinary since it does not include either economics or philosophy around issues of ethics and climate justice, involves about 340,000 young people (in annual flow), whatever their specialisation, in climate issues, which represent nearly a quarter of this teaching. An extension of the effort is being considered for primary and middle school –

K-9 classes in the international grading system [Conseil supérieur des programmes 2019]. At university level, isolated initiatives have emerged in some institutions, but the great mass of students is not introduced to the problems of the ecological transition, except in a small number of specialties directly oriented towards the environment [Shift Project 2019]. A new policy could emerge in 2021 on this point, through recommendations made to higher education institutions by their responsible ministries.

### 3. New goals for climate education

In its 2016 annual report cited above, UNESCO highlights the difficulty of integrating the issues of ecological transition (climate, biodiversity in particular) into formal education, mainly primary and secondary. This integration represents a challenge for education systems, faced with the need to take account of new objectives, such as curricula, training and support for teachers, or the acceptability of dealing with a subject that seems, wrongly, controversial to them. This challenge extends to a necessary opening of schools to families and to the entire local community, since it is not only a matter of educating, but also about initiating the ecological transition, if only in everyday actions.

Regarding climate change education, it is important to specify these challenges here, by successively questioning how teachers and their students can *understand* it, *trust* the sciences that predict its consequences, *act* to mitigate or adapt to them, and finally *grasp the solidarities* involved. Let us look briefly at these four points.

#### 3.1. *Understanding*

Climate change requires a systemic understanding of a scientific nature, allowing for an inevitable complexity. Other moments in history have confronted the common sense with the complexity of natural phenomena: the Copernican revolution, the pastorian vision, the indeterminism of the microscopic world. Here again, it is therefore, first of all, a question of setting up teaching rooted in the “hard sciences”, which tell the reality.

Considered as a whole, the Earth system, with its physical components and biosphere, is governed by a multitude of interactions between subsystems. It is also characterised by a diversity of spatial scales, ranging from the most local — temperature or rainfall, for example — to the most global — the Earth-Sun relationship —; temporal scales, ranging from a day to a million years; multiple parameters, coupled between oceans, continents, atmosphere; and sometimes predictable, sometimes chaotic, sometimes intermediate and prone to instabilities with major consequences. The contribution of the human biosphere to the Earth system introduces elements of social sciences, human geography, economy, and demography that further complicate the understanding. Limiting the teaching subject to the climate does not prevent us from noting that the need for systemic understanding is apparent in other major themes, such as the depletion of biodiversity, the demographic explosion and risk management. In this skein of notions, we must “*help each student to build solid reference marks, in order to be able to give meaning to the news and to take a rational position*” [Masson-Delmotte 2019].

#### 3.2. *Trusting*

The search for “understanding” also involves the confidence that it is possible and even necessary to place in what science proposes. To accept the facts and probabilities of occurrence of the projections, it is necessary to establish a relationship of trust with science, by grasping how it works and how its conclusions are validated, within the so-called scientific community. This relationship of trust is now seriously undermined, especially in developed societies, where *fake news* and conspiracy theories flourish. A survey conducted in 2019 by the Fondation Jean Jaurès and *Conspiracy Watch* shows that 21% of the French population believes in at least five conspiracy theories, the proportion being highest among the youngest. The theme of climate change, both

complex and incredibly abundant — more than 20,000 scientific articles published each year — presents a major difficulty for students, but also for teachers: what do we know? how do we know? who to trust, and why? [Fondation Jean-Jaurès 2019].

This goal of education in the nature of science explores the scientific mind, critical thinking and trust, the role of evidence, the collective functioning of the scientific community. It is an issue for the practice of science in the classroom, as promoted by the action of *La main à la pâte* and the tools it proposes [Farina 2018; Fondation La main à la pâte 2020; Zimmermann et al. 2017].

### 3.3. *Acting*

There is no education that would not include hope for the future. If education, in middle school, high school or university, were limited to conveying the alarming message of climate projections and their human impacts — such as climate migration in millions — addressed in successive IPCC reports, it would be a complete failure. Children or adolescents whose future would be so bleakly presented could find no reason to live it and would sink into solastalgia. This education must therefore be given a dual purpose: *a critical mind and a hopeful heart* [Ramanathan et al. 2017]. All the intelligence and energy of the world's youth will not be too much to imagine, design and implement, with all the tools of science and technology, the new configurations required by a carbon-free and sustainable society. Humanity has been able to mobilise and captivate its youth in other times for the construction of Europe or for the conquest of the Moon: these are the examples that give hope [Jouzel and Larroutourou 2017].

Yet, this teaching subject must find a ground which links the tiny field of action of the individual to the immensity of the global problem. The movements of eco-schools, green high schools, the introduction in France of eco-delegates in all classes (2019) can provide many opportunities for a different school where action is combined with understanding, requires it and illustrates it. For example, *voluntary carbon offsetting* strategies offer here a field of practice for all scales, since one can try to offset the carbon footprint of one's personal journeys by car as well as that of one's high school.

### 3.4. *Solidarity*

Education is never limited to knowledge, it also means to offer values. Contrary to the authoritarian transmission of an ideology, the school proposes and the freedom of the child is nurtured there, so that the man or woman this child will become has learned to exercise this freedom. Beyond knowledge, climate change education calls for values of humanity and solidarity that have probably never been required on such a scale. The traditional generational solidarity that once hardly went beyond the second generation is replaced by a new one. Solidarities with distant spaces or times are not self-evident. Climate justice is the search for a concrete and efficient translation of these new solidarities.

The value judgment is learnt, it also applies to the illusion of an omnipotence of technology to address climate issues [Blamont 2018; Pope Francis 2015].

## 4. **The key role of teachers**

A survey was conducted in 2019 in the United States among secondary school teachers who were asked about their position towards climate education, as well as with parents [NPR-IPSOS 2019]. While the vast majority of them want this education for their children (80%), the teachers list the obstacles encountered: thematic unrelated to the subjects prescribed by the curricula; students too young to tackle it; concepts not mastered by the teacher; lack of teaching tools. "Climatosceptic" teachers are a very small minority (8%). This observation, made in the United States, would not be much different in Europe. It would be further strengthened in developing countries, as we have seen for ourselves in recent years during numerous training sessions, in Asia

and Africa, for primary and secondary school teachers. The place of climate issues in the media does not leave these teachers indifferent or ignorant, and they are willingly benevolent towards these issues, especially as they measure the interest of their students and the confidence they place in them, as highlighted above. In this regard, they perceive their ignorance of the scientific complexity of the subject and their lack of teaching tools to deal with it. The disciplinary compartmentalisation characteristic of the programmes and their training does not facilitate the necessary systemic vision. This is even more true when it comes to combining the analyses carried out respectively by the so-called “hard” sciences and by the human and social sciences, for example with regard to mitigation or adaptation. Four other important factors are also present among teachers: the first concerns their ability to distinguish an opinion from a fact, established by science with certainty or with a given probability; the second is their ability to understand the methodology or to accept the results of climate projections for one or more decades ahead, a century or more, as this may upset “good sense” or common sense. The third concerns their position, as teachers who feel bound to the objectivity of knowledge, when faced with choices that involve ethics and politics. The introduction of scientific concepts on the definition or functioning of the global climate would not be sufficient to address these three concerns. Finally, the fourth relates to the “distant” nature of the problem to be studied. Many teachers in developed countries and even more so in developing countries are more willing to work with their students on local and immediate issues: deforestation, the proliferation of waste, air and water quality. These themes, apart from being perceived as conceptually more accessible, are also more “rewarding” because the actions that can be implemented have immediate and visible effects. Resolving this last difficulty requires anchoring global change, and in particular its impacts, in the local and the present. This requires a good knowledge of the subject, as general considerations are not sufficient, and therefore refers to the previous difficulties.

It is unlikely that a transformation of such magnitude can be achieved without vigorous support measures for the teaching profession. We must work quickly — a decade at most — because climate deadlines do not wait. We must act everywhere, because all the world’s youth are affected by this global problem, as they have already shown. As early as 2017, the principles of such support, aimed at teachers, were proposed in the IAP Statement of the Academies of Science, quoted above. These principles include:

- (1) An elementary, multidisciplinary and clear introduction, to factual scientific knowledge, to the understanding of its solidity and the methods that led to it, to the multiple interactions within the Earth system, between atmosphere, ocean, biosphere and human action. This introduction is based on the “hard sciences”, but does not ignore the human and social sciences.
- (2) A pedagogical strategy that aims to combine for the pupils, according to their age and cognitive maturity, three distinct, complementary and different elements: knowledge of facts and risks, as told by science; positive perspectives on mitigation or adaptation actions, from the very local to the most global; human values involved, such as solidarity or climate justice.
- (3) Access to appropriate teaching tools (classroom resources), involving an active and cooperative attitude of pupils, from the beginning of primary to the end of secondary school.
- (4) A necessary initial training and continuing professional development of teachers.

In each of the successive IPCC reports (*Assessment Reports* every five to six years, intermediate *Special Reports*), scientific evidence is repeated, summarised and simplified in *Summaries for Policy Makers*, which inform and serve as the basis for political, economic and financial decisions taken by states and civil society. Teachers, from both primary and secondary, and educational managers need similar translations that are accessible and meet their needs — which is not the case with the IPCC Summaries for Policymakers. The four proposals above are therefore complemented by a fifth, namely:

- (1) The IPCC reports are now expected to produce “Summaries for Teachers”, which translate, simplify and adapt the scientific substance. Tools for teachers, of a more specifically pedagogical nature, can then result in the necessary adaptations, to the cognitive level of the pupils on the one hand, and to the local climatic and educational contexts on the other hand.

The mandate of the IPCC does not explicitly include this specifically educational dimension, and it soon became clear that this body, while supporting it, could take charge of it. On the other hand, the more general initiatives of the UN CC:Learn and the creation of "Youth" focal points by the UN-FCCC, mentioned above, already provide an element of response.

However, since the 1990s, a major project has been launched around the world to provide science education for young schoolchildren aged between 6 and 16 (from the age of 3 in some countries, such as France). This project sought to address the serious shortcomings of science education in almost all countries, namely its low presence and a "vertical" pedagogy, neglecting or ignoring the practice of observation and experience. Offering an *inquiry-based* education adapted to the natural sciences, this project was initiated by renowned scientists. Developed in nearly a hundred countries as pilot projects, sometimes structurally penetrating school curricula and teacher training, it has been significantly extended in France, under the name *La main à la pâte* [Charpak et al. 2005; Fondation La main à la pâte 2020]. Its guidelines are to support teachers — primary, middle and secondary school — in teaching attractive science, involving the active participation of students in observation, experimentation, formulating hypothesis, argument and reasoning. The success of this endeavour relies on a scientific community closely associated with the support and professional development of teachers, the production of resources relevant to the classroom, within the creation of national, regional and international networks. The considerable development of these actions around the world has contributed to the development of wonder, curiosity, imagination, rationality and understanding of the process on which science is built, in more than ten million young schoolchildren.

Many of the lessons about supporting teachers or producing educational resources, drawn from teaching the natural sciences during this quarter-century, can be transposed to climate change education, even if it must be extended to the humanities and social sciences, and include an ethical dimension. Scientific notions are more complex, the young child will only grasp very broad lines, and he will also be prepared for a moral virtue of attention, respect, trust, and personal commitment.

## 5. The Office for Climate Education

In 2017, this successful model of a renewed pedagogy of the natural sciences provided a solid foundation for a specific and original, international project focused on climate change education and the goals of Art. 12 of the Paris Agreement. This project was conceived following COP21 in 2015, during a reflection conducted between the Academy of Sciences and the French Development Agency (Colloquium 2016), then built through an in-depth dialogue with climatologists and educational networks (Vatican Colloquium 2016). After a feasibility study within the Fondation *La main à la pâte* in France, in line with the recommendations of the Academies, the project led to the creation, in March 2018, of an Office for Climate Education (OCE).

The Office for Climate Education aims to accompany the IPCC reports by making available to the teaching profession worldwide, *Summaries and Tools for Teachers*, consistent with the inquiry-based pedagogy mentioned above, prepared in close collaboration with a network of actors in the world led by the OCE and with the scientific community, in particular the *Technical Support Units* of the three IPCC working groups and the Academies of Science [Office for Climate Education 2019]. The main target of the project is aimed, through teachers, at young people in the age group mainly ranging from 9 to 16 years, without ignoring secondary school. This choice leaves to other bodies the equally essential responsibility of developing university education. Many communication actions in the broadest sense,<sup>1</sup> many climate education resources already exist around the world, and are available on the Internet, most often in English. The originality of the project is to specifically address education systems and teachers, to offer them a precise pedagogy that has proven its worth and to

---

<sup>1</sup>Here are some examples: In Hamburg, Germany, the *International Climate Change Information Program* (ICCIP: <https://www.haw-hamburg.de/en/ftz-nk/programmes/iccip/>); in the United Kingdom, the *Climate Outreach and Information Network* (<https://climateoutreach.org/>); in France and towards universities, the *Shift Project*, thinktank of the carbon transition (<https://theshiftproject.org/>); in the United States, *Teach the Earth*, producing resources for professors (<https://serc.carleton.edu/NAGTWorkshops/climatechange/index.html>).



provide them with a variety of multilingual means to implement it, all based on a constant commitment of scientists. To date, such synergy does not generally exist.

In 2019, during its first year of existence, the ECO organised ten national or regional events (Asia, Latin America, Africa, France), involving more than 400 teachers and trainers and accumulating more than a thousand hours of training. In line with the above, multilingual summaries for teachers have been produced and disseminated on the occasion of the IPCC Reports on *Global Warming of 1.5° C* (2018) and *Ocean and Cryosphere* (2019), another summary is being prepared on *Land*. A wide variety of classroom resources, also in line with the educational principles of investigation and projects, are being produced and widely disseminated. Their design and implementation combine a global climate vision and essential local variations, carried out within a large international network of partners. At the beginning of 2020 and on the proposal of the French government, the ECO project was recognised by UNESCO, which granted it the status of "Category 2 Centre under the auspices of UNESCO", thus facilitating local dialogues with educational bodies.

Let us illustrate with a few examples these different tools made available to the educational community.

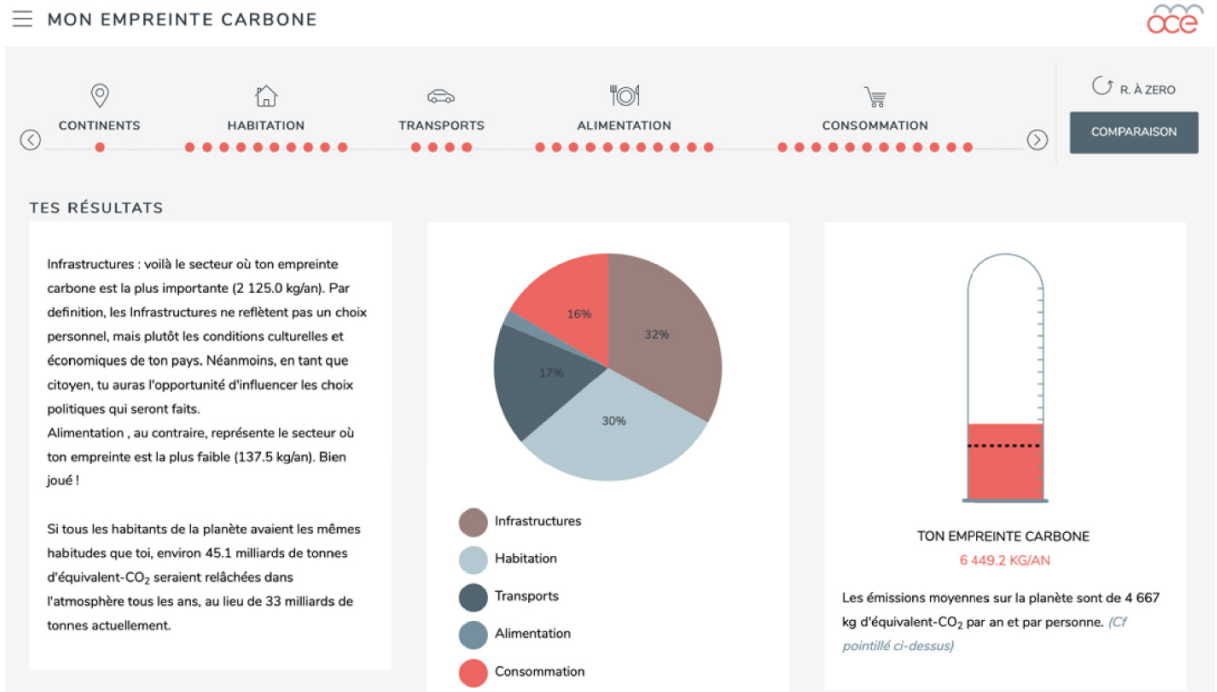
(a) The *IPCC Special Report Global warming of 1.5° C — Summary for teachers* is an explanation, made available to teachers, of the scientific content of this report. It is introduced by this quote: *Each degree matters, each year matters, and each decision matters: not acting today is adding to the burden of the next generations [...]. Limiting global warming to 1.5° C is not impossible but requires strong and immediate policies* (V. Masson-Delmotte, this colloquium, 2020). The document contains, in about 20 pages, the main conclusions of the IPCC, with simple vocabulary and figures, exercises and links for further reading. Published online and in four languages (French, English, German, Spanish), it is used during teacher or trainer training sessions, and can serve as a common basis for pedagogical developments implemented in different local contexts, depending on the region of the world [Lescarmontier, 2018]. A similar Summary for Teacher was produced in 2020 to accompany the IPCC Special Report "Ocean and Cryosphere" [Lescarmontier, 2020].

(b) In support of the IPCC's "Ocean and Cryosphere Report" (2019), a developed teaching guide has been prepared, tested in many classes and published under the title *The climate in our hands. - Ocean and Cryosphere* [Rocha and Wilgenbus, 2019]. The proposed activities help to develop pupils' scientific knowledge and skills as well as their critical thinking, but also to raise their awareness of environmental and social issues and to encourage their creativity. This guide is therefore highly multidisciplinary, based on traditional scientific disciplines, on the human and social sciences, as well as on the arts and physical education. It implements active pedagogies such as the inquiry approach or project-based learning. It includes a variety of proposals, which teachers can adapt according to the level of their pupils and the local context.

This teaching guide is the first in a series that will cover future IPCC reports. It is structured in four parts: an accessible and detailed *scientific perspective*, in particular, to enable the teacher to accept the questions of his pupils without fear; a *pedagogical perspective*, contributing to an active approach of the pupils; a series of thematic sessions under the title "*We understand*", which include experimentation, role-playing, encouraging debate and group work, literature review; and finally the series "*We act*", during which the class chooses, designs and implements an action plan, aiming to mitigate, adapt to or raise awareness of climate change: the pupils become actors of change in their environment and community. Very short videos of climatologists and multimedia animations complement the tools offered to teachers (Figure 1).

These educational resources, available to all, also support intensive week-long professional development actions of teachers, organised specifically with local educational collaborations, in many countries, especially in developing countries. An international network of partners, particularly in Latin America and South-East Asia, makes it possible to gradually structure a community of practice and as closely as possible to the field, locally disseminating the proposed scientific and educational content.

It is worth mentioning here another approach, complementary to that of ECO, and also coming from the scientific community. TROPICSU was initiated in 2018 by Lingadahalli S. Shashidhara, a biologist and professor at the University of Pune (India). This initiative received the support of the International Council of Scientific Unions (ICSU, integrated into the International Council for Science in 2019). The original aim is to offer teaching sequences on climate change that can be used at the end of secondary school or at the beginning of



**Figure 1.** The carbon footprint is one of the interactive animations in the "Climate in our hands" Guide [Rocha and Wilgenbus, 2019]. This sequence, proposed by the teacher, aims to encourage young people to take an active stance on their carbon footprint, with multiple adjustable parameters.

university, regardless of the specialisation of the course taught. The offer is diversified and includes courses dominated by physics, chemistry, environment, geography, social sciences, etc. A detailed analysis of the scientific and pedagogical quality of the extremely diverse resources available on the Internet is carried out by the Pune group. From these, lesson plans are constructed, adapted to the specialisation and level of the pupils, as well as to the region of the world. Workshops for educators are held in India and other regions, including Africa and Latin America [Tropicsu 2020].

## 6. Conclusion

Scientific education for all young people, from primary school onwards, seems to be essential to make tomorrow's societies capable of tackling the ecological transition and acquiring the basic elements needed to understand and act on it. The climate theme is well adapted, as it includes key elements of the "hard sciences" while requiring other skills, relating to the human and social sciences, and finally, others linked to value choices. Given this need, its translation into pedagogical terms for the benefit of hundreds of millions of children around the world is an endeavour as daunting as it is urgent, which can only be achieved with a great many contributions and initiatives. These will have to aim at school curricula, but equally and perhaps even more at teachers who, in the current state of education systems, are far from being prepared for such a highly interdisciplinary objective.

Alongside institutional actors and NGOs, the scientific community is already mobilising to support them, and will have to do so in the coming years on a much wider national, regional and global scale. It is certain to be met with the teachers' concrete yet sometimes apprehensive expectations, and to then respond to a deep demand of the youth, whose creative commitment will be necessary to achieve decarbonised societies.

## References

- Accord de Paris (2015). United nations framework convention on climate change. [http://unfccc.int/files/essential\\_background/convention/application/pdf/english\\_paris\\_agreement.pdf](http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf).
- Agenda ONU (2015). <https://www.un.org/sustainabledevelopment/development-agenda/>.
- Allea Report (2020). *A snapshot of Climate Change Education Initiatives in Europe*. <https://allea.org/publications/>.
- Aykut, S. C. and Dahan, A. (2014). *Gouverner le climat ? 20 ans de négociations internationales*. Fondation des sciences politiques, Paris.
- Blamont, J. (2018). *Réseaux. Le pari de l'intelligence collective*. Cnrs Éditions edition.
- Bony, S., Stevens, B., Helt, I. H., et al. (2013). Carbon Dioxide and Climate: Perspectives on a Scientific Assessment. In Asrar, G. and Hurrell, J., editors, *Climate Science for Serving Society. Research, Modeling and Prediction Priorities*, pages 91–414. Springer, Berlin.
- Brundtland, G. H. and World Commission on Education and Development (1987). *Our Common Future : Report of the World Commission on Education and Development*. Oxford University.
- Charney, J. G., Arakawa, A., Bolin, B., et al. (1979). *Carbon Dioxide and Climate: A Scientific Assessment. Report of the Ad Hoc Study Group on Carbon Dioxide and Climate*. National Academy of Sciences, Washington (D.C).
- Charpak, G., Léna, P., and Quéré, Y. (2005). *L'Enfant et la science*. O. Jacob, Paris.
- Clean (2019). [https://cleanet.org/clean/educational\\_resources/index.html](https://cleanet.org/clean/educational_resources/index.html).
- Conseil supérieur des programmes (2019). <https://www.education.gouv.fr/renforcement-des-enseignements-relatifs-au-changement-climatique-la-biodiversite-et-au-developpement-5489>.
- Eduscol (2020). <https://eduscol.education.fr/cid143130/enseignement-scientifique-bac-2021.html>.
- Farina, M., Pasquinelli, E., and Zimmermann, G. (2018). Esprit scientifique, esprit critique. In *Un projet pédagogique pour la classe*. Le Pommier, Paris.
- Fondation Jean-Jaurès (2019). <https://jean-jaures.org/nos-productions/enquete-complotisme-2019-les-grands-enseignants>
- Fondation La main à la pâte (2020). <http://www.fondation-lamap.org>.
- Godwaldt, T. and Karsgaard, C. (2018). International Youth White Paper on Climate Change. Education and Cities. IPCC and University of Edmonton (Alberta, Canada).
- InterAcademy Partnership (2017). A statement on climate change and education. (Léna, P. and Chanin M. L., coord.). <https://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/une-declaration-sur-le-changement-climatique-et-l-education>.html.
- IPCC, Intergovernmental Panel on Climate Change (1988). <https://www.ipcc.ch/>.
- ISC, International Council for Science (2017). *A Guide to SDG Interactions: from Science to Implementation*. International Council for Science, Paris.
- Jouzel, J. and Larroustourou, P. (2017). *Pour éviter le chaos climatique et financier*. O. Jacob, Paris.
- Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C.-Y., and Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, 5:1014–1023.
- Lescarmontier, L. (coord.) (2018). Rapport spécial du giec. réchauffement global de 1.5 °c. résumé à destination des enseignants. Office for Climate Education, Paris. <https://www.oce.global/fr/resources/resumes-pour-enseignants/rapport-special-du-giec-rechauffement-15degc-resume-destination>.
- Lescarmontier, L. (coord.) (2020). Rapport spécial du giec. l'océan, la cryosphère et les changements climatiques. résumé à destination des enseignants. Office for Climate Education, Paris. [https://www.oce.global/sites/default/files/2020-04/OCE-RAP\\_SROCC-EN-10-WEB.pdf](https://www.oce.global/sites/default/files/2020-04/OCE-RAP_SROCC-EN-10-WEB.pdf).
- Masson-Delmotte, V. (2019). Pour une culture générale du climat. In *Les Cahiers pédagogiques*, volume 551. Février.
- NPR-IPSOS (2019). Most teachers don't teach climate change. <https://www.npr.org/2019/04/22/714262267/most-teachers-dont-teach-climate-change-4-in-5-parents-wish-they-did>.
- Office for Climate Education (2019). <http://www.oce.global>.

- Pape François (2015). *Laudato si'*, lettre encyclique. [http://www.vatican.va/content/francesco/fr/encyclicals/documents/papa-francesco\\_20150524\\_enciclica-laudato-si.html](http://www.vatican.va/content/francesco/fr/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html).
- Ramanathan, V., Han, H., and Matlock, T. (2017). Educating Children to Bend the Curve. In A., B., Léna, P., Sanchez Sorondo, M., and von Braun, J., editors, *Children and Sustainable Development. Ecological Education in a Globalized World*. Springer.
- Ramanathan, V., Millar-Ball, A., Niemann, M., and Friese, S. (2019). *Bending the Curve: Climate Change Solutions*. The Regents of University of California.
- Rectorat Créteil (2019). Enquête Éducation au développement durable. [http://edd.ac-creteil.fr/IMG/pdf/edd-enquete\\_2019-20.pdf](http://edd.ac-creteil.fr/IMG/pdf/edd-enquete_2019-20.pdf).
- Rocha, M. and Wilgenbus, D., editor (2019). *Le climat entre nos mains. Océan et cryosphère, manuel à destination des enseignants du primaire et du secondaire*. Office for Climate Education, Paris. <https://www.oce.global/fr/resources/activites-de-classe/le-climat-entre-nos-mains-ocean-et-cryosphere>.
- Shift Project (2019). Mobiliser l'enseignement supérieur pour le climat. <https://theshiftproject.org/article/nouveau-rapport-mobiliser-superieur-climat/>.
- Tropicsu (2020). Climate change education, across the curricula, across the globe. <https://tropicsu.org/>.
- UN CC:Learn (2009). <https://www.uncclearn.org/>.
- Unesco (2016). *Éducation pour les peuples et la planète'. Global Education Monitoring Report 2016*. Unesco, Paris.
- United Nations Framework Convention on Climate Change (UNFCCC) (1992). <https://unfccc.int/>.
- Wallenhorst, N. and Pierron, J. P. (2019). *Éduquer en Anthropocène*. Éditions Le Bord de l'eau. 33310 Lormont.
- Zimmermann, G., Pasquinelli, E., and Farina, M. (2017). *Esprit scientifique, esprit critique. Un projet pédagogique pour l'école primaire*. Le Pommier, Paris.