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Participating the climate change in school: an Italian case study

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Introduction

The challenge of global climate change need a large effort for providing the public with the best information possible, establishing and sustaining a genuine sharing of understanding between science and society. Within this frame, a project involving teachers, families and stakeholders was realized – starting January 2009 ending April 2011- with the support of the European Commission Funding Programme LIFE+: R.A.C.E.S. – Raising Awareness on Climate Change and Energy Savings.
R.A.C.E.S. involves five partners: the scientific partner Institute of biometeorology of the Italian National Research Council (CNR Ibimet), the Municipality of Florence, acting as project coordinator, the Municipality of Modena and the EuropeDirect offices of Bari, Potenza and Trento. Main objective of R.A.C.E.S. is to set up an awareness raising campaign on climate change issues in the five partner cities providing citizens with an accurate information context on the local dimension of climate change, linking information and educational aspects with the experimentation of eco-friendly and energy saving consuming patterns.

In order to develop an effective information and education action, firm belief was the need to apply a bottom-up approach, starting from the ideas, opinions and attitudes expressed from the targeted publics: before planning and implementing the communication actions, a qualitative research was realized in the five Italian cities involved in the project, with families representatives, teachers and stakeholders. In addition to this phase, a quantitative survey, based on the qualitative findings, was conducted on a sample of 130 teachers with the aim of measuring the meanings they ascribe to the climate change, their interest in work on this theme in their classes and which are the educational tools more adequate to work with.
Subject of this paper are the qualitative and quantitative findings of the research with the teachers on one side and the description of the information materials for schools developed under their opinions and suggestions by the promoters of the project.

1. Background

The need for an effective participation of citizenship in the public debate of scientific issues is largely argued in the field of the Science and Technology Studies (Funtowitcz 1993, Carvalho 2008, Felt and Fochler, 2008).
In the era of the global crisis represented by the climate change, scientific and technological causes and consequences are more and more important in the public debate agenda (Ford, 2008): after the crucial tipping point represented by the year 2007, climate change has became a matter of respect and urgency for the general public, as most of the surveys on this issue show (Eurobaromenter, 2009, Carvahlo, 2008). As far as the Italian country, a 2008 survey (*Science in Society Monitor*,

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Observa) demonstrated that 90% of Italians are convinced that the earth climate is warming up, and over one fifth consider climate change as the most relevant problem at global level, second to poverty in the developing world the only and well before other potential sources of worry, such as religious conflicts or economic crisis.
Moser and Dilling (2007) stressed that promoting social change to address climate change faces a number of hurdles but is ever more pressing; involving youngster is of crucial importance to help transforming the culture of future generations showing the limits of consumerism on earth resources.
On the school side, researches on young people and science in society issues showed that teachers are of great importance in orienting opinions and raising awareness not just among their students, but also as vehicles between students and their families (Gouthier and Manzoli, 2008).
We consider the teachers as a most effective mediator between the students and the "outer world" and they are therefore a fundamental target to achieve the goal of raising awareness on the topic of the climate change. That's why R.A.C.E.S. considered school and teachers as a main target inside the project activities.

1.1 The Italian school environment

In order to develop effective tools and materials for the schools, together with the results of our research, we took in consideration the latest recommendations of the European Commission, which stated that the European school needs innovative practices in teaching and sensitize youngsters on scientific matters and that teachers play a fundamental role in the renewal of science education (EC, *Report Rocard*, 2008).

In today's Italian school system teacher's explanations, textbooks, and classrooms lessons are keeping their role as main vehicles of education. With the boom of interactive information technology, teaching and learning models have been slightly evolved, to integrate the new technologies in the instructional framework. Anyway, the traditional one-way teaching/learning mode still prevails and a serious gap between generations enlarged.
Today's students grow up surrounded by computers, videogames, video cams, cell phones and all the other digital tools. Since 2001 Prensky describe the young people as "digital natives" and affirm that "today's students think and process information fundamentally differently from their predecessors", due to an innate confidence in using technologies as part of their everyday life. Within this context it's clear that face-to-face conveyance of knowledge could reveal itself as inadequate in some circumstances. Many teachers are aware that current educational system do not satisfy the requirements of today's students anymore, and that they are not a correct answer to the complexity of current organization of knowledge and information. More and more teachers are accepting the challenge of new information technologies trying to meet the new learning skills and competences of today students. (Ferri, 2008)

Therefore, teacher's role is becoming more complex every day. In order to improve the effectiveness of the education for the new generations of students, the contribution of various factors/actors is required:

- systemic education's reform;
- cooperation between teachers and researchers to develop didactic tools useful and appropriate to "new" student's ways to learning and absorbing knowledge;
- cooperation between teachers and students to compensate reciprocal gaps.

Moving over the academic debate about "digital natives" vs. "digital immigrants", many studies agree that digital technologies have a great potential for improving learning and teaching. In the field of science education, Kim assert that "technological advances have yielded tremendous

opportunities for transforming science learning and teaching: collecting and analyzing data, modeling, and communicating results; locating and representing information in dynamic and interactive ways" (Kim et al., 2007).

Computer-based tools potentially could improve inquiry based activities in classroom. Obviously, technology *per se* is neutral. It is important, therefore, to understand the factors involved in technology-enhanced scientific inquiry and develop well-designed computer tools able to support students' inquiry processes.

1.2 The opportunity of interactive geography

Many researchers affirm that geographic browser, like Google Earth (GE), "will turn into important tools for education, awareness-raising, and informed decision making" (Craglia et al., 2008). 3D animations and modeling tools have enabled students to explore and observe relationships between factors and variables. Google Earth provides an easy way to visualizing scientific concepts dynamically and it's "an excellent visualization aid" (Butler, 2006) that increase students understanding of complex and abstract environmental phenomena, as climate change.
At the same time GE enable students to work collaboratively on the construction of knowledge and represent an interactive and exploratory tool and a laboratory for learning and for multidisciplinary education and science (Craglia et al., 2008).
Indeed, leaving aside its value as a merely didactic tool, GE is a great way to integrate Web 2.0 technology into the teaching frameworks. Students can have an active role to create content, and they become "source of knowledge" and not only "passive recipient".

2. Methods

As far as the qualitative research is concerned, the method used was that of the focus group discussions (Maxwell, 2008, Bauer and Gaskell, 2000). The whole research comprehended fifteen focus groups in five Italian cities, from the very North to the very South of the country: Trento, Modena, Firenze, Potenza, Bari. The three core targets were teachers of the first and second school grade (covering part of the compulsory school and the high school, corresponding to students in the age 10-18), stakeholders (NGOs representatives, administrators, representative of the local agency for gas, energy, water distribution, etc.) and families representatives[2].

Fig. 1: The 5 cities involved in the project R.A.C.E.S.

[2] With representatives of families we mean people in their working life, either female and males, with children. So to have a complete comparison among stages of life, we also included some retired participants and singles.

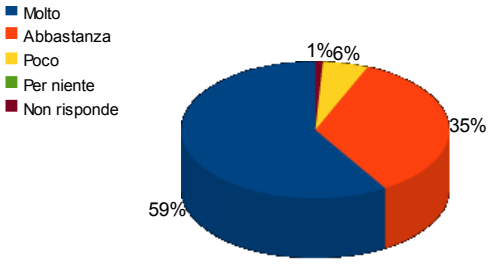
Main topics of the discussion concentrated on the perception of the climate change, the main local issues on the problem, the best communication activities and contents hold as effective to involve the citizenship and the schools in particular. Data were analyzed using the traditional paper-pencil method (Bauer and Gaskell, 2000), enriched with the text analysis software T-Lab. Beside the classical discourse analysis, the use of this software allow to use a set of linguistic and statistical tools for content analysis and text mining (Lancia, 2009).
On the base of the qualitative findings a questionnaire directed to a sample of teachers of the same school grades as the qualitative research, from different scientific disciplines, most of them in the region of the scientific coordinator (65% of the respondents from Tuscany). Questions have focused on the existence and the causes of the climate change, on the local impacts, the possible solutions (regarding either the mitigation and the adaptation), the actors responsible for a change, teachers' previous experience in activities related to the climate change, the need for refresher courses on this topic, the actual and potential tools more suitable to teach and raise the interest of their students, and web tools in particular.

3. Results

3.1. Social research results

Results of the qualitative and quantitative research show a sound consistency with the major qualitative and quantitative surveys in the Anglo-Saxon and European contexts: people tend to mix the idea of whether and climate, the first action they are willing to enterprise in favor of the mitigation is recycling, followed by a reduction of the energy consumption. After all, however, the use of the car is the less practicable countermeasure. Participants think that the climate change is due to the human modernity (conveyed by concepts as "social evolution", "irresponsible development", "economical model") and only secondly to natural causes. Its effects will take to the global warming, to the growing of natural disasters and to dangerous relapses to the human health. A great emphasis is posed on the extreme alarmism spread by the Italian media. In terms of education and communication actions, focusing on the local dimensions emerges as the best strategy to motivate people in adopting more sustainable behaviors.
Teachers in particular show a very high awareness of the existence of climate changes, and they definitely ascribe the causes to human activities.

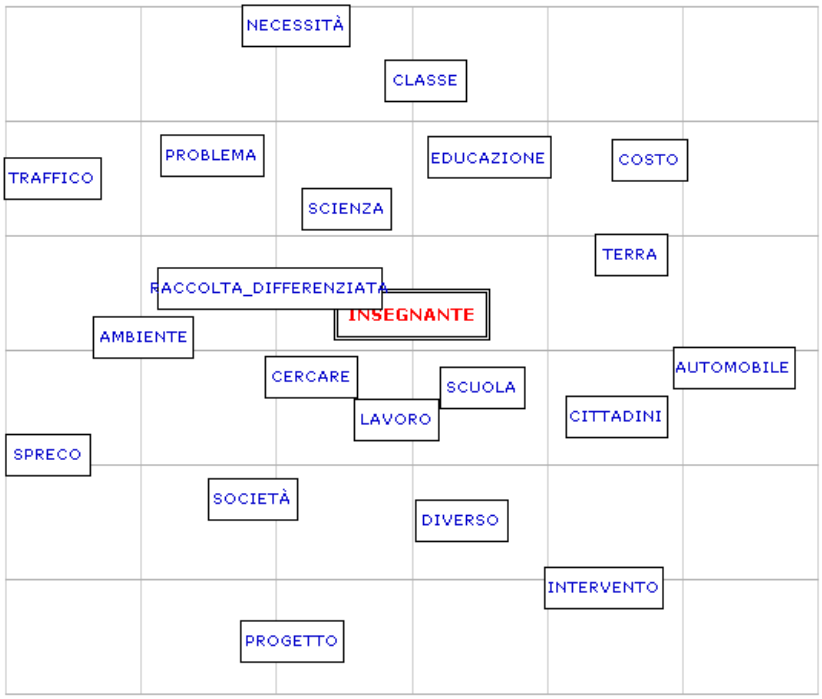
Graph 1. Do you think a climate change is going on? ("non so" = I do not know)



Graph 2. Is climate change related to humans activities? ("molto" = very much related, "abbastanza" = quite related)

Positioning the word "teacher" at the centre of the association map obtained through the software Tlab on the whole text corpus (graph 3), the words more frequently associated result: *recycling*,

science, *work*, *school*, *education*, *environment*, *family*, *society*, *project*, *waste* and *costs*. These words explain the scientific approach from which teachers start to talk about climate change.



Graph 3: Association map around the word "teacher"

Matching these results with the traditional text analysis (discourse analysis), it emerges the frequency – and importance - of the most practicable measure to contrast the environmental problems, as the recycling is. Teachers have a wide view on the issue of climate change and connect the world of the school with that of the family and with the society in its whole. This connection introduces in their discourse the wide issue of the *responsibility* (Olausson, 2009, Pellizzoni and Osti, 2003). In respondents' opinion, the *international community* first and then the *European Union*, the *State* where they live and, following, the *local administrations*, the *citizens* and the *school* are responsible for enterprising action to contrast the climate change and its impacts. At the same time, teachers recognize their important role in connecting their actions with that of the students and, consequently, with their families.
Moreover, in the association map in graph 3, words as *waste* and *costs* confirm the importance of the economic issue strongly argued by teachers. These two words evoke two main issues: the *waste* in terms of energy dispersion in the schools' buildings on one side, and the *costs* for enterprising activities with students on the other. Burocracy obstacles in starting with new projects and the lack of economic incentives to the teachers who carry on new *projects* (in all the sectors outside the legal curricula) represent the main barrier in committing themselves on the themes of the sustainability and climate change. On the other side, interdisciplinarity, which correspond to a peculiar feature of projects on climate change, represents an ideal incentive, in theory, while it is widely denied in the practice: collaboration among teachers from different disciplines realizes quite rarely given the strict schedule and school programs.

Regarding the actions to contrast the impact of the climate change, in general terms, in teachers' opinion the most adequate measures to take to a greater awareness on climate change cover the area of communication and education on one side and the area of the policy on the other. As showed in graph 4, more information and education, a change in consumers' behavior, promotion of recycling,

policy making and a overcoming of the modern individualism are the ideal measure.

Graph 4. Which are the most adequate measures to face the climate change?

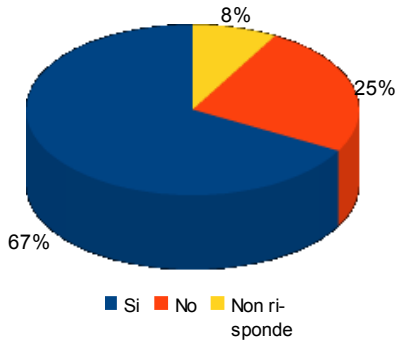
Concretely, in order to realize activities on the climate change in the school, teachers support the *philosophy of practice*: much attention is posed to inquiry-based activities, whether for the action already realized and for the proposals they advance. Some examples are reported in the following quotations:

> *You need to show facts and not theories. Here in the mountains there is the need to put young people in contact with the nature.* (city: Trento)
> *A concrete approach is needed. Students want to see more than listen: teachers should take them to the river, to monitor the quality of the water with the help of instruments.* (city: Florence)

Central actors are institutions (scientific institution, administration, services in the field of environment), able to supply competences and concrete tools for implementing the projects, as measurement instruments, meetings with scientists, projects in collaboration with research institutes, multimedia, websites for students:

Graph 5. What are the most effective tools to work on the theme of the climate change in school?

Great attention has to be posed, finally, on the teachers background: even when coming from scientific studies, often they do not have a sufficient competence for covering the theme of the climate change, even at the middle high school level.



Graph 6. Would you need refresh courses on the theme of climate change?

The highly declared need for refresh courses (see graph 6) confirm the necessity of training actions for teachers and the request of tools for facilitating the education activities in the school.

4. Discussion: the project SCHOOL KIT on line

Starting from the research outcomes, R.A.C.E.S. developed a set of information materials and tools to help teachers working on climate change and sustainability issue in classroom. All the product were distributed through the web site www.lifeR.A.C.E.S..eu inside the section "At school", realized in order to build an homogeneous environment where teachers would satisfy the information needs highlighted in the research: downloading information materials; creating collaboration with local stakeholders and researchers, finding tools based on practical approach to involve and engage students also in behavioral change. It was also developed a Web 2.0 application using Google Earth as a way to deliver information on climate in a more effective and powerful visual format and allowing students to contribute actively in the project.

A "School kit" was published inside the R.A.C.E.S. web site offering different information material and proposing exercises and activities. The R.A.C.E.S. school kit was conceived as an "open product", following the idea that delivering information is just the first step of the engagement process and a real participation needs a more collaborative approach, where students and teachers are involved with practical and collaborative activities. Conceived as a project to raise awareness on environmental priorities related to climate change, R.A.C.E.S. primarily intend to promote behavioral change; in doing so R.A.C.E.S. worked to transform awareness in action offering opportunities to students to be involved in something concrete and strengthen their personal engagement in their local community. This is consistent with the researches underlying that only the "engaged" citizens are generally found to be really committed to change their habits towards less carbon intensive lifestyles putting attitudes in practice (Lorenzoni et al., 2001).
This is the underling approach of the whole R.A.C.E.S. project and of its school activities.

4.1 Formal educational tools

The School kit is composed of more **formal education** materials and informal ones. For the formal tools the project produced:

- **4 booklets on climate change** dimension, impacts and solutions: "Climate Change. Signals"; "Changes underway. Impacts"; What's happened. Causes"; facing climate change. Solutions". This booklets in Italian contains the most important output of the IPCC 2007; the 2008 European Environment Agency Report on Climate Impacts; The Italian 2008

environmental Report of APAT (Italian Agency for the Protection of the Environment) and its special chapter on Climate Change. The booklet are conceived as communication materials to presents accessible information and high impact pictures

Figure 2: The 4 booklet on Climate Change

- The publication "**Climate is changing in town**" facing the local dimension of climate change in the five cities partners in R.A.C.E.S.: Trento; Modena, Florence, Bari and Potenza. For each city the publication illustrates the local climate and the changes occurred in the last ten years; the environmental vulnerabilities related to recent changes; the local best practices to save energy and promote a more sustainable environment.
- **Free resources**: a collection of videos, web sites, blogs, teaching networks, didactical resources, scientific and institutional references, other school project on climate and sustainability. This last thing in particular respond also to the need expressed by teachers to get in contact with colleagues working on the same issues or simply to be informed of other schools' projects to share experience and results.
- **Exercises**: a set of proposed exercises, organized in the web site section "To exercise", that can be used by teachers to works with students on climate change and sustainability issues always having in mind an hands-on approach. Here some examples:

    - ***Temperatures' analysis***: *Download the file with the historical series of global temperatures* ***t****o work with students making analysis and graphs. Search local data for your city, make elaborations and publish results on R.A.C.E.S. web site on the web page dedicated to Observations.*

    - ***Climate and history***: Take a look at the scheme of climate evolutions through ages to reflect on how climate influenced history and men's evolutions. Use the file. Read the article on "Climate and history" (in italian) on meteogiornale: http://www.meteogiornale.it/news/read.php?id=9312

    - ***Mind maps****:* Write at the centre of the board the expression "Climate change" and writes words and comments arising from students discussion. Split students in small groups to discuss some of the issues like "Am I convinced about the evidence of climate change?"; "Which are the basis of this belief?" (direct experience, scientific articles, media coverage); etc. Finally each groups will report to the whole classroom. We suggest you to make this exercise before making lessons on the issues as not influence students views and opinions.

    - ***A climate rap!:*** Watch the video You Take aim at climate change. Great for students! Science in music http://passporttoknowledge.com/polar-palooza/whatyoucando/taacc/. Download the lyric and work with students to translate it into Italian.

Through this material we tried to answer to different **needs expressed by teachers** in the research:

1. Request of tools for facilitating the education activities in the school (concrete tools for implementing the projects, as measurement instruments, meeting with scientists, multimedia, websites for students...);
2. Teachers support the philosophy of practice: much attention is posed to inquiry based activities (EU, Report Rocard, 2008), either for the action already realized and the proposals they advance;
3. Propose an interdisciplinary approach to climate change and sustainability projects in school, even if this is widely denied in the Italian schools' practice where a true collaboration among teachers from different disciplines is quite rare;

4.2 Informal educational tools

The school kit was also composed of informal education activities **proposed to students through the web sites and local partners** to involve actively the schools into the project.

- **Action research**: the opportunity to take part in the social research run by R.A.C.E.S. to help project partners and researchers to better understand motivations behind environmental friendly behaviors. An experiment of social research offered to two classes in Florence working together with researchers through focus groups and facilitated meeting with the aim of organizing a public action on climate change in town.
- **Carbon budget**: a invitation to students to join in the carbon budget with their families. The carbon budget will help families to monitor along 10 month their domestic carbon emissions associated to their electricity, heating and mobility consumes.
- **Create your communication Campaign**: How would students communicate to peers climate change urgency? An invitation to be creative and work in classroom to produce a proposal for a campaign in your city; better examples will be hosted during the raising awareness exhibition (Climate is changing in town) organized by project R.A.C.E.S. in the five cities Firenze, Modena, Trento, Bari e Potenza in Spring 2010.
- **Observations and interactive geography**. The real innovation side of the project! A proposal to use Google Earth on the web site page dedicated to "Observations" to see in real time how climate is changing globally and locally. Students are invited to become "researchers" collecting and producing information on their territories and publishing into the Google Earth as signpost.

4.3 Interactive geography for climate change

R.A.C.E.S. proposed to use a Google Earth application to encourage a Web 2.0 approach where teachers and students become active information producers improving the information and project communication.

Social networking and Web 2.0 offer great opportunities to strengthen the collaboration between scientist and users (in the case of R.A.C.E.S. teachers, students and local actors) and to include information provided by users: local community are in fact the best source of knowledge about local environment. The Google Earth is used in R.A.C.E.S. as a way to disseminate school's activities using the geographic environment as the cognitive frame where produce and share contents related to global change issues. Using a Web 2.0 participative approach users, like teachers or students, would be able to:

- Browse geographically the information content produced by the project and by other schools
- Produce and share the information produced during school activities thus collaborating in the creation of local content/data sharing generating "volunteered geographic information" (Goodchild 2007/b).

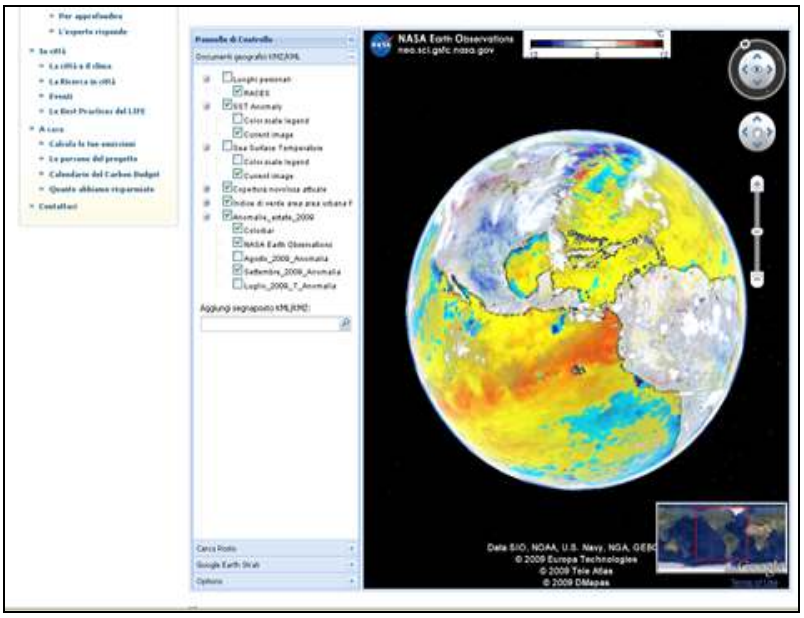


Figure 3. A screenshot of the R.A.C.E.S. web pages of the GE application

Inside the web page Observations http://www.lifeR.A.C.E.S..eu/node/169 Ibimet using an i-frame, the Google Earth plug-in and the library developed by http://blog.thematicmapping.org/ showed the globe with of specific information layers on climate variability. Users are invited to implement the information with local data using signposts.

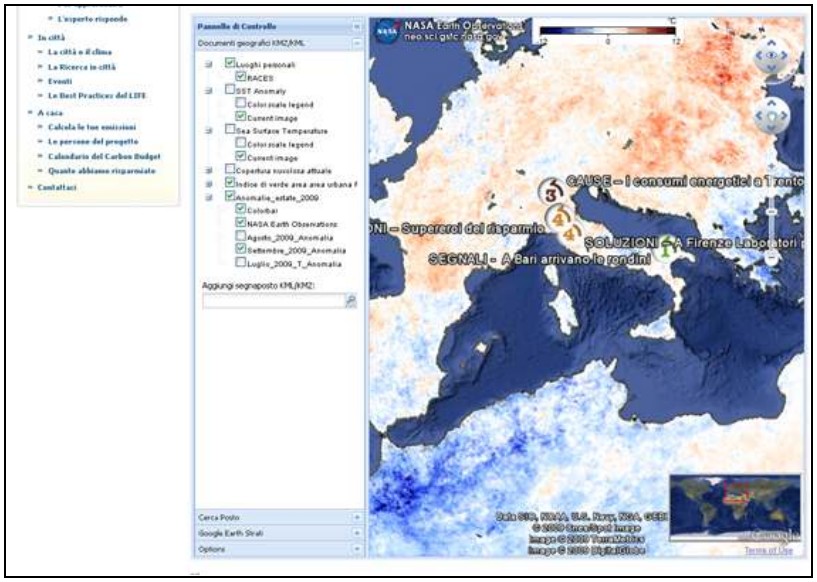


Figure 4. A screenshot of the R.A.C.E.S. web pages of the GE application with the signposts

The Goggle Earth tool in R.A.C.E.S. is conceived to:

- Offer teachers and students a more attractive and easy way to organize information in a geographic environment to understand climate change dynamics

- Propose an easy way to produce content and publish them on the web so to stimulate a co-production of the project web site;
- Invite student to became "observer, researcher and producer" of local information on their community environment following an IBSE approach;
- Integrate climatic information layers with "local observations" uploaded by teachers and students
- enable students and teachers to **make collaboration at local level** (municipalities, museums, companies, foundations, parents, teachers, etc.) as a way to put resources in common to foster local changes;

This call on participation answer to some requests highlighted by teachers during the qualitative and quantitative research:

- Request of tools for facilitating the education activities in the school (concrete tools for implementing the projects, as measurement instruments, meeting with scientists; multimedia, websites for students...);
- Collaboration with research institutes;
- Didactical tools that respond to the approach of philosophy of practice, the need of direct students involvement;
- Teachers' request to be connected in activities in the community outside the school institution.

5. Conclusions

Although R.A.C.E.S. is still a work in progress (the project evaluation will end on April 2011), we can draw some preliminary conclusions.

First of all, school confirms itself as a key actor in communication on climate change and local responses. Inside the R.A.C.E.S. *process* teachers have been involved both in the research study, as fundamental information sources, and in the communication actions, as key actors at local level: this double strategy showed to have real impact both in terms of scientific and communication results. Starting from their idea of climate change and sustainability, which showed to be completely lined up with the current surveys on this topic, their contribution has been of real usefulness in building local strategies and effective tools.

Thanks to this bottom-up process, a better involvement of the teachers participating at the research phase, and their colleagues, using tools coming from the same interest group, can be obtained.

Secondly, we found an effective formulation of our philosophy from what stated in the last edition of "*State of the World 2010: Transforming Cultures - From Consumerism to Sustainability*" published by World Watch Institute: "without an intentional cultural shift that values sustainability over consumerism, no government pledges or technological advances will be enough to rescue humanity from unacceptably hazardous environmental and climate risks".

In its local dimensions, and as an experiment of participative democracy, the R.A.C.E.S. process demonstrates that school could collaborate actively to better understand the regional dimension of climate change, inviting students to became local observer of changing climate. Youngsters are crucial actors of local community and changing their culture is fundamental to shape a sustainable future.

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