



CONFÉRENCE

L'APPRENTISSAGE DES SCIENCES DANS L'EUROPE DE LA CONNAISSANCE

Grenoble, 8 et 9 octobre 2008

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SCIENCE LEARNING IN THE EUROPE OF KNOWLEDGE DETAILED PROGRAMME

Wednesday morning, 8 October

- 9 am** Word of welcome from **Jean SARRAZIN**, chief education officer at *l'académie de Grenoble* (France), Delegate-General of the conference;
Word of welcome from **Michel DESTOT**, Grenoble's deputy mayor
- 9:20 am** Inaugural session:
Jean-Louis NEMBRINI, Director-General of School Education, ministry of education (France);
Mariano GAGO, minister for science, technology and higher education (Portugal);
Georges CHARPAK, winner of the Nobel prize for physics 1992, *Académie des sciences* (Paris, France);
Michel ROCARD, member of the European Parliament and France's former Prime Minister, Chairman of the group of European experts in charge of the report "Science Education Today": A Renewed Pedagogy for the Future of Europe", published by the European Commission;
- 10:30 am** Break
– **11 am**
- 11 am – 12:30 am** Roundtable discussion no 1 : P: "Why teach sciences? The role of science in culture."
Moderator: **Jean-Jacques DUBY**, university professor, honorary president of *Observatoire des Sciences et des Techniques* (Paris, France)
Experts :
– **Vasilis KOULALIDIS**, vice-president of the department of social and education policy, at the University of Peloponnesus (Athens, Greece);
– **Gerardo DELGADO BARRIO**, professor at the Institute of Mathematics and Physics (Madrid, Spain)
– **Steve FULLER**, professor of sociology, University of Warwick (England);
– **Dr. J.H. Walma VAN DER MOLEN**, University of Amsterdam, department of social and behavioural sciences (Amsterdam, Netherlands).

Dinner

Wednesday afternoon, 8 October

2 am – 3:30 pm Work conducted within the framework of four thematic groups operating simultaneously.

Thematic groups: topics and participants

Thematic group 1: Science for all: equal access to science education and success for all.

Moderator: **Ana SERRADOR**, European Commission, Directorate-General of Education and Culture;

Experts :

- **Harrie EIJKELHOFF**, Department of physics and astronomy, University of sciences of Utrecht (Netherlands);
- **Anthony TOMEI**, director of the Nuffield Foundation (London, England);
- **Monika RETI**, founder member of the Association of Hungarian research professors;
- **Dr. Barbara HARTUNG**, ministry of Science and Culture of Lower Saxony (Hanover, Germany);
- **Nicholas TENGELIN**, Project Manager, AB Volvo (Gothenburg, Sweden);
- **Olivier DUSSERRE**, doctor of management, member of *fondation C génial* (Paris, France);

Thematic group 2: The relations between formal and informal science education.

Moderator: **Dominique ROJAT**, Inspector-General of Education (Paris, France);

Experts :

- **Justin DILLON**, Department of Education and Professional Studies, King's College London (England);
- **Ana NORONHA**, director of the national agency for scientific culture and technology (Lisbon, Portugal);
- **Ilan CHABAY**, professor, University of Gothenburg (Stockholm, Sweden);
- **Guy SIMONIN**, Science Director of *Palais de la découverte* (Paris, France);
- **Sheena LAURSEN**, science consultant, *Experimentarium* (Denmark);
- **Andrée TIBERGHEN**, director of research at CNRS (Lyon, France).

Thematic group 3: Teachers training.

Moderator: **Patrick BARANGER**, President of CDIUFM (group of university directors for the training of university lecturers) (Paris, France)

Experts :

- **Wynne HARLEN**, professor at Haymout Coach House (Berwickshire, Scotland);
- **Anna PASCUCCI**, chairwoman of the Italian association of sciences;
- **Mika SEPPALA**, professor of the University of Helsinki (Finland);
- **David JASMIN**, director of "La main à la pâte" ("Hands on"), *Institut national de recherché pédagogique* (Montrouge, France);
- **Claus MADSEN**, head of the public affairs department, European southern Observatory (Garching, Germany);
- **Van DRIEL**, professor, ICLON Graduate School of Teaching, Leiden University (Netherlands);
- **Prof. Dr. Jürg KRAMER**, Institut für Mathematik, Humbolt- Universität zu Berlin (Germany).

Thematic group 4: Teaching Sciences in the context of society issues

Moderator: **Annie MAMECIER**, Inspector-General of education (Paris, France);

Experts :

- **Jean-Michel BESNIER**, university professor, Sorbonne university - Paris-4 (Paris, France);
- **Guillaume LECOINTRE**, director of research at the natural history museum (Paris, France);
- **Cyrille BARRETTE**, honorary professor at the University of Laval (Quebec);
- **Laurence LWOFF**, Head of the Bioethics Division, Department of Health and Bioethics, Council of Europe.

3:30 pm – Break

4 pm

4 pm – Roundtable discussion no 2: "How to teach science, today?"

5:30 pm

Moderator: **Yves QUÉRÉ**, professor, physicist, *Académie des sciences* (Paris, France);

Experts :

- **Florence ROBINE**, Inspector-General of education (Paris, France);
- **Peter BAPTIST**, professor, Lehrstuhl für Mathematik und ihre Didaktik, Universität Bayreuth (Germany);
- **Peter CSERMELY**, professor, Semmelweis University, Department of medical chemistry (Budapest, Hungary);
- **Doris JORDE**, professor of science of education, the University of Oslo (Norway), co-signatory of the report "Science Education today: A Renewed Pedagogy for the Future of Europe".

5:30 pm – Roundtable discussion no 3: “Mathematics and natural

7 pm sciences: Which mutual benefits?”

Moderator: **Michèle ARTIGUE**, university professor, *Université Paris Diderot - Paris 7* (France), chairwoman of the ICMI (the International Commission for Mathematical Instruction).

Experts :

- **Ola HELENIUS**, NCM [national centre for science education], University of (Gothenburg, Sweden);
- **Celia HOYLES**, professor, London knowledge Lab, London (England), director of NCETM [the National Centre for Excellence in teaching mathematics];
- **Manuel DE LEON RODRIGUEZ**, director of the institute of mathematical sciences, Madrid (Spain), vice-president of UMI (International Mathematical Union);
- **Volker ULM**, professor at the institute of mathematics, University of Augsburg (Germany).

8 pm Museum of Grenoble city: Guided tour of the art collection and buffet supper offered by Grenoble city council

Thursday morning, 9 October

9:30 am – Speech by **Xavier DARCOS**, minister for education (France);
10 am

10 am – **Ján FIGEL'**, Commissioner in charge of Education, Training,

10:30 am Culture and the Young: presentation of the European policy as regards science education.

10:30 am Press briefing;

10:30 am Return to work of the four thematic groups.

– 12 am

Thursday morning, 9 October

Chairman of the session: **Professor Luigi BERLINGUER**, President Comitato Cultura Scientifica M. U. R. (Italy)

1:30 pm – projection of a video showcasing cluster Math-science

1:45 pm technology;

1:45 pm – Roundtable discussion no 4: “Science and technology:

3 pm What interactions?”

Moderator: **André PINEAU**, professor at *École des Mines – Centre of materials* (Paris, France);

Experts :

- **Professor Svein REMSETH**, University of Trondheim (Norway);
- **David BARLEX**, director of the Nuffield Design & Technology Project, Nuffield Foundation (London, England);
- **Anne-Kathrin WINKLER**, Autostadt, head of the project “Science in Schools” (Wolsburg, Germany).

3 pm – Plenary session: synthesis of work of the thematic groups
3:30 pm and roundtable discussions by **Pierre LÉNA**, *Académie des sciences*, Education and training delegate (Paris, France);

3:30 pm – Conclusion by **Patrick HETZEL**, Director-General of higher
4 pm education, ministry of higher education and research (France).

SCIENCE LEARNING IN THE EUROPE OF KNOWLEDGE ISSUES DISCUSSED BY THE THEMATIC GROUPS

GT1 Thematic group No 1

Science for all: equal access to science education and success for all

→ Issues

The objectives of the strategy introduced by the Council of Europe in Lisbon (2000) included raising the standard of the science education of European Union citizens, on the one hand, and the number of students entering courses leading to science careers, on the other, in order to develop engineering and scientific research.

Obviously, to achieve these objectives, the issue of wider and better access to science education for young people needs to be addressed. The benchmarks adopted by Europe lead us to examine gender issues, by looking at the obstacles encountered by women and girls in choosing their educational paths; obstacles that either prevent them from considering pursuing studies in the scientific field or divert them from their initial ambitions. This desire to increase numbers on science courses also prompts the study of the way in which science education can both foster and take advantage of the wider inclusion of groups with particular educational needs; minorities, such as vulnerable populations (for example migrants) and students with disabilities.

The general issue can be divided into several key points, forming the basis of the group's discussions:

- What are the reasons, linked with the representations conveyed by civil society, business, teachers, the school system and the taught content that inhibit access to science studies for the above groups?
- Opening up school and likewise science education to as many as possible cannot be considered a goal in itself if it is not accompanied by an improvement in the chances of success of these new groups. How can the success of a wide and diverse group of young people in science training be fostered? Conversely, what are the strengths and responsibilities of science education with regard to success at school?
- Beyond the reports, what tools developed, initiatives taken and good practices have already shown some effectiveness and could be transferred to other regions, countries of the European Union?
- In what way can Europe contribute toward achieving these basic objectives: access and success? What is the most relevant level (national, regional, local) to foster opportunities and drive change?

GT2 Thematic group No 2

The relations between formal and informal science education

→ Issues

The transmission of scientific culture is partly entrusted to an institution, the school, which ensures a formal standardised, uniform and egalitarian learning process, precisely defined in both means and objectives.

Informal learning relies on the family, friends, acquaintances, reading, the Internet, museums, etc. This learning process, being less well defined and based on availability, cultural context, the desire to learn or curiosity, is a priori not egalitarian, and dependent on the environment.

The efficiency of such informal learning makes it both useful and daunting: one may fear that it will compete (because of its apparent easiness and the large amounts of time which can be devoted to it) in a damaging way with formal learning (which is more demanding and has to be carried out in less time), although it can also be seen as a sought after complement.

- What is the place of informal learning in the area of science? How does it evolve, notably in relation with the growth of on-line media?
- How can informal learning be made compatible with the equality of opportunity which is the right of all? How can the quality be improved and access for all be made available?
- A part of informal learning is due to institutions (associations, museums, scientific foundations or firms...). How do these different institutions organise and finance their actions? What guarantee of quality and intellectual independence do they offer?
- Informal learning of sciences insists on knowledge rather than the manner in which knowledge is constructed. Does not this characteristic harm the development of the mind? Can the construction of knowledge be presented within an informal learning framework?
- Is there coherence between formal learning and informal learning? How can they be brought into synergy rather than competition?

GT3 Thematic group No 3

Teacher Training

→ Issues

The way in which sciences are taught in schools depends on the content of school curricula, the nature of tests and exams and also on the training received by teachers. On this score, the involvement of university in initial and continuing education is a determining factor, particularly through the links that it establishes between science that is carried out and that which is taught and learnt. At primary school (6–11 year olds), teacher training must provide this initial science training. Inadequate training can lead to teachers disregarding or playing down this part of the curriculum. At secondary level (11–18 year olds), are teachers, often well-educated in their disciplines, adequately informed regarding new pedagogical approaches in science education and can they come into contact with living science as practised in companies and research centres? The report presented to the European Commission in April 2007 recommends the introduction of Inquiry-Based Science Education (IBSE) which places greater importance on observation and experimentation. How can teacher training prepare teachers to master this approach and combine it with deductive approaches?

Using concrete examples selected from good practices developed in several countries, this discussion group should:

- look at primary education teacher training in science, teachers' educational support, the study objectives specifically adapted to pupils at this level, the importance of interdisciplinarity and the importance given to the scientific content, understanding the scientific approach and acquiring the language;
- look at the didactic, pedagogical and epistemological training of secondary school teachers in particular, the balance between this training, personal knowledge and practicing science, and the necessary expertise in a scientific field;
- examine the issue of the continuing education of primary and secondary school teachers and their professional development. It should also look at whether the continuing education of primary school teachers should be compulsory, particularly in sciences;
- the means of developing cooperation between teachers, between schools, between teachers and the external environment (professionals, researchers) in order to develop introspective attitudes towards, among others, teaching practices and the exchange of ideas and materials;
- discuss in what way and at what level Europe can foster and facilitate discussions on and the improvement of teacher training.

Documents

Science Teaching in Schools in Europe, Eurydice Report (July 2006)

Science Education Now: a renewed pedagogy for the future in Europe, presented to the European Commission by Michel Rocard and the High Level Group on Science Education (EUR22845, April 2007)

Teachers Matter: Attracting, Developing and Retaining Effective Teachers, OECD report (2006)

Avis sur la désaffection des jeunes pour les études scientifiques supérieures (Opinion regarding young people's loss of interest in higher science education), *Haut Conseil de la Science et de la Technologie* (French High Council of Science and Technology) (April 2007)

La formation des professeurs à l'enseignement des sciences (Science Teacher Training), *recommendations by the French Academy of Science* (November 2007)

GT4 Thematic group No 4

Teaching Sciences in the context of society issues

→ Issues

- to compare the different European partners' views as to the teaching of experimental sciences within the context of social issues likely to challenge religious, philosophical, moral, or ethic convictions of school learners
- to set back the link between topics on values (political, moral or ethic values) and topics on fact
- to assess how the notions of nuclear energy, genetically modified organisms, protection of the environment, mastery (regulation?) of reproduction... are introduced into curricula? What are the didactic and pedagogical orientations given to teachers?
- to envisage didactic recommendations giving priority to a positive ethics: is science free to explore every thing, doesn't it acknowledge another law different from its own? Or must it account for its practices and care for values that are not inside its practice, such as the choice between what is right to do and what is not?

SCIENCE LEARNING IN THE EUROPE OF KNOWLEDGE

ISSUES DISCUSSED BY THE ROUND TABLES

TR1 Round Table 1

Why teach sciences? The role of science in culture

→ Issues

Culture is the way of relating with the world that a society establishes for its members, the type of behaviour it induces and all the knowledge it involves. Therefore, culture is, among others, the 'place' where the link between science and society can be made.

Science primarily represents a way of comprehending reality and, in this respect, our society benefits from a long Cartesian tradition. In addition to this ability to comprehend the world, the link between science and culture concerns: the relation with education and the transmission of this legacy; economic development, innovation and employment; citizenship and public decision-making. In a European society whose development relies on knowledge, the issue of a scientific and technical culture is key to ensuring social cohesion and avoiding the generation gaps and information divides that the rapid evolution of science and technology risks creating.

Science's cultural contribution primarily stems from its approach but also from its creativity; its opening on the world which gives it a key role. Removing doubts but continuously raising others, it shakes up our vision of the world. Two key points become apparent:

- The links between science and culture are under continuous renewal due to changing society, on the one hand, and changing sciences, on the other. Therefore, scientific culture is under continuous development and the worlds of science and education, among others, are greatly responsible for transmitting these changes.
- One must accept that the communication of science in our societies is based on the communication of its results, of knowledge; overshadowing that which preceded it and defined the distinctive nature of science, its approach, its initiative. To forget this opens the door to other methods of knowledge production and also to the irrational.

These aspects, difficulties, should be taken into account to facilitate the development of relationships between science and society.

The round table will seek to examine the nature of the interaction between science and culture in greater detail:

- the status of knowledge in our society,
- the importance of the scientific approach in education, the mediation of sciences in society
- the interaction between science, technology and society, particularly in the fields of economy, public decision-making and others.

Issues such as biodiversity and climate change can only be analysed in a cultural context. The round table will particularly base its discussions on these concrete examples.

TR2 Round Table 2

How to teach sciences, today?

→ Issues

In our contemporary society and because of the advances in sciences, it is essential to offer a scientific and technological culture that is based upon formal and non-formal learnings and to encourage young people to study fundamental and applied research by motivating their interest into a scientific career. This step can only be successful if the scientific approach is understood by all, if people wonder about the way of making sciences at school, if we define exactly what should be taught as scientific knowledge, if we wonder if sciences and technologies require specific teaching and implementation.

The questioning must also relate to the will to give an increasingly large part to the inquiry-approach and its recognition in the school curriculum, to make converge the scientific disciplines while keeping their specificities, to integrate, by targeting the most relevant level, a teaching approach of investigation such as the French programme *La main à la pâte* ("Hands on"), to evaluate the experimental capacities and to build programmes of training based on the mastering of skills and the acquisition of an acquired knowledge.

That is why, after an inventory of various didactic approaches tested in different education systems, the exchanges of good practice, analyzed, evaluated, compared, developed, could make it possible to impel new pedagogical approaches, recommended by the group of European experts directed by Michel Rocard, and to encourage to divide and guarantee common values in the perspective of a cooperation.

TR3 Round Table 3

Mathematics and natural sciences: which mutual benefits?

→ Issues

The choice is made to focus the conference on natural sciences learning. Yet, separating these, as well as engineering sciences, entirely from mathematics would not be wise, given the strong ties between these two branches of knowledge. The round table shall discuss these ties, how teaching must account for them, and their impact on teacher training and curricula, with an emphasis on primary and middle school, which may in some European countries be common for all pupils, while offering diversified paths in other. It shall:

- consider the two points of view, eventually complementary, on elementary mathematics teaching: one being focused on developing abstract thinking, the other more related to concrete objects and situations, both requiring imagination and rigor.
- consider the articulation between natural sciences and mathematics, along different points of view: the school paths of the students; their professional future; the degree of specialisation of the teachers; the efficiency of natural sciences learning. How can the success in learning use the diversity of student's talents, to be developed by an adequate pedagogy? From which grade(s) does science and technology teaching require more specific mathematics tools?

- discuss the question of the digital world, under three main aspects: how does one understand and teach its mathematics foundations? Which is the relation between the digital world and the teaching of mathematics? How to use the new simulation tools to improve science teaching? How to relate and master the fast technological changes? Pedagogical tools and teachers training will be discussed.

TR4 Round Table 4

Science and technology: what interactions?

→ Issues

The choice has been made to focus the conference on natural sciences. But it would not be reasonable to separate them entirely from technologies, as neither to-day can progress alone. If, in principle, the engineer or the technician aim at a direct impact on the world, society, health..., an aim which distinguishes them from the knowledge-oriented action of the scientists, reality is often a continuum, nowadays more than ever.

How to demonstrate the strength of this relationship between science and technology? Through which pedagogy? Is it possible, or even necessary, to reach a common definition of "technology", which to-day deals with life and health, as well as with raw matter, or even immaterial exchanges of information? If our societies are shaped by technologies and their use, how should one prepare future citizens to understand them and not passively adopt them?

If these societies, for their development or survival, require to increase their potential for technological know-how, how should this goal be implemented in the various curricula?

In light of these questions, the round table may examine some very concrete points:

- How diverse are the European systems, along the compulsory school period? How is the transition made with professional training?
- Which connections are, or are not, made between the teaching of natural sciences and the one dealing with such or such technology? How much should these subjects be integrated or separated? Do they need specialized teachers, with different training?
- Does "Inquiry based sciences education" (IBSE), which seems today make consensus for science teaching, also apply to technology education?
- Which respective places are given, in education systems, to sciences, technologies and their mutual relationship? Are these places optimal, with respect to the strong ties between the two domains and the diversity of talents among the pupils?