EDUCATION
TRAINING
YOUTH

TEACHING, LEARNING, INFORMATION:

Towards an open Socratic school

Proceedings of the Ampere Seminar, February 1997

EUROPEAN
COMMISSION

EDUCATION
TRAINING
YOUTH

TEACHING, LEARNING, INFORMATION

Towards an open Socratic school

Proceedings of the Ampere Seminar, February 1997

EUROPEAN
COMMISSION

EUROPEAN COMMISSION

AMPERE study (1995-96)
Project head: A. Fracchia, DG XXII/A
'Teacher, pupil, information'
Carried out by:
Université Catholique de Louvain (Belgium)
Professor P. Cochinaux

AMPERE seminar (1997)
Project head: D. Deberghes, DG XIII/E
'Towards an open Socratic school for all'
Carried out by:
Amitié (Bologna, Italy)
Pier Giacomo Sola

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu.int).

Catologuing data can be found at the end of this publication.

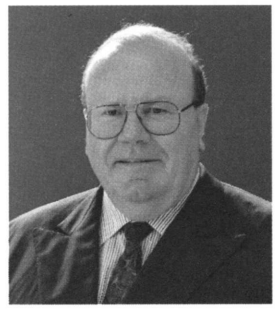
Luxembourg: Office for Official Publications of the European Communities, 1998

ISBN 92-828-2414-4

Printed in Luxembourg

Summary

Foreword



The new information technologies lie at the heart of everyday life in our societies. They have begun to transform the nature and content of work; they facilitate personal exchanges and multiply information sources and training opportunities.

Education, whether institutional or otherwise, is benefiting from this revolution, discovering new resources for individual development. These tools make it possible to support individually those wishing to acquire knowledge. They open up the possibility of a 'Socratic school' for all, no longer reserved for the privileged few benefiting from an environment particularly conducive to their development.

Being responsible in the European Commission for industry, research, education and training respectively, we established as our main objective the development of an information society at the service of all citizens, without discrimination. The task force on educational software, which we organised jointly, has now produced an analysis of the situation with regard to educational multimedia, enabling us to put forward a Community action plan entitled 'Learning in the information society'.

This is based on the principle that proper integration of these technologies into education can only be achieved through working on the quality of the products offered, developing equipment in our schools and encouraging more awareness among teachers of what these changes can offer, while offering them training in new teaching practices.

The proceedings of the seminar 'Towards a Socratic school for all' form part of this process of raising awareness of this new state of affairs. They put forward specific pathways for developing teaching practices so that all, young people as well as teachers, may benefit from the opportunities offered.

This publication reflects the questions and proposals from 250 teachers and trainers who met in Luxembourg in February 1997 to try to pave the way for a successful integration of educational multimedia into their everyday work. We hope that for many others in the field of education it will be a source of inspiration, discussion and action in the service of education for young people.

Édith Cresson
Member of the Commission
responsible for research,
innovation, education and youth.

Martin Bangemann
Member of the Commission
responsible for industrial affairs,
information and telecommunication
technologies.

Address of welcome

Erna Hennicot-Schoepges
Minister for Education
Luxembourg

Your Excellencies,

Ladies and gentlemen,

May I begin by commenting on how apt I consider the theme of this workshop — 'Towards an open Socratic school' — to be. To refer to Socrates during a workshop largely devoted to communication technologies demonstrates that the organisers feel that our humanist heritage is by no means incompatible with the demands of modernity. Indeed, the wisdom of antiquity has much to offer by way of guidance to today's educational policies which, unless we are vigilant, are vulnerable to the threat of what I would call 'the temptations of technology'. I do not know whether Socrates would have spent a lot of time at the keyboard or surfing the Internet; what I am certain of is, however, that he would have been able to guide us in the proper use of such tools, because he was ultimately the first of the great European thinkers to reflect on the art of learning.

I do not, therefore, think it is incongruous to draw our attention briefly in this setting to the wonderful figure of Socrates, especially as, in many ways, his message remains astonishingly modern and as our task today is to give concrete meaning to the Socratic dimension of the school of the future. As a disciple — albeit a very independent one — of the sophists, Socrates might appear at first glance to be a sceptic. Everyone knows that famous comment of his: 'I know that I know nothing'. He was, however, a sceptic who did not despair of discovering truth. That is, at least, how Plato presents him to us in his dialogues: as a sceptic hunting down prejudice and flushing out false knowledge. As a master, he constantly urged his followers to question what they thought they knew. Socrates' irony reduced to nothing the scholarly pretensions of his interlocutors; not to humiliate them, but to get them to discover the true knowledge that they carried within them.

As the son of a midwife, Socrates applied maieutics — the art of midwifery — to pedagogy. He taught that to teach is not to convey ready-made knowledge; rather, it is to release from a follower the knowledge that he carries within him, albeit unconsciously.

Socratic maieutics redefines the role of teacher and pupil in a thoroughly modern way. The role of the teacher is no longer to inculcate precise and permanent knowledge into the pupil; it is to enable the pupil to acquire his own knowledge by his own means. Applied to our own era, this means making the pupil capable of using intelligently the increasingly sophisticated tools that give access to knowledge and, more importantly still, capable subsequently of transforming this knowledge into real learning.

The teacher is today no longer the person who knows, and still less the person who knows everything. Rather, the teacher is the person whose role is to reveal to the pupil access to knowledge and to guide him along the paths to learning. Of course, the nature of knowledge and the importance of learning have changed considerably since Socrates' day, yet Socrates' thinking is not alien to our contemporary concerns; quite the contrary.

For Socrates, knowledge or science was only a means to the end of a perfect society based on the notion of goodness and justice and ruled by the best and the wisest. It was also the only way to wise living, which defined a good citizen. Here, we touch on the fundamental principle of Socratic philosophy: virtue is acquired by training. There is a very close correlation between knowledge and virtue. It is not those who have knowledge who behave badly, but those who are ignorant. Evil is the fruit of ignorance.

If you will allow me a brief digression, it is true that Socrates' conception of ethics as a science is rather problematic for us today. Since the Enlightenment, we have seen a gradual separation of scientific discourse and ethical discourse. Today, there is no longer any universally acknowledged truth to serve as the foundation for ethical values. However, by consensus, we can still identify the 'common values' shared by any civilisation or, indeed, those of all human civilisations. The European Commission's 'Reflection group on education and training' has, for example, agreed on a 'table of shared values of European civilisation' which includes in particular:

- human rights and human dignity;
- fundamental freedoms;
- democratic legitimacy;
- rejection of violence;
- human solidarity;
- conservation of the ecosystem;
- individual responsibility.

To return to Socrates, however, who embodied both truth and goodness, both wisdom and virtue, I believe I can add one factor to the equation without running counter to his philosophy, and that is freedom. We should not forget that maieutics is also the art of deliverance. A wise man is both free and virtuous; as Voltaire had it, 'An enlightened man is a free man'. To be enlightened is to be as free of prejudice as is possible; to be free of those who wish to exploit our ignorance; to be free to be what we are, not a robot controlled by all kinds of manipulative forces.

When we consider Socrates' teaching, it is evident that in a way, he anticipated the four pillars of education evoked in the report of the International Commission for Education in the 21st century, chaired by Jacques Delors. These pillars are:

1. *Learning to know.* Today, more than ever, we need to apply Socratic maieutics and to make the pupil the centre of an autonomous system of training. We must perfect his research abilities; teach him to frame precise questions before beginning his task and to formulate hypotheses as to the possible outcomes; and develop his judgment and critical awareness so that he may judge the relevance of the information he obtains. In a word, we have gradually to accustom the pupil to do without the teacher.

2. *Learning to do.* This means putting our knowledge into practice and adapting education to the work of the future. It is clear that the meaning and value of work have changed considerably since Socrates' time, but the principle remains that man realises himself and assumes his place as a citizen of an equitable society through his work. Socrates' father was a sculptor and his mother a midwife. He himself devoted his life to training young Athenian men, to helping them to discover the nature of good and evil, justice and injustice, wisdom and folly, courage and cowardice, the State and the citizen. Thus his was the most noble of professions — that of spiritual midwife — and that of which we perhaps have greatest need in today's high-tech societies.

3. *Learning to live together.* This was the aim Socrates had already identified for education, and it remains today the only way of overcoming exclusion, oppression and all the forms of contempt for humanity that threaten contemporary societies. Some people fear that information technology and new ways of organising work are reinforcing the isolation of individuals. It is precisely the world of education that must combat this danger by making use of the interactive opportunities of the new tools available to us. One example among many is that of groups of learners in different countries working together via the information super highway to carry out joint projects and thereby to create a global community of pupils learning to respect the values of different cultural and ethnic groups in an electronic environment emancipated from racial or religious prejudice. Learning to live together also means discovering the democratic values of respect for the person and thought of others. Or perhaps it means rediscovering these values, since we should remember that Athenian society was also the cradle of democracy. More than two

thousand years separate the Agora and the Internet, yet it is astonishing what they have in common. The Internet has become the planet's meeting place, the electronic Agora of our global village.

4. *Learning to be.* This is the central pillar of all education. Each human being is unique and irreplaceable, and while respecting the freedom of others and peaceful coexistence with other individuals, each human being has the right — and even the moral duty — to live out his uniqueness.

The main role of the school is to recognise and draw out this uniqueness. To do this, it must be able to distinguish between pedagogical approaches and even individualise them in so far as it is able.

Computers can make a valuable contribution to adapting education to the needs, problems and specific scope of each individual pupil. They can, for example, help an ethnic minority pupil to learn syntactic structures that do not exist in his or her mother tongue, or they can enable a gifted child to work to the very limits of his or her abilities.

Yet computers cannot replace teachers. Only teachers — only those qualified in Socratic maieutics — can use their own experience of life, their wisdom and their example to teach their pupils to make the right choices, to develop their critical faculties, and to become the unique and irreplaceable human being that constitutes the value of every individual.

I want to stress the role of the teacher in a Socratic school and to caution against what I referred to earlier in my speech as 'the temptations of technology'. I should like, if I may, to quote Federico Mayor, Director-General of Unesco, in a speech at the opening of the last Education Conference in Geneva, he said, 'Today, when new communication technologies are revolutionising many sectors and processes, some are tempted to make technology the centre of the process of education. It is not. Although it is a wonderful tool and an asset in education, technology remains a tool. It is the teacher who remains at the heart of the process of training and social transformation.'

If we seek to move towards the open Socratic school of tomorrow, we need teachers who have mastered the new tools and their pedagogical use. We do not, howerer, need just education technicians or pedagogical engineers; we need real teachers who are open to the world, to the wealth of opportunity for the future and, above all, to the enormous creative potential of their pupils. We need teachers who, to quote Federico Mayor again, put into practice 'the only pedagogy possible: that of love and example.'

Of course we have need of electronic tools in our attempts to prepare schools for the challenges of the 21st century. Yet we have even greater need of Socratic thinking and human wisdom if we are to remain masters of these tools and avoid the fate of one day seeing them working, thinking and deciding for us.

Foreword

Alice Fracchia
European Commission
DG XXII/A
Daniel Deberghes
European Commission
DG XIII/E

'The mastery of information represents one of the major challenges to be addressed by Europe. It is not merely a question of technological evolution or functional assistance, but rather the emergence of a new sociological phenomenon (the need for almost instantaneous information) and the contraction of time and space, enabling autonomy in decision-making and action, cohesion and also the preservation of Europe's social and cultural characteristics.

As a result of the economic, social and demographic changes characterising our societies, it is imperative that we make available permanent and more flexible education and training opportunities for the individual in the framework of a continuum between education and training.

Above all, it is necessary to develop from early childhood onwards the capacity, not just to learn, but to use a hypothetical-deductive "research" mode of reasoning which will enable each and every one of our citizens to be better prepared to face the events life brings. Today, information technology can help teachers in this fundamental pedagogical approach', wrote Jacques Delors (1).

This approach, aimed at making available to educationalists the fabulous array of tools of the information society solely to support teachers in their attempts to teach 'all their pupils' to acquire knowledge and reasoning, was the subject both of the Ampere group's deliberations (2) and of an analysis of the concept and of European experiments, carried out by DG XXII/A of the European Commission in 1995 and 1996.

To initiate a process of exchange on the issue of democratisation of training in the method of hypothetical and deductive reasoning in primary schools, using multimedia, DG XIII/E of the European Commission organised a workshop held in Luxembourg in February 1997 which was attended by more than 250 people, including lecturers, teachers, representatives of educational bodies and government officials. The aim of the workshop was to identify some orientations for training teachers.

This collection of papers reflects the work done there. Readers can read it sequentially, familiarising themselves first with the general principles, the social implications of the whole question and the examination of the development of European civilisation and the issues it raises, then immersing themselves in the chapter on new skills for teachers, and finally, in the third chapter, considering the multimedia tools available for use in the classroom. There is also an extensive bibliography and a list of participants, enabling readers to pursue their own investigations.

All that remains is for us to thank all those involved in putting this collection together, experts, lecturers and the teachers of Europe, for their spontaneous and enthusiastic support both of the 1995-96 study and the 1997 workshop. It is our hope that every child may now be fortunate enough to benefit from the education described in these pages.

(1) Foreword to *Information technology in primary school*, DG XXII/A.1, May 1996.
(2) Address given by Yves Franchet at the February 1997 workshop.

It is in education that the great secret
of human nature's perfection lies.

Immanuel Kant

Opening speech

Vicente Parajon Collada
European Commission
Deputy Director-General
DG XIII

Madam Minister,

Directors-General,

Ladies and gentlemen,

As this workshop opens with more than 200 participants, I should like first of all to welcome you to Luxembourg and to the Commission and to thank each of you, whether you are a teacher or lecturer, are representing an organisation, or are a colleague from DG XXII, DG III or Eurostat, for taking the time to take part in this two-day workshop on 'Training teachers in new teaching methods in primary schools using information technology'.

This workshop is the logical consequence of the convergence of two major realisations on the part of society:

- Europe is becoming an enthusiastic member of the information society;
- Education may rediscover its Socratic vocation using multimedia tools and hence produce more citizens equipped with creativity, as George Brown, US Trade Secretary, told the G7 in 1995.

Building on this convergence, the European Commission has formulated a number of initiatives on the basis of a three-point strategy:

1. to develop training in the use of multimedia and sources of electronic information in SMEs throughout all sectors of the economy;
2. to develop training of specialists for the information industries;
3. to develop the use of multimedia in schools
   - by supporting both the supply of new products by the educational software task force
   - by supporting the demand from schools through the 'Learning in the information society' programme.

These initiatives are jointly supported by the DG XXII Socrates and Leonardo programmes, DG III (Web for School), and the telematics and INFO 2000 programmes of DG XIII.

The theme of this workshop is the demand from schools referred to in (3) above.

Against that background, I should like, if I may, to share with you how important I think this area is; indeed, its importance was the subject of a European study carried out in 1995 and 1996 by colleagues in DG XXII and DG XIII in Luxembourg, the 'Information technology in primary schools: Ampere' study.

The IT revolution can be compared to the Industrial Revolution. Information is its raw material, and once a computer has been programmed, it can read, write, compare and calculate the data given to it. It is merely a tool, dependent on the adroitness and expertise of the user, yet the ever-widening range of applications a computer can be used for and its vast capacity to process numeric, alphanumeric or symbolic data virtually in real time have irrevocably changed the very foundation of our existence. We are now facing exponential technological growth.

All these changes have required an enormous range of new skills in the world of work. Those in the workforce with adequate levels of general education have been able to take part in courses to widen their skills, but others, who have not had this type of education, have found it more difficult to adapt. To use information technology requires not only an open mind and adaptability but also new skills and the ability to

upgrade these as the market develops and changes ([1]). Unfortunately, those who are not constantly changing and developing get left behind, as is clearly illustrated by the rise in long-term unemployment among those in their 50s. The teaching profession has remained largely untouched by this sociological and technological trend that has changed the course of our working lives, since teachers have had neither the time nor the range of training courses available to keep pace with the change. Globalisation of the economy has also made new demands on the population. It is no longer enough to be aware of what is going on in our immediate surroundings to take an active part in our democracies; the areas of politics, economics, society, history and culture are now in a state of perpetual change and each citizen owes it to himself to keep informed on the key developments. In this sort of world, 'learning to learn' is becoming more important than the content of that learning. Without the ability to learn throughout his life, the individual will have difficulty in mastering the increasingly complex situations in his social and working life. This interference cannot help but create tensions that could well detract from the quality of the fabric of our society ([2]).

The extreme rapidity of communications in the 20th century has widened our vision of space but has also led to anonymity and greater underlying complexity in the rules by which we live our lives, since a linear progression from education to work is becoming obsolete. The individual is gradually losing his identity and has trouble finding his way around the labyrinth of knowledge ([3]). The traditional concept of socialisation by the inculcation and internalisation of roles, norms and values no longer meets the individual's needs, perhaps because of the contradictions within our social institutions (such as the family, the school, the media and the economy), or perhaps because each of the models on offer is itself contradictory at heart.

Today, each individual must play an active part in developing his own personality and his own identity. He can build his own identity by bringing together differing elements, which may sometimes be disparate or even contradictory, acquired from his encounters with education and other institutions. He creates his own 'patchwork' personality as in a 'self-service' environment where discrete personality traits are on offer on every shelf. He has learned to choose and select for himself in his own sociocultural universe, according to his own needs and desires ([4]). Here lies the importance of the educational system, whose role is to prepare the new generation to become the citizens of tomorrow's democracies.

Among this mass of instantly available information, combined with the impact of the media, the educational system cannot remain wedded to the microcosm of the school. It must give future citizens strategies for learning that they can use throughout their lives, and give them the necessary skills to sift the welter of information and assess its relevance and coherence. If we decide to neutralise the ills in the Pandora's box opened up by technological progress, educational systems have also to be a mirror to society and to enable children to make effective use of the new methods and tools.

Conclusion

'The new frontiers are those of the mind'. This statement is more apt than ever. The rapidity and extent of technological change are heralding major qualitative changes in the way our economies and our societies are organised.

The question is whether we shall be able to manage this change and rapidly to integrate the 'new deal' promised by the information society. There is nothing inevitable about either decline or a new golden age. We are all pioneers in the information age, clearing the land for new cyber-fields.

The Commission has given a clear indication of its determination to stimulate thought and debate around changing social needs and how they can be met within the framework of an imminent information civilisation.

Assessing the opportunities as well as the risks associated with this change is a key stage in the building of a society that will be prosperous, democratic and built on greater solidarity, and I am convinced that the recommendations the workshop will make will be considered carefully by the European Union institutions.

([1]) Haggis, S. (1993), *L'education pour tous: les objectifs et le contexte*, monograph 1, Paris, Unesco, pp. 42-43.
([2]) Cochinaux, P. and de Woot, P. (1995), *Moving towards a learning society*, Louvain: CRE-ERT, pp. 28-30.
([3]) Deberghes, D. (1993), 'De la vie à l'école à l'école de la vie' in *La Formation en Europe, Les Annales des Mines*, Paris, p 59.
([4]) Cochinaux, P. and de Woot, P., op. cit.

Opening speech

Yves Franchet
European Commission
Director-General
Eurostat

Directors-General,

Ladies and gentlemen,

I have the pleasure of chairing the workshop session which, as you will have realised, marks a major step in the implementation of concrete measures for schools in the area of information technology, the result of analysis and reflection over a number of years by Jacques Delors, President of the Commission, which I personally consider to be of great importance.

Back in 1989, President Delors charged Eurostat with organising an international conference in Luxembourg on the subject of 'Human capital at the dawning of the 21st century', and I should like here to outline the conclusions he gave us in November 1991 on the essential values of humankind.

1. The 1991 conference

As European societies stand at the dawn of the 21st century, it is not enough for the way ahead to be clearly marked out. At a more fundamental level, the hearts and minds of European citizens themselves have to be won over to the changes lying ahead, despite the fact that at present, they fear these changes. To put it briefly, with the rediscovered significance of the values that underlie our lives, our societies themselves have to rediscover their meaning, meaning in general. Let us take just one example: education. How can we hope to reform our educational systems on the base simply of utilitarianism? How can we foster relish for learning to learn if we do not, ultimately, restore worth to simple communication and importance to the gratuitous acts of meeting a friend, colleague, or neighbour, or of a chance encounter? Knowledge that is devoted solely to power will wither; it has also to be channelled towards recognition of others as the result of better understanding of ourselves and of others. And this is what I personally expect of our educational systems.

You may say, 'That's all well and good, but what are these values you are talking about?' It is no coincidence that precisely this question had already produced a wide-ranging debate among Europeans following the Second World War. What were the shared values around which could be built unity that would ensure that there would never again be war between us? They did indeed build such unity and this may inspire others.

Denis de Rougemont has written of these intense and lucid post-war debates. Intellectuals such as Benedotto Croce, Salvador de Madariaga, Karl Jaspers and André Malraux, the forerunners of the Hague Congress, dealt in differing ways with the European ideal, guided by the *idée fixe* of no more war between us. Yet beyond that need, they also shared a fundamental value, that of the dignity of the human person, which gave rise to the value of human freedom. However, freedom itself, as European cultures understand it and as it has become entrenched in our history, cannot be dissociated from the values of responsibility and creativity. Freedom, responsibility and creativity are what can give a society, or restore to our societies, their democratic qualities, their dynamism, and their ability to harness science and technology in the achievement of humane progress.

To sum up, and drawing on the history of Europe, the spirit of the Enlightenment enshrined in the Declaration of Human Rights reflected, and still reflects, an exemplary synthesis between individual and collective values.

2. The Ampere group

Immediately after this conference, a group of men and women of goodwill from all backgrounds agreed to meet, to exchange views, and to get initiatives under way, not on the future of education but on the 'tools', the equipment, that future European citizens would need to deal with the mass of information and increasingly

complex rules, in order to develop their creative abilities and to face the events of life. When we consider the example of the scientist, naturalist and philosopher André-Marie Ampere, and his humble life devoted to sharing his knowledge, we realize that this man alone not only made scientific use of hypothetical-deductive reasoning as defined by Kant in the early 19th century but also discovered in electromagnetism the tool which 150 years after his death was to enable the knowledge and reasoning to which he had devoted his life to be made universally accessible. As a result, the group very naturally became known as the Ampere group and it is still chaired by André Danzin, who will draw our work today to a close after his brilliant speech yesterday on 'European education and civilisation'. The group began to analyse experiments under way in Europe under the umbrella of the Ampere study, conducted by Janice Richardson, and also suggested holding this workshop as a forum for discussing results and drawing up recommendations for future initiatives.

Before handing over to our rapporteurs, however, I should like to share with you my view, as a member of the Ampere group, of the importance of this workshop.

3. Education

Children inherit their ability to adapt and learn by means of a mechanism of cultural transmission from their family circle and from their environment, which are the main mediators of culture. If the family does not play its part for one reason or another, such as pre- or post-natal deficiencies, family problems, cultural gaps and so on, or if it refuses to do so (because of social marginalisation or exclusion, or association difficulties), the child suffers from a 'cultural deficiency' (or even, as some would argue, from 'cultural privation'), and difficulty in learning and integrating will inevitably surface when the child starts school ([1]). Consequently, primary education is of crucial importance, since it is the environment in which the link is formed between learner and mediator and other children from different age groups or social backgrounds. School offers children an opportunity to widen their horizons in a new social and educational context.

It is in this initial stage of their education that children's strengths and weaknesses emerge. If difficulties with learning and education are not overcome as soon as they surface (in the case of serious disorders such as blindness, hearing impairment or physical disability), then the educational system cannot give equal opportunities to all its future citizens. For those who have not yet developed their ability to adapt to the new educational and social environment and to understand it, this is therefore the starting point of the process of opening up to society for, as we know, schools have a dual function in our society. They are the source of change and of cultural and social mobility and, simultaneously, the basis for our foundations, our cultural points of reference and our history. Schools both conserve and pass on our heritage ([2]).

Today, traditional educational systems are being challenged and are changing radically as a result of rapid development in information processing coupled with better understanding of the process of learning. The spread of communications and information technology has highlighted the gap between schools and society at large, and has made our everyday lives more complex and less concrete. As a result, it is one of the factors behind the change in family and social structures. Children today have access to much more extensive sources and channels of information; they 'drown' in a sea of media-hyped 'culture' against which their schools have to fight to teach them their traditional cultural roots. Schools have to strive to create new skills to enable future citizens to distinguish real culture from mass information and the real world from the virtual world. We have to formulate the parameters for partnership between schools and society, where two thirds of an average employee's working hours are given over to processing information ([3]). It is our duty to integrate into our teaching and learning methods the crucial tools of employment and, indeed, leisure.

4. Conclusion

The value of this workshop has been to bring into the public arena a duty and a moral obligation, and it is my hope that as you disperse to your own countries, each of you will take with you this message that is so crucial to the development of our European civilisation.

([1]) Conseil de coopération culturelle: Division de l'éducation scolaire (1988), *Innovation in primary education*, Strasbourg: Council of Europe, pp. 7 and 8.
([2]) *Idem*, p 7.
([3]) Baudé, J. (1995), 'Rapports d'activités et orientations pour 1995-96' in *La Revue de l'Association EPI* No 80, p. 22.

The education of Europeans in the metamorphosis of civilisation

André Danzin
Member of the Club of Rome
Chairman of the Ampere group
Chairman
of the International Human Science Forum

I. Abstract

1. Creating young Europeans today primarily means assisting them to embark on the metamorphosis of civilisation that is under way

- Metamorphosis in the relationship between man and nature, in response to pressure from science and technology.
- Metamorphosis in the human condition in the social field (such as increasingly abstract activities, new ways of managing time, and the new position of women).
- Metamorphosis in the economy (globalisation) and the redistribution of political groupings.
- Metamorphosis in our world vision (replacement of the influence of the Enlightenment with new paradigms).

This transformation of society reflects a reversal of the vision of Copernicus: man in the universe is not lost on one tiny planet in one minuscule solar system in the ballet of the galaxies, but needs to understand himself as the centre of the creation of 'negative entropy', that is, the centre of creation of knowledge data production and processing.

2. Educational systems lie at the heart of this metamorphosis

Our educational systems have to take account of these fundamental changes and prepare the decision-makers of the future, or else persuade current decision-makers to give relevant responses to the new conditions of our social, economic and cultural lives.

More than ever before, education is becoming the very cornerstone of our construction of society. This gives rise to two widely acknowledged key ideas:

(a) education system should primarily be the place for learning to learn, with the learning of what we need to know going on elsewhere;

(b) education is a lifelong process.

There is, therefore, an urgent need to combat the early social marginalisation that results from difficulty in reading and writing. Educationalists must also, however, accept two further notions:

- the authentic school;
- we are all autodidacts.

What this amounts to is an acknowledgement that the ultimate goal of education is to learn to learn, so that each and every human individual may, over sustained periods, build him- or herself in a cycle of improvement that ends only with death.

This requires:

- early social integration;
- respect for learning;
- challenging qualifications;
- challenging free education;
- combining the forces of pupils, family, teachers, the professions, local communities, and voluntary groups from community life;
- challenging teaching methods, requiring technological imagination, distance learning, experimentation with tutoring, and so on;
- rejecting the 'massification' of higher education;
- challenging what is taught; a well-trained mind is better than a well-stocked mind, but in this age of new information and communication technology, a well-trained mind is not what Montaigne envisaged when he wrote of it.

3. Making use of the universal laws of evolution

This means:

- giving mutants an opportunity for experimentation;
- accepting selection;
- implementing forms of subsidiarity;
- giving (supervised) autonomy to educational institutions and accepting that they will compete with each other;
- supporting changing attitudes towards technological revolution;
- restoring the quality of the relationship between teacher and pupil.

Conclusion

The diversity of Europe must be put to work in the process of change in the educational world.

- Progress can come only from those operating the education system itself, teachers and educational administrators.
- Comparison of the wealth and diversity of experiments being conducted in various EU Member States must be harnessed — and, indeed, is the only way — to change attitudes, overcome the obstacles of conservatism, and find new routes.

The role of the EU needs to be enhanced, not to dictate solutions but to help people to devise solutions, make it easier to implement them, and disseminate good practice. This is how we will build Europe, with procedures running much more smoothly than European Union procedures currently seem to be running.

The EU will then have refocused its attempts to elevate man to the position of a key force in the emergence of mind.

II. Address

1. The four metamorphoses

(a) The metamorphosis of technology and scientific knowledge, including:

- the finite nature of the habitable world;
- fragility of the biosphere;
- demographic and fertility control;
- ethics in applications.

(b) The metamorphosis of the human condition in the social field:

- towards a more abstract nature of activity;
- towards new ways of managing time;
- towards new demographic patterns (longer life expectancy and higher expectations of good health);
- towards the new position of women.

(c) The metamorphosis involved in (economic) globalisation:

- the fundamental reshaping of political forces (USSR, south and south-east Asia, and the greater hispanisation of America, etc.);
- solidarity between economies;
- management of flows of information in an abstract and hence unbounded economy;
- decentralisation.

(d) The metamorphosis in our world vision, with many different models and paradigms, marking the end of the influence of the Enlightenment.

Braudel said, *'There can be no progress, no reasoning or fruitful hypothesis without a general reference system within which we can situate ourselves and to which we can orient ourselves'.*

We can sum up in a few key words the cultural gap to be filled if we are to have a future full of promise. The overriding issue is that of complexity. We need to stop using simplifications, typologies, methods of linear causality, and fragmentation and, instead, respect subtle complexity, by laying stress on the relationship between the differing parts and between the parts and the whole, and by identifying nodes of causality in order to speculate on their interreaction. We have to change our former structures in order to master interdisciplinarity, intersectoriality and interministeriality; we have to use initiative and responsibility not at the apex but the base (subsidiarity) and use networking structures, rather than a pyramidal hierarchy, drastically reducing bureaucratic and technocratic superstructures. We have to accept the philosophy of risk and uncertainty and commitment to a period of permanent change by implementing a process of trial and error, and we must acknowledge the inevitability of the forces of Darwinian selection.

A mechanistic and determinist vision.

A biological, non-determinist vision, with reasoning dominated by Cartesian thinking (approved concept of Cartesian thinking to domination of systemic thought).

The relationship between energy and information.

Entropy (Marx and Engels).

Negative entropy (constant growth in complexity, awareness and abstractness).

The reversal of the vision of man: Copernicus's vision of a man lost on one planet amid the infinite universe is turned on its head, with man as the central element in the emergence of mind.

2. Education in this fourfold metamorphosis

We need to respond to new economic, social, political and cultural forces:

- The metamorphosis in education calls on teachers to accept radical change in their thinking about education and about the structures of the educational system.

What are the bases for our anticipation?

(1) Acceptance of the idea that, more than ever before, education is the key to building society. A fragmented and abstract society will produce illiteracy and marginalisation. There is no longer room simply for brawn, especially in those countries with high labour costs.

In France, for example, the agricultural labour force has shrunk from 55 % of all employees to less than 5 %, while 10 % of the entire workforce is now employed in the four fields of information processing. Yet Europe's educational systems are turning out more than 20 % of adolescents who cannot read or write fluently.

However, we need to redefine illiteracy, which will soon become the inability to use information systems, to disentangle complex rules, rights and obligations, to complete a tax return, and so on.

For those within the mainstream, the baggage of knowledge they need is constantly expanding, to include such things as an understanding of science and technology, the 'leisure culture', mastery of at least one foreign language, vocational specialisation, preparation for changes in career direction, and so on.

There is, therefore, now almost general agreement on two conclusions:

- that primary and secondary schools and higher education are the places where we learn to learn, not where we accumulate knowledge that will remain unchanged for the rest of our lives;
- that education needs to be lifelong, and that we therefore need breaks in our careers to acquire additional knowledge, by means of updating or retraining courses.

(2) We must accept the notion that life, and not the educational system, is the authentic school, the authentic university.

We are all, and will increasingly be, autodidacts.

However, our own construction of our persona must be guided and assisted by education, so that we can learn to learn to teach every individual to construct him- or herself.

This leads to the notion of basing education on a symbiosis within a unique human system of pupils, family, teachers and employers assisted, of course, also by local communities and groups towards 'civic education'.

Teachers have to acknowledge that they are only one part, albeit the major one, of a symbiotic educational system.

This has a number of consequences:

- Early integration in employment. It is a mistake to extend study by highlighting vocational specialisation far beyond the age of responsibility, that is, far beyond the period of adolescence.
- Respect for learning.
- Challenges to qualifications. If we teach ourselves our main qualities, and if we are all autodidacts, then we need to stop being judged on initial qualifications which should serve only as a reference point for our entry into working life and which should be capable of being obtained at any age.
- Challenges to free education.

  If education is becoming one of society's key priorities, then it, along with health, is one of the main poles of growth in human activity and one of the most important sources of creation of specialised employment (teachers, administrative support staff, learning tutors, volunteers, mentors and so on). In this situation, it is possible that the proportion of GDP spent on education could rise to between 10 and 15 %. Such growth could not possibly be paid for out of taxation.

The role of the State needs to be redefined in terms of stimulation, supervision, and responsibility for ways of compensating for unequal wealth and cultural opportunity; it cannot, however, take on the finance needed for all those involved — families, employers and learners.

- Challenges to teaching methods with a view to achieving optimum efficiency, involving:
  - ⇨ an appeal to technological imagination
  - ⇨ distance learning as preparation for teleworking

- ⇨ new language-teaching methods from early childhood onwards
- ⇨ correction of the major misjudgment of the 'massification' of higher education (illusory qualifications, what Larku calls the 'infernal machine', and training for interpersonal contact).

- Challenges to what is actually taught:
  - ⇨ the shock phenomenon of the volume of knowledge needing to be conveyed;
  - ⇨ the volume of sources of information;
  - ⇨ the need for Montaigne's well-trained mind to take precedence over a well-stocked mind.

It is impossible to know everything, even about one narrow specialism; as a result, what is most important is to know how to gain access to knowledge and where to find information, so as to construct the 'search engine' that will enable us to find models of representation along with the information necessary to solve the problem at hand.

- Challenges to the phenomenon of language.

We need to understand the metamorphosis of education as the manifestation of a crucial episode in the evolution of humankind.

We also need to be humble enough to acknowledge that humanity is swept along by evolutionary forces that it no longer controls.

The general laws of evolution in the inanimate world (astrophysics), the living world (biology), and in man. The development from hunter-gatherer societies to agrarian and craft civilisations and thence to industry and to a more abstract civilisation.

New solutions are obtained by mutants, pioneers, innovators and prophets who are isolated, opposed and sometimes even subject to hatred. However, the agents of this change need to be able to express themselves, carry out experiments and disseminate their findings, whether unsuccessful, to be abandoned, or successful, to be made widely available.

We cannot escape selection; we are entering a Darwinian world, hence the success of market sanctions. Education cannot escape this phenomenon either; to reject it is to defer sanctions to a time when they will be even more painful.

Educational systems need, therefore, to be rethought with a view to increasing their freedom and right (as well as means) to embark on experimentation, hence the need to generalise:

- subsidiarity (teaching at the level at which it is most effective, especially in the working environment);
- autonomy in teaching institutions, particularly in higher education;
- a basis in changes in technology;
- personal commitment by individuals to a teacher-learner relationship.

We need always to bear in mind that evolution is not merely a Darwinian lottery but also symbiotic help to both the environment and the mutant.

Evolution is the result of a systemic effort and of resonant relationships between suggestions for innovation and acceptance by their beneficiaries.

None of our countries can deal with this symbiosis in isolation from its entrenched traditions and its bulwarks of conservatism.

Only the European Union, with its wealth of diversity, can give all of us concerned the differing mirrors we need to be able to scrutinise ourselves. Being scrutinised by others, confronting failures or inadequacies resulting from differing, even conflicting, sources, and emulation of success should help teachers to achieve change, first in their attitudes and then in their strategies and structures. Educational systems can be adapted to the problems, challenges and risks, but also the opportunities of the 21st century only if teachers themselves take its evolution in hand with full enthusiasm and commitment.

Accomplishing Europe through education and training

Jean-Louis Reiffers
President of the European Group on Education
France

Education and training stand at the centre of debate on the future of our societies and European integration; bringing Europe and its citizens closer together has been viewed as a central axis.

The Commission has launched an in-depth discussion on the guidelines for action proposed by its White Paper on teaching and learning: towards the learning society (adopted in November 1996); the Commission also established a study group (of 25 high-level independent experts) on education and training in July 1995. The themes to be discussed could be selected on its own initiative, but also as a request from the Commission. This led to the identification of two operational working levels for the group's work:

(1) contributing its views to the White Paper on teaching and learning and to the launch of the European Year of Lifelong Learning;

(2) the study group has developed its own ideas on the basis of themes determined on its own initiative.

This report is not an official Commission document. The group's views have been synthesised from the views expressed by its individual members, so they reflect a majority consensus within the group, but not necessarily unanimity on all matters.

The study group takes the view that technology and international competition present opportunities that can be grasped. The study group members are in agreement that Europe's education and training systems must take three major imperatives into account:

(1) the need to strengthen European competitiveness in economic, technological, innovatory scientific and organisational terms;

(2) the need to appreciate the difficulties of the current situation;

(3) the need to respect the basic principles of education.

During the course of a heritage accumulated over the centuries, three fundamental aims of education and training have emerged through a long process of maturation:

(1) development of personal autonomy;

(2) stimulation of opportunities for social integration;

(3) improvement of vocational competences.

The study group considers that changes required in education and training systems should envisage four aims, significant progress towards which should be made between now and the year 2000. These aims are:

1. Constructing European citizenship through education and training

This one is, above all, a humanist concept, based on a shared democratic culture where Europe must promote education and training that aims to destroy all stereotypical images of human beings.

For the purposes of developing a programme of citizenship through education the following five essential dimensions have been retained in this report:

(1) the recognition of the dignity and centrality of the human person;

(2) social citizenship, social rights and responsibilities;

(3) egalitarian citizenship;

(4) intercultural citizenship;

(5) ecological citizenship.

Europe should take action through education and training to consolidate European citizenship in the three following domains:

(1) to affirm and transmit the common values on which its civilisation is founded;

(2) to assist in devising and disseminating ways of enabling young people to play a fuller part as European citizens, with a particular focus on teaching and learning;

(3) to identify and disseminate the best practice in education and training for citizenship.

2. Reinforcing European competitiveness and preserving employment through education and training

The principal long-term and valid option for promoting European competivity in the market is to ensure a strong capacity in the quest for quality and innovation. Through innovation and personal initiative, Europe could develop productive service sector employment and self-employment. Systems of education and training must orient themselves to those occupations most in demand.

The study group recommends that Europe should contribute to improving:

(1) relations between general and vocational education and training.

General education must provide preparation for a vocational skill, and vocational training must continue to develop the basic competencies provided by general education;

(2) the definition and the comparability of acquired competencies/skills.

It is necessary to facilitate personal mobility in Europe, to evaluate training systems, and to develop self-directed and lifelong learning;

(3) the definition and the acquisition of new occupational profiles.

3. Maintaining social cohesion through education and training

To make progress, Europe needs to mobilise all its human potential: not only young people but also adults needing education and training, the study group considers that our education and training systems must show greater flexibility and adaptability, and so it is necessary to consolidate the dominant democratic principle which stipulates that all children have a right to universal knowledge to education, regardless of their inherent abilities, family or social circumstances.

Europe should be able to use its main action programmes, in particular Leonardo da Vinci and Socrates, in order to initiate specific experiments whilst leaving Member States to implement these on a wider scale if they do so wish.

4. Education and training in the information society

The exponential development of new information technologies (IT) will lead to profound transformations in education and training. The following changes should be noted:

(1) the transition from objective to constructed knowledge;

(2) the transition from an industrial to a learning society;

(3) the change in the educational mission from instruction to the provision of methods for personal learning;

(4) the increasing role of technology in the communication process and in knowledge acquisition;

(5) the shift away from formal educational institutions such as schools and universities towards organisational structures for learning which have yet to be determined.

The study group considers that IT should provide a means to improve education:

(1) by freeing teachers from numerous less central tasks;

(2) by improving teaching and learning methods;

(3) by encouraging individual and small group work;

(4) by encouraging the world of education to open itself up to the community.

As IT comes into more general use in mainstream education, and in the home, it is necessary to bring about changes in attitudes and to acquire the necessary equipment for schools and other such establishments.

The development and use of IT in education and training demands action on a variety of fronts, which implies that the various policy initiatives that exist in this field must be brought into cooperation with each other. The study group's report identifies some 15 possible dimensions of response which, taken together, relate to three main problems:

(1) the development and provision of appropriate equipment for all educational levels and contexts;

(2) the encouragement and support of the use of IT by teachers and trainers themselves;

(3) the fostering of innovations in learning processes themselves and for accreditation purposes, including for those competencies acquired in non-formal ways.

5. Making education and training systems more dynamic and giving support to the actors

The study group considers that there are five things we need to do:

(1) orient the education and training systems more to users;

(2) increase productivity and effectiveness;

(3) upgrade the jobs of teachers and heads;

(4) introduce evaluation procedures both to encourage reorganisation and to enable users to make informed choices;

(5) be more open to all forms of cooperation.

Teachers play a primordial role because they are the only people in our societies providing a service of such a marked multidimensional character, but many teachers do not have the training or experience to cope with this greatly extended role. It is clear that they should benefit from high quality pre-service teacher education; therefore the study group recommends focusing on the concept of added value as one of the main possible guidelines for evaluation procedures. In an educational context, added value is the difference between the knowledge and skills learners possess when they enter an establishment or course, and what they possess when they leave or finish.

Our education and training systems must develop a wide range of partnerships with the other players in society.

I tell you you will have to destroy this edifice and restore the supreme regard for the rational part of man, for the Socratic spirit, in Europe's members. And this because of a schoolroom truth of which you must never lose sight: because it is only by embracing this rational part of themselves that men can hope to see their differences disappear and the dawning of reconciliation. Remember the master's words: 'Men are similar in nature only in so far as they live according to reason ... It is on this condition alone that each man's nature will necessarily accord with that of another.'

Julien Benda
Discours à la Nation Européenne
[Discourse to the European Nation]

Background paper

Janice Richardson
Consultant in Education Sciences
Luxembourg

After a decade of experience as a primary school teacher in Australia, moved to Paris in the late 1970s to found a language teaching association dedicated to researching new teaching methods in adult training. Part-time lecturer at the Sorbonne in the field of computer technology, law and information systems from 1989 to 1995. Research attaché at the Louvain Catholic University for the duration of the Ampere study (1995-96). At present consultant in educational sciences, lecturer at ENSTA (Paris) and author of the background paper for the 'Towards an open Socratic school' seminar and the recent publication Information Technology — a new path to creativity in education, *realised in collaboration with Daniel Deberghes.*

1. Meeting the challenges of the information age

The information age, born of the profound transformations that have taken place in information processing and communication methods over the past few decades, has radically modified the relationship between man, information and knowledge. Consequently, if our education systems are to succeed in educating today's pupils to become fully-fledged citizens in tomorrow's democracies, then they must also modify the roles and functions that they assume.

The basic function of education has always been the transmission of knowledge. However, change is currently taking place at such a rate that an estimated 15 to 20 % of the existing knowledge base in many sectors becomes obsolete every year; some estimates claim that two thirds of the technology needed by the year 2000 has yet to be invented. In such a world the old linear concept of education-profession has disappeared. The citizen must become an independent lifelong learner if he is to succeed in adapting to his new living and working conditions. Initial training can neither produce a 'finished product'nor supply an adequate 'stock of knowledge' that he can use throughout his entire working life. Elementary education should therefore no longer consist of the accumulation of knowledge in a teacher-directed environment, but should rather aim at encouraging the learner to develop the skills and strategies which will enable him to cope with the complex situations he will incessantly encounter. Learning in school must be promoted from level 1 — transfer of knowledge — to level 2 — learning to learn — in a meaningful environment that the pupil can carry with him throughout his life.

The new technology that has heralded the advent of the information age has also dramatically transformed the means of transmission of information and knowledge. It has led to an extension of space and anonymity and an overwhelming complexity of the basic rules of life. The individual is finding it increasingly difficult to navigate in the labyrinth of knowledge. If he is to succeed in his lifelong path of learning he needs to master the strategies necessary to sift through this mass of information for appropriateness, coherence, relevance, and even verity. This can only be achieved if, from an early age, pupils are encouraged to develop a 'network-structured' logic through the mastery of enquiry-based reasoning strategies in a Socratic-type approach whereby they constantly acquire their own knowledge through the skills of deduction, prediction, formulation and verification of hypotheses and the seeking of relationships.

New information and communication tools have, at the same time, increased the demands of society on the citizen. The distance between nations has been reduced to the seconds it takes to transmit large masses of information across the planet; the world has turned into what some call a social, political and economic global village. It is no longer enough for our citizens to know what is going on in their immediate environment, to take an active role in the democracy of our nations they need a far greater awareness of

international issues in the field of politics, economics and social life. All of these domains are undergoing constant change. Unless the individual is able to keep abreast of these changes, he will gradually find himself excluded from society, a factor which will eventually increase social tensions and contribute to the destruction of our social fabric.

The spread of information and communication technologies in our everyday life has broadened the traditional gap between the school and the outside world and undermined the role of our educational institutions as repositories of the social and cultural values of society. In addition to formal education, children now have access to a whole range of information sources and channels. They are inundated by such large doses of culture handed out by the media that if the school is to succeed in 'handing down the sound roots of culture' it must work towards developing new skills that will enable citizens to distinguish culture from the mass of information so readily available, to discriminate between the virtual and the real world. How can education fulfil the new mission it has been attributed by society? What can be done to integrate into the classroom and the learning process the tools that have become commonplace in both work and leisure?

2. Four fundamental pillars of knowledge

In his recent publication *L'éducation: un trésor est caché dedans*, Mr Jacques Delors suggests that the broader mission of education is to train our citizens in four basic types of learning which should become for every one of us four fundamental pillars of knowledge: learning to know, learning to do, learning to live together, learning to be. We shall now examine these four concepts more closely as they provide a solid basis for reflection not only on the new role of education in the information society, but also on that of information technology in the learning process.

Learning to know — given the exponential rate at which change is currently taking place, children must be encouraged to discover and perfect their own knowledge-seeking skills that they will use for the rest of their lives. In this context, problem-solving strategies, exploration of resources and autonomy in learning take on far greater importance. If pupils are to learn to know, they must master the skills of clearly defining research parameters and formulating precise questions before they begin a task. They must also be capable of formulating hypotheses on possible solutions to the task in hand, and be proficient in the art of collecting, sorting, organising and applying knowledge. In this way, not only do they learn to navigate in a mass of information to extract the knowledge needed, they also develop a greater facility for finding the most appropriate source of information (books, newspapers, etc. remain a major reference resource, even in IT-equipped classrooms) and learn to use their sense of judgment in assessing the value of information obtained. By giving children a greater degree of autonomy in applying basic skills and strategies in their learning, knowledge becomes far more than what the teacher says or what they read in a book; the ready-made formulae learnt at school become part of a dynamic process that links school to the outside world, allowing the learner to understand the underlying concepts and know-how and when to apply them.

Literacy becomes more important than ever when children are encouraged to learn to know, particularly when information technology is incorporated in the learning process. Computers essentially communicate by text, therefore providing an inherent incentive for children to improve their skills of reading and written expression.

Learning to do is closely linked to learning to know. The challenge facing education today is to implement methods that will succeed in transforming school knowledge into practical competence. It is now generally accepted that the most efficient and pertinent teaching is that which leads learners to solve the problems that they encounter in life and that are immediately attached to life, rather than learning by rote or repetitive exercises. There is a fundamental need to incorporate 'doing' in learning, otherwise this learning cannot have its natural outcome in action.

Learning to do has always existed in the classes of enterprising teachers, though it is no easy feat to simultaneously involve every pupil in the 'doing' process when one teacher is expected to cater to the needs of 20 to 30 learners (the average size class in Europe). IT offers a ready-made environment that enables the

teacher to provide rich, hands-on learning experiences for all. With a sufficient number of computers in class, each group of pupils can have its own 'tool' permitting it to carry out its own experiments, rather than having one group 'do' while the rest of the class watches. When pupils are physically involved in the learning process, they develop greater confidence in their own capacities to carry out tasks efficiently and a greater sense of autonomy at an early age. Certain IT applications can enable even severely handicapped learners to learn to do, thereby extending their autonomy in ways that could not have been imagined a decade ago.

Learning to live together is the only possible means of overcoming the exclusion, oppression and war that is wreaking havoc on society today. Classroom activities can be organised in such a way that pupils are encouraged to work together, to develop a sense of team spirit, to appreciate the value of individual effort for the good of all. The authoritarian model still existing in many classrooms inculcates the opposite of this objective. How can citizens learn to work together in society if they do not master the art at school?

Information technology-incorporated lessons engender new organisational methods that favour group interaction through the sharing of learning tools and by encouraging a more collaborative, cooperative relationship between pupils and teachers, who work together and learn from each other, children often being more competent in using computers than their teachers. Electronic network link projects go one step further by breaking down geographical boundaries. Groups of learners in different countries can work together via the information highway to realise joint projects, thereby creating a global community of pupils who naturally come to appreciate the value of other cultural and ethnic groups in an electronic world blind to the prejudices of colour and creed.

Learning to live together also implies that each citizen is aware of what is going on in his immediate and more distant environment and is capable of exercising sufficient reasoning capacities to take his place as a responsible member of the community. True democracy can only exist if every individual is given the opportunity to develop his full reasoning potential, which he can only do if he is given the learning 'space' to test his own theories and concepts and so advance in the spiral of cognitive development. Living together in harmony depends on each individual being able to exercise his own sense of judgment; without this he will remain at the mercy of the media, sensationalism and the new dangers of loss of privacy and individual freedom that the information age has accentuated.

Learning to be — in traditional classrooms children are given few opportunities to express themselves, or even to be themselves. The golden rule is 'speak when spoken to' (by the teacher), the goal is to cover the prescribed curriculum, and assessment methods compare individual results against a class average. Every learner has a learning rhythm and aptitudes of his own. Until schools succeed in individualising teaching methods to suit the needs of the learner and promote assessment methods that take into account learning differences in individuals and serve as a means of setting new learning objectives adapted to the capabilities of the learner, few pupils can learn to be at school. By extending the possibilities of the teacher to provide individualised work for each pupil, the computer is already bringing about radical changes in this domain. Greater emphasis on group work is another step in the right direction. Children have a marvellous capacity for recognising the qualities of their fellow pupils who, by developing self-confidence in what they are good at, gain incentive to try out new roles and to discover the full dimensions of their own identity.

3. Information technology in the learning process

What are the immediate and long-term effects of information technology in the learning process?

Few studies have been carried out to assess the value of information technology in education — it seems that research and development is a concept that has not yet earned itself a place in the realm of education. A British publication — *The Impact report* — does however offer a preliminary insight into the learning gains that can be directly contributed to this new medium. This report is based on the findings of a large-scale comprehensive, longitudinal and in-depth investigation carried out in England and Wales, and focuses in particular on the core subject areas of mathematics, science, geography and English. The results of the study are conclusive — IT definitely enhances the learning environment in numerous ways. Unfortunately,

insufficient data are yet available to determine whether the learning gains induced by this new learning medium will have a long-term effect on the future learning potential of pupils. Some of the immediate learning gains arising from frequent IT use in the classroom are reported as follows:

- computers are found to be good motivators which heighten pupils' interest and enjoyment of subjects; motivation is intricately linked with increased concentration and sustained effort;
- heightened interest and enjoyment have a positive effect upon the status of the subject in which IT is used;
- computers aid concentration by focusing pupils' attention on the work in hand and as a result some pupils and teachers believe that the standard of work produced is of a higher quality than it would have been otherwise;
- involvement in IT-incorporated activities is often sustained over quite lengthy periods — sometimes an hour or more — for pupils, regardless of age;
- IT provides new opportunities to work in an open-ended way, enabling pupils to become involved in more complex and challenging learning situations beyond that typically experienced;
- where pupils use software to improve the presentation of their work, they often show more pride in their product, as contrasted with that achieved with more conventional media;
- some pupils are keen to continue with IT work outside normal lesson time and continue to discuss activities after the lesson is over — they appear to retain knowledge of what they have experienced over time;
- conceptual misunderstandings are often made more apparent through the interaction with a computing environment since IT provides for a greater understanding of detail and 'connectedness'.

The report, however, suggests that there is a minimum access threshold below which IT will make no sustainable contribution in the learning process.

A somewhat different approach was adopted in the year-long Ampere study, launched by DG XXII of the European Commission in June 1995. The findings of this study show that, when used in a global approach, IT is a valuable aid in transforming the traditional teacher-directed environment in which pupils accumulate knowledge into a child-centred environment in which pupils develop their own independent lifelong learning strategies. A standard grid used to record and analyse observations carried out in classrooms in nine European countries shows that IT plays a positive role in:

- promoting skills of deduction, prediction, seeking of relationships, independent formulation and verification of hypotheses;
- developing creativity, interdisciplinarity and communication skills;
- producing positive interactions and new and rewarding dimensions in the pupil-to-pupil, pupil-to-teacher and pupil-to-knowledge relationships.

Findings from several pilot sites indicate that IT can serve as an invaluable tool in overcoming three learning obstacles that are preventing a good many citizens from realising their full learning potential and assuming their rightful place in the democracy of our nations:

- learning difficulties due not only to learning impairments but also to the socioeconomic environment in which children are brought up;
- an inability to carry out formal operational reasoning, a form of reasoning inherent to the decision-making process;
- physical handicaps which prevent certain children from developing autonomy in learning and from taking part in mainstream education, hence limiting their possibilities to socialise with physically able children of their own age.

The long-term objective of the Ampere study was to identify teachers' needs in the aim of accelerating the integration of IT into current teaching practice on a European scale. Of course, information technology — the equipment, software and methods for the automatic processing and transmission of information and the associated know-how — is no more than a learning medium, its capacities limited to four basic functions:

to read, to write, to compare and calculate (compute). Its efficiency in the learning process is entirely dependent upon the way the teacher incorporates it into his teaching programme.

What new teaching skills are called for if teachers are to successfully integrate IT into their teaching practice?

IT-incorporated activities radically modify organisational methods and necessitate a new pedagogical approach since they place a greater emphasis on pair and group work; the teacher must succeed in encouraging pupils to work in a motivated and self-directed manner if they are to carry out their tasks efficiently without his constant supervision. Secondly, if children are to gain a maximum benefit from learning activities organised around interaction with peers, groups must be carefully constituted, taking into account the personality and ability of each. Individualisation of teaching takes on a far greater importance — the teacher must keep his finger on the learning pulse of every member of his class, sense when his intervention is necessary and know how to choose projects that correspond both to the interests and the learning goals of his pupils. This requires close collaboration between teacher and pupil, and the introduction of new assessment methods that follow individual progress and assist learners in settings their own goals.

The far-reaching effects that information technology is having on the learning environment is mirrored in the changing role of IT-using teachers. Gradually they are shedding the former 'school master' approach to take on the guise of a coach spurring on each member of the team to make greater efforts whilst sitting on the sidelines and letting the child get on with his own learning process.

4. State of integration of IT in current teaching practice

Although all figures on the integration of IT in primary education in European Member States are not yet available, it seems that few schools can offer their pupils more than spasmodic IT access. In England, where an intensive effort on behalf of both the government and private sectors has been made to equip schools, the pupil/computer ratio stands at 18:1 (30:1 in 7 % of schools); in the Netherlands, the ratio is 110:1 in the smallest schools (not including special schools where the ratio is 110:8) and 60:1 in the largest primary schools. In other countries such as Luxembourg, Italy and Portugal, computers are provided by local municipalities and therefore no State-wide ratio can be provided.

Besides the material factors determining how and when IT is used in class, restrictions imposed by the national curriculum also determine to a large extent the level of integration of this new teaching tool. Although most national curriculum's today make specific mention of the use of IT even in the earliest grades, a global learning approach incorporating IT appears to be a concept unheard of or unheeded by the educational hierarchy. Subjects are sliced up into a set number of 'learning hours' with little attention given to the value of associations between subjects as a means of creating a more meaningful learning environment. Work programmes are still set for each school grade, listing the operations that should be covered if the child is to progress to the next class. Only in England, where an intensive effort is being made to introduce IT as a means of catering to individual learning rhythms and aptitudes, has the curriculum broken away from the traditional vertical organisation in 'grades'. It is now horizontally organised into key stages (KS) — KS1 usually includes 4-7 year-olds, KS 2 basically refers to 7-11 year-olds. Each child continues to work through a key stage until he has reached the required attainment level. Attainment levels comprise a set of ideas, principles, knowledge and skills that the child can master at his own rhythm in a spiral progression. This method of organisation gives teachers greater freedom to tailor their programmes around the interests and learning aptitudes of their pupils and overcomes the negative social effects of 'staying back'. However, it also underlines the needs for a new approach to assessment.

Despite a lack of school-provided equipment and often seemingly insurmountable administrative constraints, an appreciable number of teachers in Europe and throughout the world are already enthusiastically working in the intimacy of their classroom to introduce this new medium in an effort to enhance their teaching/ learning environment and help pupils to develop their full potential as independent lifelong learners. Because of the lack of training facilities available to them, a large percentage of these have acquired their computer literacy through a personal interest in information technology, contacts with friends and family, or

professional needs to produce teaching aids or cope with the heavy administrative tasks expected of them. Others have come to discover the intrinsic potential of IT through their contact with children and their interest in how their pupils spend their time out of school hours. In some instances, teachers use their own hardware and software in class, or take it upon themselves to approach the municipality, parents or manufacturers to compensate for the lack of resources provided by their hierarchy.

But how exactly is IT being used? The major criteria which determines this is obviously the amount and type of hardware and software available. When a teacher has access to just one computer, this is more often than not used as a teaching (but not learning) aid, somewhat like a blackboard in motion; the teacher inputs the data, or chooses one of his pupils to work at the keyboard, other pupils passively watch the screen display (with difficulty considering the size of the screen and the quality of the image) but no real pupil/computer interaction can take place. Some more enterprising teachers divide the class into groups and send one group at a time to work on the computer whilst the rest of the class work on complementary or preparation activities. But in both cases, we cannot help but ask the question: 'With such limited access what sustainable learning gains can be achieved?' This type of activity necessitates extra time and effort on behalf of the teacher in terms of class organisation, work preparation, supervision, technical trouble-shooting and correction of work. Under these circumstances, we can understand the reticence of most teachers when they bemoan lack of time, lack of training, lack of computer experience, lack of material, etc. as an excuse to avoid the issue of introducing IT into their classroom practice.

However, rare are the primary school classes in Europe that are fortunate enough to have access to even one computer all day long. In many cases, two or three computers are shared by the whole school and access is painstakingly programmed a week, a month or a term in advance in order to give every child the smallest degree of access. In other cases, the computers are set up in a laboratory or in the school resource centre and the class must move out of the everyday classroom context, with all the material disadvantages and the disruption to routine that this entails, if they are to benefit from their computer time slot — rarely consisting of any more than one hour per week. If a minimum IT access threshold does exist, it is evident that IT can have little impact in the learning process under these conditions.

The choice of software is also an important issue. Most teachers can do no more than to comply with selections made by the school board, head teachers or voted by the teaching staff majority. How can teachers tailor their programmes to cater to the individual needs of their pupils if they are not able to choose their own teaching aids? Moreover, how can they make an informed choice when so little detailed information is available on the precise content of software, curriculum and age suitability, and organisational and pedagogical approaches adapted to its use? Teachers throughout Europe are calling for ongoing training and assistance from teacher trainers and software publishers to overcome these difficulties.

5. Which technology for an open Socratic school?

Due to the low level of integration in European schools, few teachers are able to incorporate information technology into an open Socratic approach. Its use is usually limited to just one or two of the five following basic IT application categories:

- computer assisted instruction (CAI) and computer managed instruction (CMI);
- control technology;

These both require task-specific software which can generally only be used for a short period with the same class. Programs of this type are rarely available in the smaller European countries because of the high cost of translation.

- expression and communication;
- datalogging and information handling;

For these applications, less expensive and more readily available general-purpose software can be used.

- reference resources, using read-only software or the information highway.

5.1. Computer assisted and computer managed instruction

CAI (computer assisted instruction) and drills were reported by the IEA (international studies for assessment of educational achievement) in 1993 to be the most regularly used approach in elementary schools, mainly in the subject areas of mathematics and mother tongue languages; Europe appears to follow this trend. However, when we consider that this type of usage implies individual pupil access to a computer, it is evident that not many children have been able to benefit so far. Simple CAI packages usually consist of one or many sets of correction-incorporated worksheets, and may provide registration facilities that enable the teacher to check on individual results. CAI is often used either for remedial work or for 'brighter' pupils needing supplementary or 'extension' exercises.

CAI+ includes options for registration of pupil's progress from one lesson to the next, as well as a range of levels for adaptation to individual needs. A test is often included to help the teacher place each pupil at the appropriate starting level, though sometimes this is done through input of reading or mathematical age. Computer managed instruction (CMI) programs offer all of the above capacities plus testing, analysis and diagnostic facilities and teaching modules which enable the teacher to incorporate and reinforce the areas covered in general class work.

Teachers regularly using this type of software report a number of advantages and learning gains:

- learners are provided with immediate and confidential feedback (ranging from the simple 'right' or 'wrong' of most CAI programs to the more complex diagnostic response in CMI programs), they do not go on reinforcing errors;
- the teacher is freed from his role of judge and has more time to devote to pupils requiring individualised attention;
- pupils are relieved of the stress of the teacher waiting for their response and therefore tend to take greater risks in trying to find an answer, confident in the knowledge that the computer will correct them and explain where they went wrong;
- children appear to work faster than when using the traditional pen and notepad;
- learning is apparently more vivid since children retain what they have learned and refer back to it when confronted with a related problem outside of their computer sessions;
- content is often presented in the form of games that help overcome negative attitudes to learning;
- a wide diversity of input and output devices can be attached to a computer which enable even severely handicapped children to work independently.

On the other hand, incorporation of this type of activity in classroom practice radically modifies organisational methods and is often not possible in the lower grades without the help of a classroom assistant (usually parents). It also requires a thorough knowledge of the entire content and curriculum relevance of the software and considerable effort in ongoing training, particularly for packages such as the integrated learning systems recently introduced in certain schools in the United Kingdom.

5.2. Control technology

Control technology basically provides a problem-solving environment in which pupils learn about cause and effect, make things happen and even design tasks. This category includes simulation, modelling and object-oriented programming. Whereas simulation is limited to an exploratory action — the model is fixed but the user can, by modifying one or more factors, modify the world that is represented – modelling is an expressive action, the goal being to create the parameters in a partly bounded domain in order to make a virtual world that is a replica (though perhaps reduced or enlarged in size) of the real one. Object-oriented programming, e.g. LOGO, takes the pupil into a miniature world which is made up of several objects functioning in relation with each other within a same system. Control technology provides an opportunity for the learner to create and test a formal description of a process that will naturally lead him to consider, on the one hand, the

properties of the constituents and, on the other, the expression of interactions. It places the learner in a problem-solving situation in which he:

- is forced to express his beliefs through action. The computer serves as a mirror in 'acting out' the consequences of these beliefs;
- assumes the consequences of his decisions and is led to discover the underlying rules in a scientific-type process, hence acquiring an intuitive idea of the way underlying principles determine various situations;
- develops mastery in basic skills such as comparison, opposition, classification, transformation, combination and formulation of possibilities;
- gains practice in the basic problem-solving skills of breaking down a problem to set about finding the required information, knowing how and where to find this information and deciding on the right method to use;
- tests the results of his own designs and consequently acquires practice in skills such as approximation and estimation;
- is gradually led to develop the higher mental processes of conceptualisation, induction, deduction and inference;
- constructs his own method of analysing and dealing with complex systems, which will provide him with a method he can continue to use in other domains.

Hence IT is preparing the ground for the development of the Socratic-type enquiry-based reasoning mode formerly reserved to an intellectual elite who reached the upper level of university studies where 'learning by research' becomes a prerequisite (e.g. for Ph.D. students). It also facilitates the process of bringing the real world into the classroom; one scale model is replaced by as many models as there are computers in the room, providing access to all students simultaneously. IT cuts down on the time needed to build a model or simulate an experiment, children can start again several times if they are not content with their results. Response time is also much shorter — feedback is now almost immediate. But, due to the shortened response time, will volatility of response become an element to be taken into consideration? What will be the residual benefit then? Will frequent utilisation be necessary if the child is not to forget? This brings us back to the question: Is there a minimum IT access threshold below which children will not make sustainable learning gains?

5.3. Expression and communication

Educational theorists have long stressed the importance of developing in our pupils a fluent, articulate command of language if we are to foster the transition from concrete to formal operational reasoning. Although nowadays it is generally accepted that logic arises from action, not language, verbal reasoning is a major vehicle or medium on which logical operations operate. Language provides the most important means by which a child can communicate his mental representations of scenarios and events, and have them received and examined, accepted or rejected, by others. Through a process of self-regulation, he will then gradually modify and build on his concepts and knowledge and continue on his path of learning. Yet it has also been proved that populations that depend on oral tradition alone never develop the capacity of formal operational reasoning. Therefore both written and oral expression serve an important function not only in the mastery of knowledge, but also in the development of reasoning and in communication in a social context.

With the widespread availability of word-processing programs and, perhaps more importantly, the cost effectiveness of a software program that will serve for pupils of all ages in all subjects, compared to task-oriented programs limited to a specific age range and a specific subject, word processing (and, in several classes in Luxembourg, 'oral word processing') is being widely used throughout Europe to develop and encourage written expression (and oral expression), particularly in group project work. This also corresponds to a recent trend in education which places a new emphasis on the mastery of the native language in the primary school, in an attempt to overcome the shortcomings that the educational system has been accused of in the past.

The use of IT in written and oral expression presents a number of advantages for both teachers and pupils:

- the blank screen and keyboard (or icons) draw children into a universe which offers a silent invitation to explore the written or recorded word;
- it gives children privacy in their creation. They can wipe out a word or sentence, start a new page with the click of the mouse; this avoids fear of error and incites pupils to seek perfection in their written production and page layout;
- the process of gathering, organising, and revising ideas is simplified as the computer does away with the physical discomfort of multiple rewriting and correction; children are therefore encouraged to persevere until they are happy with their final result;
- self-correction, far more gratifying and efficient than teacher correction, is possible through immediate feedback on spelling, vocabulary, structure, punctuation, grammar and style;
- the computer gives help on setting out documents by providing models on which pupils can base their own work;
- the final printout is almost professional — children are thus encouraged to take greater pride in their work;
- children using word processing regularly in class write much longer compositions and their motivation has greatly increased;
- children are able to dissect their own 'production' – rearranging, deleting and adding as they wish. In this way, they develop another, more abstract, form of thinking, disconnected from the concrete and direct experience. This form of 'decentred' or 'disembedded thinking' is indispensable both in aiding a child to express himself coherently in public and in developing the higher cognitive skills needed if he is to succeed in his school work;
- children work in groups around the computer, those with greater capacities helping their peers to reach a higher level by enabling them to bridge the gap between what they are capable of doing alone and what they can achieve with the assistance of others more knowledgeable or skilled than themselves. This constitutes what Vygotsky defined as the proximal zone of development, whereby a child's potential for learning is revealed and indeed is often realised in interactions with others who are more knowledgeable. Obviously, this factor comes into play in all group interactions, where the computer serves as a medium that facilitates exchanges and provides more numerous occasions for children to share a creative experience;
- the teacher is freed to a large extent from the onerous task of correcting since his pupils have in their hands an efficient auto-correction tool. It also overcomes the problem of illegible handwriting;
- work can be stored all year long and easily accessed on floppy disks to make the assessment of progress easier, more rapid and more effective.

Wide area network links are being used in some countries to take the expression and communication process one step further, though not many schools are fortunate enough to have ready access to a telephone point or sufficient budget to cover the high cost of communications. Network links create a new language learning environment by bringing together a multinational community of learners and providing for new social exchanges. Written expression takes on a new dimension when eager authors are sure that, at the end of the telephone line, they have an enthusiastic audience waiting to receive their 'publications'. Suddenly, because the content of written expression exercises takes on a new importance, pupils become aware of the fact that they must express themselves clearly if their ideas are not to be misunderstood by readers with whom they will never have the possibility of dialogue. Through the necessary coordination of a multitude of cognitive skills, strategies and knowledge that are involved in the process of formal representation, they gradually begin to develop meta-cognitive knowledge, i.e. the capacity to reflect upon their own knowledge.

5.4. Data logging and information handling

The use of general purpose software programs such as spreadsheets, graph plotters and databases enhances the processes of data logging and information handling (mainly incorporated into the area of natural science at primary school level) in a number of ways:

- pupils can gather and store much more information faster than was previously possible with pencil and paper methods;
- the tasks of manipulation, interrogation and interpretation of results are streamlined through the use of IT;
- data can easily be presented in a form that brings out the significance of results and make patterns and trends in data more accessible;
- automatic computation options save time and will overcome any interpretation errors due to mathematical errors when pupils are investigating results;
- graph facilities in spreadsheet programs enable pupils to present their work in attractive and meaningful ways that they are often not able to achieve without the help of the computer;
- observations become more pertinent because of the greater mass of data that can be collected and because of alternative classification possibilities that can be carried out by the computer;
- prompt feedback and interaction between children make the learning experience one of collaboration and communication;
- the use of more sophisticated computer programs or input devices can also extend the range of observable phenomena and increase the physical quality of measurement of data.

Information handling projects carried out jointly by schools in different countries via electronic networks (e.g. weather, environmental issues) are providing pupils with new opportunities to discover and better understand the implications of the global village in which they live.

5.5. IT as a source of reference

The incorporation of electronic resources into classroom practice are having far-reaching implications in education. Firstly, pupils are given easy access to a fantastically rich reserve of information in sound, text and moving images. Secondly, events are presented in a more realistic, factual context which aids in opening up the classroom to the outside adult world. Through the use of CD-ROMs, the Internet, etc. the development of cross-curricular skills such as information retrieval, handling and presentation are largely enhanced. The network organisation of the information stored on electronic resources leads users to discover the connections and associations that exist between data, thereby calling on the long-term rather than short-term memory in the learning process. Searching, accessing and retrieving information poses an exciting challenge for classroom practice since the richness of an overall experience is necessarily related to purpose-driven exploration.

An in-depth assessment carried out in a large number of primary and secondary schools in the United Kingdom has shown that frequent use of CD-ROMs and the Internet are having far-reaching effects on learning:

- pupils want to read better with greater understanding; noticeable improvements are evident in both reading and writing;
- learners have fewer spelling-related difficulties when looking up topics;
- language skills have improved through discussion of the steps of the tasks incorporated in the knowledge-seeking process and, perhaps more importantly, because pupils have become motivated to watch and discuss television news programmes with their parents at home;
- information has become a more personal thing for pupils, and their interest in world and current affairs has been stimulated.

A major drawback to the use of the information highway is the high cost of telephone communication, lack of telecommunication links in classrooms and libraries, and the dangers of access to unauthorised programs.

5.6. IT in a global learning approach

Information technology regularly incorporated into the classroom in several of the above ways facilitates the task of the teacher to create a meaningful learning environment in which pupils can determine their own learning goals, develop and perfect their own learning strategies and, through an enquiry-based reasoning process, continue independently in their spiral of intellectual development. Three factors are of vital importance in the link between the knowledge acquisition process and that of intellectual development:

- the independence a learner is given when building up his stock of knowledge (and assimilating school and social rules);
- the interaction that takes place between the learner and the whole of his environment during the learning process;
- the use of assessment as a formative tool and a guide to proficiency.

We have seen from the description of learning gains attributed to the various categories of IT applications that these three key factors are largely enhanced through the use of computers.

The Ampere study describes in detail the work of a teacher in Luxembourg who has incorporated IT (four computers, a printer, general-purpose software, a camera for digital photos and scanned images, a telephone and modem) into an open Socratic approach with a class of 15 11-12 year-olds. It is difficult to assess the 'academic' results of this approach, although the compulsory national exam for all 12-year-olds has shown that his pupils cover the required curriculum and produce results comparable to others of the same age throughout the country. The teacher considers that the major advantages of this IT-incorporated approach is that it has opened up vast communication possibilities, facilitated many menial and time-consuming tasks, and increased pupil motivation, interaction and independence. He underlines a number of other learning-environment gains:

- he has assumed a new role as leader, counsellor and mentor, responsible for providing a rich environment in which children will become aware of their own centres of interest and learning objectives, and the most appropriate means of achieving these;
- he is now able to closely follow the progress of each learner, provide individualised attention, adapt a differentiated approach that caters to the needs of each and every one;
- he can 'time' his teaching to suit his pupils' needs; when they encounter a problem they cannot resolve with peers, they are highly motivated and psychologically ready to receive and apply the information he imparts to them;
- greater socialisation opportunities: as the computer screen renders all work 'public', other members of the class feel free to comment on what they see on-screen, thus encouraging cooperation, collaboration and a greater pride in work that can be seen by all;
- openness to the community: easy access to outside sources of information through the telephone and modem has broken down the barrier between the school and the outside world;
- openness to the world: the production of a weekly newsletter with schools abroad has developed the pupils' capacity to see what news is important to, and can be shared with, others. Children take a more critical, personal and objective approach to what they read in the newspaper. They show a more meaningful interest in geographical, demographic and cultural features of other parts of Europe, and a greater tolerance and understanding of other nationalities and ways of life;
- openness to the economic sector: work on projects about the local economic sector has created a deeper understanding of the community, the responsibility of the individual in it, and the need for professional skills to serve it.

It seems then that the information age has invented its own tools to meet the challenges of tomorrow.

6. Which teaching skills for an open Socratic school?

What is the profile of the teacher able to effectively integrate the information tools of our era into his current teaching practice? The teachers encountered during the Ampere study have several points in common:

- an awareness of the need to acknowledge and cater to the differences in learning rhythm and aptitude of their pupils. This can usually be attributed to one (or more) of four factors:
  - positive (though sometimes negative) learning experiences during their own educational training;
  - ideas sparked by pedagogical literature or as a result of initial or in-service training courses and developed through personal effort and the firm conviction that the school should do more in providing equal learning opportunities for all;
  - contact with innovative colleagues on the same teaching team, through membership of an association or club, or through electronic network links;
  - 'persuasion' and support from teacher trainers, head teachers, inspectors and colleagues;
- the ability to apply an active research reasoning method, learning by doing, to find the right tools and adapt their teaching style to suit the needs of their pupils and the reality of today's world. This method cannot be learnt in a three- or four-year initial training course; it is gradually developed through the teacher's own learning experiences at an early age, or sometimes force-fed through the 'master-apprentice' contact with scientific researchers at the level of higher university studies.

  Education is a vicious cycle. Unless the teacher is stimulated by a strong external influence, he will reproduce the methods and role models he himself has encountered during his own learning experiences. Applying an active research reasoning method in class implies that the teacher has the self-confidence to learn by his own errors as well as by his successes, alongside his pupils, with his pupils, and even from his pupils. By admitting to his pupils that he is not an infallible fountain of knowledge, he frees his pupils from the fear of errors and encourages them to embark on their own quest for knowledge;
- a pragmatic view of teaching and sufficient organisational flexibility to create a learner-directed environment in which children set about their own learning tasks enthusiastically and independently. A teacher is no longer someone who just 'gives lessons'; he is rather someone who organises, observes, stimulates, assesses and fosters the various learning processes in children, ready to take remedial action whenever necessary. Information technology serves as a medium between the pupils and teacher, stimulating the learning process for the children whilst freeing the teacher to provide individualised attention when necessary and enabling him to 'keep his finger on the pulse' of all children at once;
- an aptitude for communication, social relations and teamwork, evident in pupil/teacher contact in class, which goes far beyond the traditional teacher-directed dialogue. Outward signs of teacher 'authority' are no longer evident — children and teacher work and learn together, conversing as equals as they set about finding the best means to go about a task, assess results, or set new learning goals. The pupil/teacher relationship is reflected in the way children quietly discuss problems and help each other; but also in the way parent volunteers and other teachers feel free to 'drop in'.

A teacher who remains closed in the microcosm of his classroom has no incentive to implement change; it is only through a positive educational climate between teaching staff that he can continue his own lifelong learning experience. If he cannot appreciate the advantages of teamwork himself, he will have little incentive to encourage teamwork in his pupils. IT-competent teachers list professional dialogue as being one of the major factors that enabled them to evolve towards a new style of teaching. All decry the lack of opportunities provided to exchange ideas on new teaching approaches with colleagues in other parts of their own country and in Europe;

- a supportive hierarchy ready to encourage innovative efforts and adapt curriculum requirements to leave the teacher more freedom to choose the tools and methods he uses in class.

  These qualities correspond closely to several points underlined in the findings of the CERI (Centre for Educational Research and Innovation), an organisation created by the OECD in 1968 and commissioned to carry out a study on the use of IT in education in the late 1980s. The CERI suggests that a teacher wishing to use IT widely in class should:

- know how to run and maintain the systems used;
- learn to understand the uses of IT through discussions with scientists and educational specialists;
- gain an insight into appropriate pedagogical applications of IT. In particular, to develop a sense of how to use the technology in the aim of helping his pupils to acquire learning strategies, a strong perception of his own value and a spirit of cooperation;
- be receptive to the messages communicated during the use of IT;
- keep up with recent evolutions in science and technology;
- be ready to spend the time necessary to reflect upon traditional teaching methods, teaching philosophy and the organisation of the learning environment.

If the role of the teacher is develop in his pupils the capacity to become independent lifelong learners, then teachers should already be independent lifelong learners. This should be one of the essential objectives of all initial training and in-service courses, which should also aim at:

- fostering greater insight into the pedagogical approaches that can be used to individualise teaching to cater to the specific needs of pupils, and the importance of IT in establishing a pupil-directed learning environment;
- providing opportunities for teachers to learn through an active research method and to discover for themselves the utility of IT in their own learning experiences;
- gaining greater proficiency in organisational methods that will allow for integration of IT into class work and give rise to enriching interactions between pupils/teachers/knowledge;
- developing the art of cross-curricular learning, thereby allowing children to make their own associations that will render new skills and learning more meaningful;
- establishing new assessment methods that enable pupils to set their own learning goals and measure their own progress;
- increasing aptitude for communication and teamwork and facilitating encounters with staff at teachers' colleges and during practice sessions who will provide valid models on the 'new' role of teachers;
- encouraging teachers to continue on their own path of learning through effective use of professional literature, on-line data sources and meaningful exchanges with colleagues.

Towards a new educational culture

Willem J. Pelgrum
University of Twente
Netherlands

Dr Willem J. Pelgrum is senior researcher and programme leader at the Centre for Applied Educational Research at the University of Twente in the Netherlands. His primary responsibility in the past 10 years was the coordination of an international comparative assessment of the infusion of information technologies in education. Currently he is involved in planning a study aimed at describing and diffusing examples of emergent practices of using CIT (Communication and Information Technologies) for educational purposes which have shown to be of good quality. He is also involved in a study which will offer policy options to the European Parliament for stimulation of CIT in schools with an eye on reshaping education to fit the needs of future citizens in the information society.

1. Introduction

As a result of a number of developments (such as the upcoming year 2000, and recent innovations in the area of communication and information technologies) an increasing societal and political awareness has shown that our countries are in a transition period from industrial to information societies. The belief is growing that this transition must lead to profound changes in the curriculum and organisation of the educational system, which may be as extensive as the changes which took place when our societies changed from agricultural to industrial. Vivid discussions are currently taking place at the national and European level about the desired direction of these changes. The general expectation is that it will be necessary to induce skills for lifelong learning, and associated with this, instead of focusing on teacher-centred ways of transfer of information (the reproductive model), more student-centred ways for acquiring information (the productive mode) will be necessary. The instructional paradigm for realising the last mode which is featuring at this seminar is the Socratic dialogue. On the road to shaping our future, this seminar is one of many in which there will be a chance to communicate about the desired changes and their implementation. This is a very important stage in a process of educational reform, namely the orientation on the need for change, its relevance, and especially its practicality from the perspective of the teacher. The last point is crucial: from a long research tradition on educational reforms we may conclude that changes will not occur if the intended innovations are not seen as useful and practical by teachers. Hence, it is very important to have seminars like this in which in an early stage of orientation on the restructuring of education there is an opportunity to communicate, from the point of view of the teacher, about the directions for change and the recommended procedures for reshaping education's future.

In this paper the following questions will be addressed:

1. What have we learnt from the past about the intended objectives, successes and failures of educational innovations in the area of information technologies?
2. What are currently the main proposed directions for the intended changes and which are the dilemma's which should be solved?
3. To what extent is there already a sufficient awareness of the need for change? What is known about the current situation in schools with regard to the adoption of ICT-based learning? Results from recent surveys will be shown to provide an estimate of the current situation.
4. Which systems for navigating the education mammoth tanker to a promising future can we at this moment envisage and what should be the role of different groups of stakeholders in education during this process?

2. Previous information technological innovations

From what has been said so far we may conclude that it is expected that the future reform of education will very heavily rely on further development and application of information and communication technologies.

Before taking a look at the road ahead it may to a certain extent be illuminating to first look over our shoulder to see how our journey along the road of introducing information technologies in education has been going so far. Therefore a short historical sketch of our tour on IT in education will be given leaving from the euphoria of the 1980s via the disappointment of the early 1990s to the current revived euphoria. Finally, the question will be addressed to what extent our experiences from the past can guide our way to the future.

3. The 1980s, when the introduction of IT in education began

In the early 1980s microcomputers became available for mass production and were purchased in great numbers for office purposes. The general expectation in many countries was that this technology would completely change society and education, and that quick responses would be needed in order to prepare the citizens of the future. As a consequence, governments (in Europe headed by France and the United Kingdom) started big campaigns, accompanied and sometimes preceded by private initiatives, to provide computers for schools and to organise teacher training in the expectation that these tools would not only be important for the preparation of students to function in an information society, but also would have very beneficial effects on the instructional process and outcomes of education. From survey results it can be seen that by 1985, in many countries, already most upper secondary schools had access to microcomputers, while this was the case by the end of the 1980s for lower secondary schools. Primary schools were usually the last to be equipped. Nowadays in most EU countries all secondary schools have access to computers. In primary schools this is not yet the case in all countries.

The surveys also showed that computers were mainly used as an add-on to the existing school curriculum (that is, to teach students how to handle hardware and software), rather than a modern tool for instruction. Many analyses were conducted to find out what might be the possible causes for the stagnating integration of computers in the curriculum of schools. Main factors which were convincingly shown to play a role were: lack of adequate preparation of teachers, lack of time to get acquainted with this new technology, lack of software.

These findings were in line with the expectations of sceptics who in the 1980s argued that a fundamental change of education as a result of introducing computers may not be expected, because so many things have to change at the same time (curriculum materials, instructional strategies, class management, the role of the teacher, the organisation of the school, etc.).

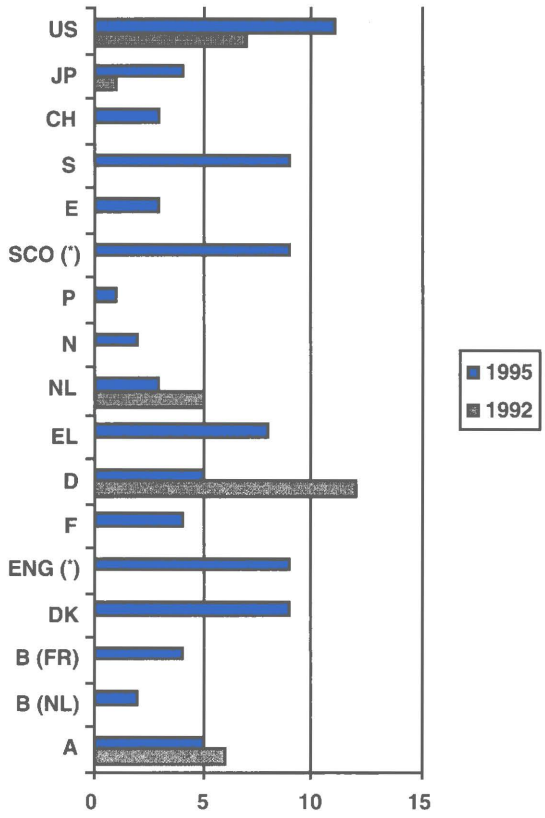
4. The early 1990s: disappointment

The many investigations on the infusion of computers in changing the curriculum of schools clearly resulted in disappointment at the political level and there were many signs throughout Europe that governments were inclined to give up their huge investments in these developments. Also at the school level there were some indications that further reform was not expected. In this respect it was for instance illustrative that many Dutch school principals expected (in the early 1990s) that no further changes would be needed. It looked like people had accepted the then prevailing situation and were just intending to continue the use of computers in education as an add-on: in elementary education mainly as a tool for drill and practice, and in secondary education as an object, with only marginal use for instructional purposes. Such types of use would not require huge investments of additional equipment or any radical changes in the teaching-learning process. From statistics which were collected in 1995, one may conclude that the integrative use of computers was still very low. For instance, when students were asked how often they used computers in mathematics lessons, it was only a minority which indicated that this was frequently the case (see Figure 1).

From the available evidence it is not possible to immediately draw conclusions about the change of computer use in mathematics education, due to the fact that the published statistics were not exactly based on comparable questions. Nevertheless, the conclusion seems warranted that two years ago computer use for mathematics instruction was still a marginal phenomenon and that this situation is not much different from what was found in 1992.

In conclusion: the development in the 1980s was quite strongly technologically driven and quite often based on the naïve expectation that simply by introducing new technologies, fundamental changes in education would result. One may argue that there was especially a lack of clearly articulated educational objectives for indicating in which direction education should change.

Figure 1 – Percentage of students using computers relatively frequently for mathematics lessons in 1992 and 1995



NB: 1992: more than 10 times in the school year; 1995: almost always and pretty often.
Source: 1992: IEA-CompEd study; 1995: IEA TIMSS.
(*SCO = Scotland; ENG = England)

5. The late 1990s: A revived interest in information and communication technologies

In only a few years time, the situation as sketched in the previous section changed completely. Suddenly there is a world-wide and massive movement of unprecedented interest in information technologies. Again the expectations about the possibilities of this technology are very high. One may wonder to what extent there is reason to believe that the current expectations are more realistic than comparable ones from the early 1980s. There are several reasons to argue that this indeed might be the case, namely:

1. The increased technological possibilities, especially for communication purposes. The change of vocabulary, namely from IT to CIT or ICT illustrates this phenomenon.
2. The increased access to information via the Internet has greatly improved the societal acceptance of information technologies.
3. The societal momentum. Where in the past most access to communication possibilities took place at offices, suddenly many citizens have access. Also the access to information has improved. One does not need to rely on databases which are available only locally, but has instantaneous access to databases all over the world.

As a result of this technological development, several governments throughout Europe intend to equip all schools with the facilities to get access to communication networks, such as the Internet. Does this mean that again education is confronted with a technology-driven change? Is this a new hype with a short life expectation? Is it old wine in new barrels? Will it result again in disappointment in a couple of years?

There is no direct answer to these questions, but one may argue that this might occur if the developments are not be embedded in a good pedagogical rationale.

With regard to the last point, there is some reason for hope. Unlike the situation in the 1980s there seems at this moment to be a much more pronounced educational rationale, which is gaining momentum especially at the higher political levels, which at the same time tends to be increasingly accepted by society.

In the next section we will examine some of the main lines of thinking with regard to this new rationale.

6. The main proposed directions for the intended changes and the dilemmas which should be solved: Towards new educational objectives

When we analyse the documents which offer some perspectives on the future and which are currently circulating (in the EU, at the level of national governments, at this conference) we may distil a number of expectations or beliefs on what should be the main directions for educational change, which can roughly be summarised as follows:

As a result of the rapid technological developments we are in a process of change from industrial to information societies. Analogous to the way that education needed to be adapted when societies changed from agricultural to industrial, it is believed that an educational change of analogous (or even larger) size is needed in order to educate the citizens of the future. In comparison with the great stability of life in agricultural societies, and the increased level of societal change during the industrialisation period, it is expected that societal change processes will be in an even higher gear in the future.

Education must change in order to adequately prepare the citizens of the future to function in a society, which will be in a constant state of flux. Consequently, the current educational paradigm of mass production of ready-made knowledgeable citizens with certificates which qualify them for a long-lasting job career, must be replaced by educational models which qualify citizens in terms of lifelong learning skills in a society in which CIT is one of the main infrastructure pillars.

What are the educational consequences of this societal philosophy? Without trying to be exhaustive I will just cite a number of potential consequences which one nowadays frequently encounters in different documents.

Actor	Current situation	Future
School	• **Isolated from society**	• **Integrated in society**
	• **Most information on school functioning secret**	• **Information openly available**
Teacher	• **Initiator of instruction**	• **Help students to find appropriate instructional path**
	• **Whole class teaching**	• **Independent learning**
	• **Evaluates student**	• **Helps student to evaluate progress**
	• **Low emphasis on communication skills**	• **High emphasis on communication skills**
Student	• **Passive**	• **Active**
	• **Learns most at school**	• **Learning at school and outside school**
	• **Little teamwork**	• **Much teamwork**
	• **Takes questions from books**	• **Asks questions**
	• **Learns answers to questions**	• **Finds answers to questions**
	• **Low interest in learning**	• **High interest**
Parent	• **Hardly active in learning process**	• **Very active**
	• **No steering of instruction**	• **Co-steering**
	• **No lifelong learning model**	• **Parents provide model**

One should note from the above, that most dreams about educational changes can be described almost without reference to ICT. Therefore the question is what ICT has to do with this. The reasoning is that many of these changes can only be implemented with the help of ICT. Some may challenge this reasoning by saying that many of these ideas have already been implemented in non-traditional schools, such as the those based on the philosophies of, for example, Freinet, Montessori, and Steiner, and that these could offer good models for an orientation on the future of education. The last part of the statement is open for dispute and many practitioners from traditional schools would be inclined to argue that a substantial number of children would not be able to survive in such open educational settings.

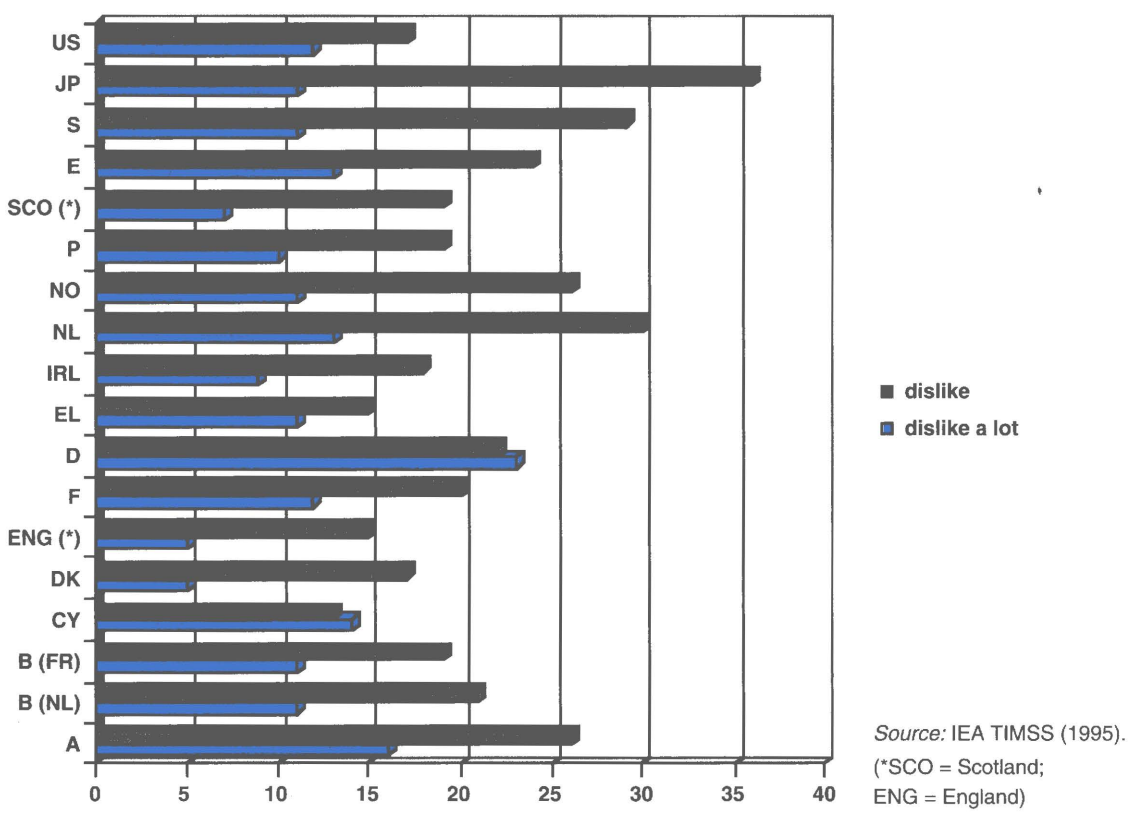
If we admit that the objectives of the reform schools cannot be realised in the education system at large, how can we be confident that such reform would be possible by using CIT? Related to this is the question of how awareness of the need for change in society at large can be raised.

This brings us to the next question, namely about the current awareness of the need for change.

7. Current awareness of the need for change

Irrespective of how rational, plausible and relevant the new objectives for education may sound, we must be realistic in our expectations as to what extent these ideals are shared by a large group of people. It is very promising to see that, unlike the situation in the early 1980s, there is now much more pronounced policy-making with regard to a reform of educational objectives, even at EU level. However, much more information will be needed before a large mass of educational practitioners can be convinced that something worthwhile is coming up. In terms of our main challenges, who is currently aware that our knowledge is (or more important will be) quickly outdated? How could we know? Which tools do we currently have to determine where we are and what realistic intermediate objectives to strive for? How will we know if education is able to induce lifelong learning skills? How can these skills be defined? Why should teachers give up lecturing to whole classes if in many cases they believe that is the most efficient way to transfer information? Who will show us what is wrong if we do it this way rather than another way? Should education be equipped with the navigation tools for guiding the trip to the future?

Figure 2 – Percentage of students at Grade 8 (lower secondary education) saying that they disliked or disliked a lot mathematics

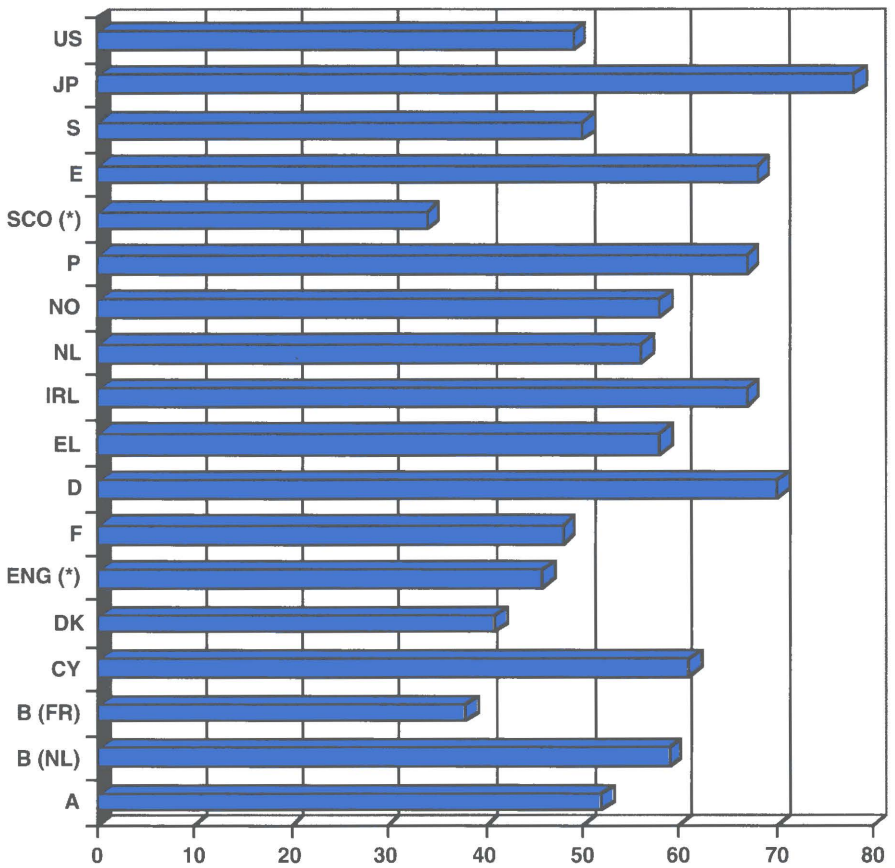


Source: IEA TIMSS (1995).
(*SCO = Scotland;
ENG = England)

Clearly another educational culture is needed, for instance a culture in which educational partners in certain countries get very worried if they see statistics like the ones in Figure 2, showing that quite a number of students say they dislike mathematics a lot, which is certainly not a good basic attitude for lifelong learning.

Or maybe even in the future, certain countries will be very upset if we see that whole class teaching is still such a popular activity (see Figure 3).

Figure 3 – Percentage of students at Grade 8 (lower secondary education) whose mathematics teachers report that they work most or every lesson as a class with the teacher teaching the whole class



Source: IEA TIMSS (1995)
(*SCO= Scotland; ENG = England)

Very important for a change of culture will be an increased awareness of citizens with regard to their knowledge and skills, and probably low-threshold tools should be made available to increase this awareness. Such tools might be derived from current popular tools which elicit curiosity, such as the self-assessment quizzes, which are frequently included in popular periodicals and weekend appendices of certain newspapers: provided that they are scientifically guided (and thus based on reliable and valid instruments) and seriously answered, such tools may be low-threshold and attractive means to make people aware of the concept of self-assessment and self-guided learning if at the same time provisions for tele-learning are made available. Especially if such efforts are to be directed at the skills for lifelong learning, teamwork, job knowledge, etc. it could well fit within the current global frameworks.

8. Navigation into the future of education

In the sections above, many questions have been posed, illustrating challenges when discussing potential future reforms in education.

The major dilemma currently confronting us is that we are faced with the task of shaping the future, without knowing what this future will look like.

Brummelhuis and Rapmund (1996) have succinctly indicated the challenge which is facing us:

It is likely that the information society will resemble the industrial society in only a few aspects. It will use other definitions, also for education. From this perspective our current education can be characterised as industrial heritage. If the industrial society vanishes, the associated definition of education will also disappear. This implies that education of the future is not a product which self-evidently is built upon our current education, but could be something new, which will arise from a new societal concept. Consequently, education of the future is not a design problem, but rather a participation problem. ... In other words: the future will define its own 'education' (translated by the author).

What is the way out of the dilemma of participating in an enterprise which has an unpredictable end? Maybe an analogy might help.

As there are no blueprints for a future society, educational reform towards creating education of the future cannot be designed but is rather a discovery tour of participation in innovatory approaches embedded in a process of successive approximation, characterised by:

1. sensitivity to societal developments and timely responses;
2. awareness of the capacity for change of students, parents, teachers, and schools;
3. an adequate system for information provision on what works and what doesn't.

Taking into account the many different factors which play a role in educational reform processes and the impossibility to change isolated aspects of an education system, the reshaping of education should be based on multidisciplinary approaches in which technical know-how, implementation expertise, training facilities, scientific evaluation and an orientation on practical feasibility are closely interwoven.

If we accept the metaphor of a voyage of discovery, we need the voyagers taking the risks and in a lot of cases they will not reach the promised land. However, the ones who reach it will show the videos back home and many will follow in travelling to that land. One problem with this metaphor is that whole groups of students need to accompany the voyager: how can we minimise the risk that something will happen, that they will be damaged? Maybe some guidelines could be created: one of the criteria should be that the experience in itself (the journey) should be healthy enough even if the originally intended goal is not to be reached. However, one may question who is going to determine if this is the case, especially if we want to avoid pedagogical paternalism. Maybe here the pragmatical metaphor of the market place would be applicable: if there are enough interested buyers, there is a market. But where then is the place? Here the answer might be that these places will need to be developed: educational market places (virtual and real) where people can orient themselves on products and prices (material as well as immaterial). Especially if (educational) experts and (educational) consumer organisations can monitor the quality of these products, a relatively safe climate for educational reform might be created. The European award scheme for high quality multimedia products might be a good way to find the good examples which may be exhibited on such a market place.

If, as expressed above, the future of our societies and hence of education cannot be predicted, active participation in exploring the possibilities and an approach of successive approximation is needed. The meaning of this term, which stems from learning psychology, very well illustrates the main features of the proposed approach: proceed in small steps and on the basis of feedback keep the good and throw away the bad. The focus on participation rather than designing from blueprints also has important implications, the main one being that the viability of new approaches is determined on the basis of positive or negative feedback from educational practice. This places the students and teachers in the centre of the new developments. In such a scenario it will be vital to install a good system for information on the progress which is made. Therefore it will be necessary to develop adequate means of informing all educational partners about the direction in which education is moving.

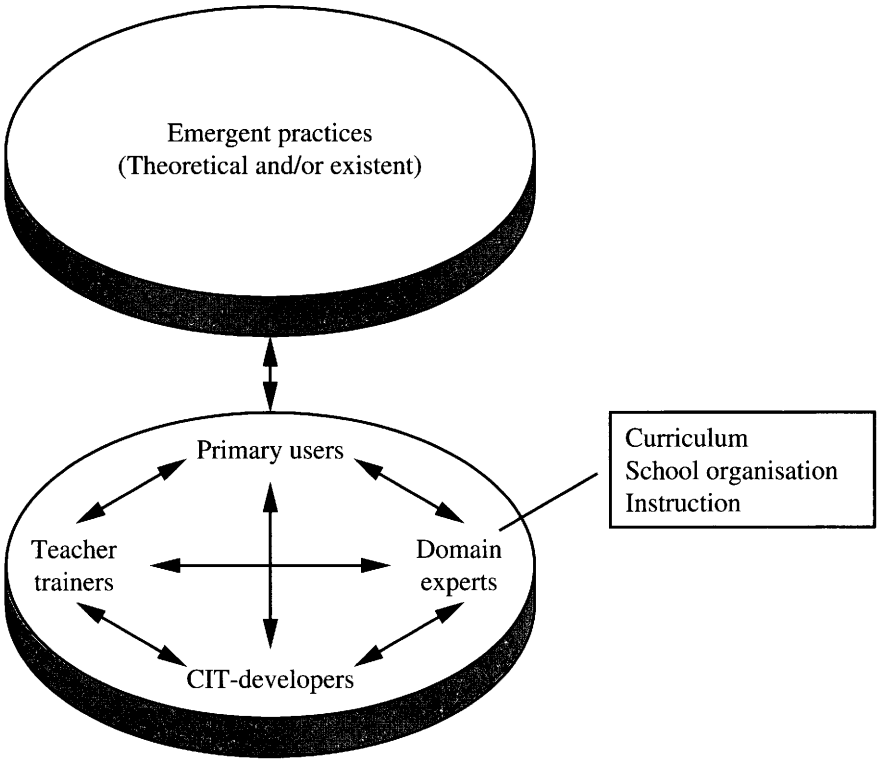
Another important question with regard to shaping the future of education is at which age to start. It may be argued that new models of learning and instruction require a completely new behavioural repertoire of future students, and in connection with this of their direct environment. It involves preparing children already at a young age to integrate the use of information technological tools in their lives. For young children this

usually is not a problem, it is rather the parents who will need to change. This will be a slow process but maybe could be accelerated by simultaneously caring for the current practices and having courage to undertake experiments. The concept of tele-playing might be explored: offer parents (and even grandparents who frequently interact with their grandchildren) opportunities for self-assessment of their children and offer them examples of how via games the social, emotional, motoric, and cognitive development of the child may be stimulated. Such programs (which may be made accessible via the Internet) cut at two sides: they stimulate the child, but also bring citizens who grew up in an ICT-poor environment in touch with advances in this area. This is not too far distant from what happens now in programmes for young children (like *Sesame Street*).

9. New roles for educational stakeholders

All of the above implies that the current roles of educational stakeholders need to change. Figure 4 illustrates the interaction which will need to exist between educational practitioners, domain and ICT-experts with regard to the determination of what are good examples of emergent practices.

Figure 4 – Emergent practices and interaction between stakeholders



10. Summary and conclusions

A currently very popular political view at the international (European Commission, 1996; Delors, 1996) as well as national (Ritzen, in Committ, 1996) levels, which is shared by an unknown quantity of citizens, is that — worldwide — our societies are in a process of drastic change.

The reasoning behind this belief and its potential implications for guiding processes of educational reform, can roughly be characterised as follows:

1. As a result of the rapid technological developments, industrial production is and will be increasingly automated. Analogous to the way that industrial production activities replaced manual labour when societies changed from agricultural to industrial, it is believed that in the future many human professional activities will be focused on handling information. In comparison with the great stability of life in agricultural societies, and the increased level of societal change during the industrialisation period, it is expected that societal change processes will be even in a higher gear in the future. Consequently citizens will need to be constantly aware of these changes and must be able to adapt to them.

2. Education must change in order to adequately prepare the citizens of the future to function in a society which will be in a constant state of flux. Consequently, the current educational paradigm of mass production of ready-made knowledgeable citizens with certificates which qualify them for a long-lasting job career, must be replaced by educational models which qualify citizens in terms of lifelong learning skills in a society in which CIT is one of the main infrastructural pillars.
3. As there are no blueprints of a future society, educational reform towards the education of the future cannot be designed but is rather a matter of participation in innovatory approaches embedded in a process of successive approximation, characterised by:
   (a) sensitivity to societal developments and timely responses;
   (b) awareness of the capacity for change of students, parents, teachers, and schools;
   (c) an adequate system for information provision on what works and what doesn't.
4. Taking into account the many different factors which play a role in educational reform processes and the impossibility to change isolated aspects of an education system, the reshaping of education should be based on multidisciplinary approaches in which technical know-how, implementation expertise, training facilities, scientific evaluation, and an orientation on practical feasibility are closely interwoven.

An important implication from what is mentioned above (in point 3) is that throughout the world many schools will be engaged in the search for new, and the replacement of old, approaches. From this perspective the world can be conceived of as a huge laboratory in which many small-scale experiments in authentic situations will take place in order to determine which approaches for educational reform towards the future information society are successful, and under which conditions.

The search-and-replace process for this reform process, can be roughly characterised as follows:

1. Select potential examples on the basis of reform criteria.
2. Describe characteristics and present examples of emergent practices to interested educational practitioners, in terms of checklists of curricular, instructional, organisational, personal and material implications.
3. Selection by practitioners.
4. Measure baseline profiles.
5. Implement conditions.
6. Implement new practices.
7. Measure and determine effects: value judgments.
8. Documents.
9. Disseminate with quality judgments.

Given the fact that it is assumed that the change process will be basically a bottom-up approach, it would be of great value if travellers on this voyage of discovery could be closely observed by those who stay home, and that subsequently (for those instances in which the discovery goals were reached) the degree of (semi) spontaneous transfer could be investigated. Such investigations would greatly help to determine the possibilities of large-scale implementation of the promising new approaches.

Educational research (in terms of providing value judgments about the pros and cons of ongoing developments) will have to play a crucial role in this process. However, it will need to be tuned to the character of the change process which will, in forthcoming years, mainly consist of large-scale try-outs in relatively small settings. It will need to be heavily focused on which innovations schools (and parents with their young children) are ready to adopt, and must be able to quickly provide means for evaluation of the try-outs in order to determine its usefulness and generalisability, so that dissemination of convincing examples (with a scientifically based quality mark) of excellent emergent practices to a broader audience can take place. No more than reform processes can be focused on isolated elements, research cannot be limited to monodisciplanary approaches. Rather it will have to be multidisciplinary. This will pose heavier burdens on the project management, and also on the definition phase of research projects, in which the design of the research and the intended outcomes will have to be carefully tuned to the needs of the users.

In this process it will be very important that, on the basis of research, a knowledge base is created in which the following aspects are integrated:

1. Innovation of the learning process: examples of emergent practices.
2. Threshold conditions and criteria for adoption of innovatory approaches.
3. Stages of concern: awareness with regard to and adoption of the innovatory emergent practices.
4. Amount of required role changes of educational actors.
5. Infrastructural needs: organisation, buildings, CIT tools, connections.
6. Training needs and load.
7. User needs and satisfaction.
8. Lifelong learning skills: motivation, self-steering, information handling skills.

The future of education will heavily depend not only on the willingness of educational practitioners to change, but also on finding new ways for cooperation and communication of all educational stakeholders. Especially with regard to the last point, lifelong learning skills and a Socratic attitude will be an essential requirement.

11. Bibliography

- Beaton, Albert E., Mullis Ina V. S., Martin, Michael O., Gonzalez, Eugenio J., Kelly, Dana L. and Smith Teresa A. (1996), *Mathematics achievement in the middle school years*, TIMSS International Study Centre, Boston College.
- Brummelhuis, A. ten, Rapmund, R. (1996), *Werken aan het onderwijs van de toekomst op basis van zorg en durf* (Working on the education of the future on the basis of care and courage), Tinfon, pp. 5, 4, 143-147.
- Committ (1996), *Teaching and learning for the future,* Den Haag: Sdu DOP.
- Delors, J. (Ed.), (1996), *Learning: the treasure within,* Paris: Unesco.
- European Commission (1996), *Learning in the information society: Action plan for a European education initiative,* Brussels: EU.
- Pelgrum, W. J., Janssen Reinen, I. A. M., Plomp, Tj. (1993), *Schools, teachers, students and computers: a cross-national perspective,* The Hague: IEA.

Children of the future

Tommy Isaksson
University of Falun-Borlänge
Sweden

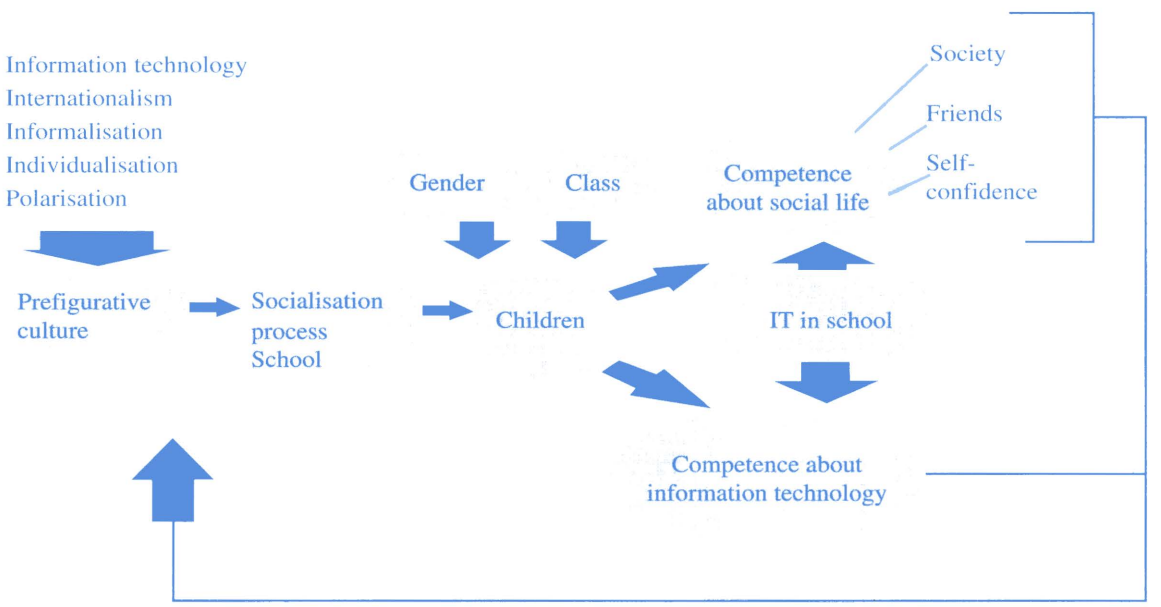
Tommy Isaksson, Bachelor of Science (1987), Doctoral student (1992). He is a lecturer at the School of Education, University College of Falun/Borlänge, an IT expert/lecturer at the School of Education, University of Umeå. He established a national network for children 'Children of the Future' in 1985. He is also the author of 'Att karda och data'.

1. Why should we work with information technology in school?

We are in a period of big change. The society is changing from the industrial society to the information society. The change is at least as big as the change from the agricultural society to the industrial society. It´s a revolution without blood. Some of the key concepts for the change and for the prefigurative culture are internationalism, information technology, informalisation, individualisation, and as a consequence polarisation. A polarisation that means that the variables gender and class are very important. There is a big risk that the losers are women and working class people. Or to say it in another way — democracy, equal opportunity and equality are the main questions.

We as teachers are working in a school developed for the industrial society. In the first step the school must change in it´s foundation and in the second step the school must be razed. The education and lifelong learning is too important and must be permeated with the whole society.

We are as teachers involved in the socialisation process of the coming generations. Two of the main areas for the children to develop are competence about information technology and competence about the social life in terms of knowledge about the society, relations with friends, other people and their own self-confidence.



Can we work with IT in school in a way that we stimulate and develop the competence of our children about social life and information technology in the light of gender and class?

2. What should we do?

A. In-service training for teachers — an example

1. IT study must start with studies about the changing society and the impact on the school.
2. IT study must include both hands-on and discussions of the pedagogic effects of the IT.

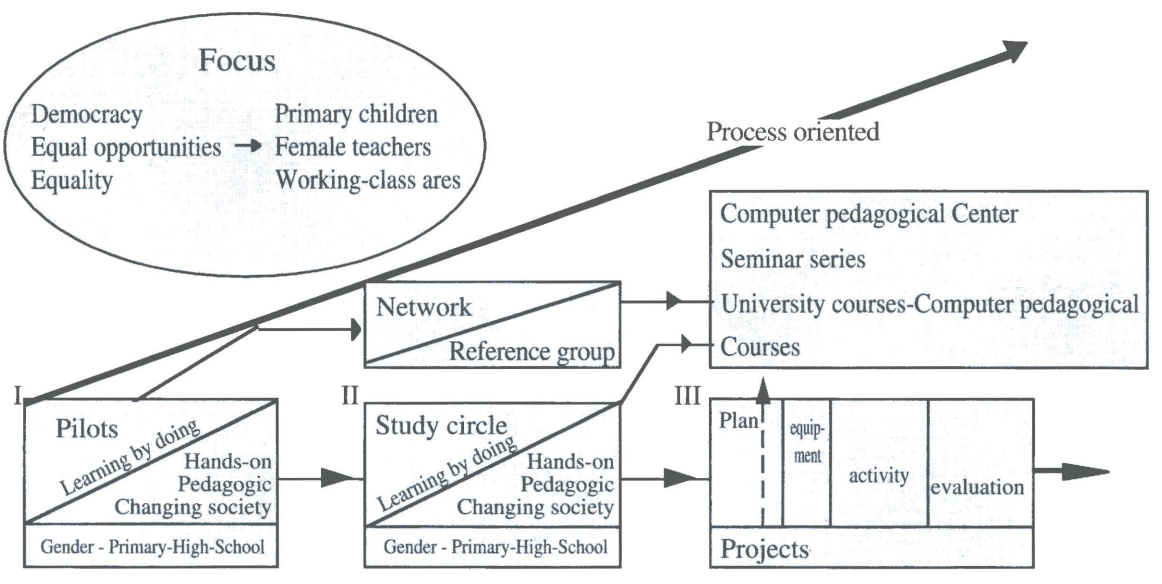
   50 % rule:

   50 % to in-service training and 50 % to equipment.

   50 % of the in-service training to pedagogical studies and 50 % to hands-on.

3. No computers in the classroom before the in-service training.
4. Priority must be given to female teachers and teachers working in the working-class areas.
5. The in-service training is a three-stage rocket. First, training for a small group of teachers — pilots, then the pilots run the training for their colleagues and after that the teachers run development projects in class or school.
6. The development project should have a written plan with goals, methods, action plans, timetables, methods for evaluating and, lastly, the choice of equipment.
7. In the small group (point 5) genders should be equally distributed if possible. It´s also preferable to have teacher participation from all levels of the school system.
8. The group of pilots (point 5) form a network and a reference group for the project.
9. To support the three-stage rocket seminar series are arranged, a computer-pedagogical centre established, different courses including university courses in computer pedagogics are offered. The courses are given at a distance using FirstClass and the Internet.

In-service training for teachers – an example



Development of content and way of working; We don't know; Take's time; Optional; Project oriented

Industrial school ——— Virtual university

B. R & D project — Children of the future — an example

The aims of the project are:

- To develop an educational method for working with children and computers in the information society.
- To build an infrastructure between children and between educators, an infrastructure based upon computer communication and electronic mail.
- To develop social competence among the children.
- To promote equal opportunities between girls and boys.
- To promote equal opportunities between children of lower and upper social classes.
- To increase our knowledge about computer-based education.

Activity

'Children of the Future' started in 1985. The children involved are between 6 and 13 most of them are 7 to 9 years old. The project comprises 15 schools with about 400 children. The schools are located in the south, middle and northern parts of Sweden. It is over 1 500 kilometres between two of the schools. Most of them have just one computer, printer, software and modem. They work with programs for word processing, graphics, databases, desk-top publishing and electronic mail (FirstClass). They do not have any 'educational software', software products for children or computer games.

The children work together with computers and produce newspapers and databases. They work with the immediate environment as a theme for their activities. This means that the children have done interviews and investigations in the area. The results have been sent to all the other centres by electronic mail and compiled into a magazine. The children also produced a database about their own interests which was distributed to all schools of the network via our computer network. From the different databases the children produce one big database which is used by the children to find new interests, new friends and pen-friends.

Our starting point was that the activity should work in an ordinary school where the teachers themselves had very little experience of computers before the project started. All the time the teachers themselves have been in charge of the activities together with the children.

All the educators involved have a two-day seminar every term. At this seminar they discuss together with the project leader the aims, plans, evaluation and results of the period.

Once a year all the children meet in a big Children of the Future Festival. This is a festival for two days during school time, somewhere in Sweden. The aim is to arrange a meeting between 'computer friends' and to have a lot of social activities.

Some results from the research:

Is it difficult to use a computer?

	Lower-class boys autumn	Lower-class boys spring	Upper-class boys autumn	Upper-class boys spring
Yes	28.9 %	10.9 %	22.0 %	8.6 %
No	71.1 %	89.1 %	78.0 %	91.4 %

	Lower-class girls autumn	Lower-class girls spring	Upper-class girls autumn	Upper-class girls spring
Yes	34.8 %	8.3 %	25.0 %	3.5 %
No	65.2 %	91.7 %	75.0 %	96.6 %

Do you want to work with computers when you have grown up?

	Lower-class boys autumn	Lower-class boys spring	Upper-class boys autumn	Upper-class boys spring
Yes	47.9 %	47.8 %	63.4 %	62.9 %
No	52.1 %	52.2 %	36.6 %	37.0 %

	Lower-class girls autumn	Lower-class girls spring	Upper-class girls autumn	Upper-class girls spring
Yes	46.9 %	52.2 %	53.1 %	62.1 %
No	53.1 %	45.8 %	46.9 %	37.9 %

A computer at home

	Lower-class boys autumn	Upper-class boys spring	Lower-class girls autumn	Upper-class girls spring
Yes	35.4 %	31.7 %	8.2 %	28.1 %
No	64.6 %	68.3 %	91.8 %	71.2 %

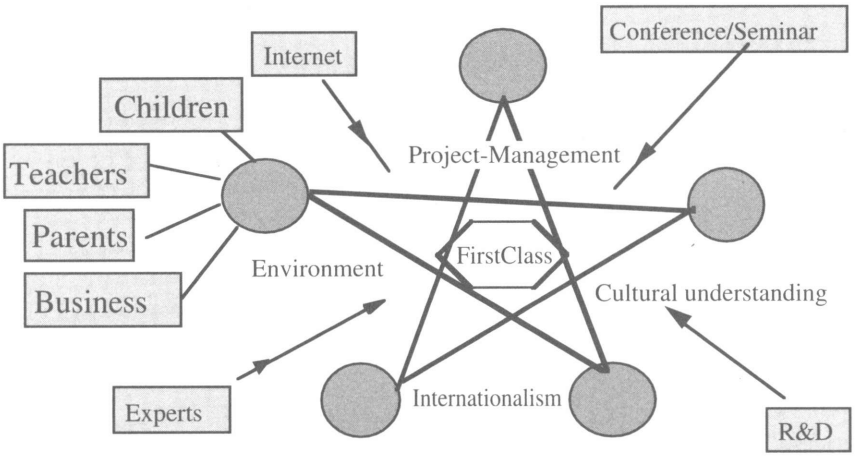
The owner of the computer

	Boys	Girls	Sum
Myself	55.2 %	0.0 %	39.0 %
Father	27.6 %	58.0 %	36.6 %
Mother	3.5 %	0.0 %	2.4 %
Brother	3.5 %	16.7 %	7.3 %
Sister	0.0 %	0.0 %	0.0 %
Relative	0.0 %	8.3 %	2.4 %
Everybody	10.3 %	16.7 %	12.2 %

C. The Vulcan project — Virtual University and lifelong learning CAN — an idea

Based on already implemented example above and the need for lifelong learning it is necessary to find an educational system with active participation from outside the school ystem.

1. The project aims at finding methods for a new approach to learning and education. The idea is to create an out-of-school system. That can have two effects. Either the school system can adopt some of the results or the school system can not adopt the results, so we may have made some contribution on the way to a new educational system.
2. The project develops strategies for distance education with IT in the perspective of lifelong learning.
3. Focus for the project is internationalisation, cultural understanding, environment and project-management.
4. The target group consists of teachers, children, people from the business sector (SME) and parents.
5. The core of the project is small groups consisting of members from all parts of the target group.
6. Each small group contains competence from one or more of the sectors mentioned in point 4.
7. The project creates a syllabus for the sectors in point 4 and one or more of the small group is responsible for the teaching.



Background	Goal	Methods
Industrial school	IT-society Lifelong learning New model for organiszation New learning methods	Process oriented Project oriented Learning by doing Hands on

Could this idea about the Vulcan project be a development laboratory to integrate theory and practice to develop a new education system for the future information society? If you are interested in a project of this kind please contact me for further information.

A child can teach you three things: he is happy without reason; he is never unoccupied, even for a single moment; and when he wants something, he knows how to demand it with force.

Dov Beer De Mezeritch

When the master reveals the man, it is no longer a cold, banal lesson. It is the beginning of education...

Jules Ferry

Which teaching skills for an open Socratic school?

Alice Fracchia and Corinne Hermant
European Commission
DG XXII/A

'It is the turn of the teachers to speak'; this workshop was aimed at them and they were the main people involved in it. Workshop session No 1 naturally became the forum for exchanges and debate that they had all been asking for. The active, and sometimes impassioned, participation of all those who attended the workshop enriched the papers given by the four speakers, and none left us indifferent.

First to speak was Pino Fiermonte whose view of education, shaped by many years' experience of supervising the intellectual, personal and social development of children at primary school, gave the versatile tool of new technology its full pedagogical dimension. Recalling that pupil activity lies at the heart of learning, he put technology at the centre of the classroom but ruled out using computers for anything other than thought-through pedagogical projects.

The title of Guillaume de Meuter's paper clearly nailed its colours to the mast: we are still a long way from properly integrating new information technologies into primary and secondary education. We need, therefore, to plan ways of moving more rapidly from the current transitional period to one in which education will be making full use of the tools available to it. Yet such a period will not mean less involvement for teachers but more: teachers will have to become veritable architects of a range of learning situations, juggling all the tasks they will have to carry out. Professor de Meuter, in suggesting concrete ways of organising the classroom so as to use didactic methods incorporating computers, brought the more reticent participants into the school of tomorrow by describing it in terms familiar from what they already know and experience in their everyday working lives.

Equally concrete and vivid was the paper given by Brigitte Denis, who traced the changing contours of pedagogical paradigms. We now know that computers do not impose a way of teaching nor a way of reasoning. They are a tool for what the teacher and the pupils build together. Whether it is flexible or rigid, poor or varied, it is the educational environment that brings out the wealth a computer has to offer or else condemns it to superfluity in the classroom. The workshop thus became a forum for discussion of the need for easy and flexible access to training and advice from other teachers who are more experienced or simply more enthusiastic about the new tools, so that computers do not join the ranks of other unsuccessful educational tools now consigned to the scrapheap.

Children love the Internet and know how to use it to learn and to share their interests, as Alessandro Candeli demonstrated. The 'Kidslink' project cost very little, yet produced enormous returns for the children who used it to build knowledge as a shared venture. The children of Bologna showed us how autonomy, a spirit of initiative and entrepreneurial ability could all be demonstrated, and we could now start to dream of making this project available to schoolchildren throughout the European Union who live in mountainous or isolated areas or even those who just live in an underprivileged environment; they could use such a project to maintain and quench their thirst for knowledge which, if it were to dry up, would for ever close the doors to lifelong learning to them.

What follows is thus an immersion in the world of the school. Take the time to move through the pages and to discover what so many people — including the European Community, working for its citizens — are trying to develop: a school where all young people can develop, a Socratic school for all.

Information and communication technology in pupil activity-centred pedagogy

Pino Fiermonte
Teacher
Ministry of Education
Luxembourg

Pino Fiermonte has taught at the Roeser primary school since 1982. Since 1996, he has been on secondment to the 'Pedagogical and Technological Research and Innovation Coordination Service' as coordinator of the action research project Decoprim 1 (Socrates programme, Comenius, Action 2). He is a founding member and Chairman of Aptice, a non-profit-making organisation which promotes information and communication technology in schools. He is also a member of the 'Information and Communication Technology in Education' task force set up by the Ministry for Education and Vocational Training.

In 1944, Célestin Freinet quite rightly criticised schools for not having developed 'in the century during which printing, the still and moving picture, records, radio, the typewriter, photographs, the camera, the telephone, the train, the car and the aeroplane reign unchallenged!' (1) Since then, some of these trophies of technological progress have burst into our classrooms, and it is hardly surprising that the modern age has also seen the arrival there of new information and communication technologies — the computer and all its peripherals.

Yet Freinet went on to argue that technological tools should be introduced in accordance with the criteria he set out in his pedagogical writings, based on the principle of pupil autonomy. He added, addressing those who take the decisions, that 'children will come to regret an education that misses out on the intermediate experiences to which they will have to return, in a radical review of the education you provide'. (2)

We have to acknowledge that, despite the time that has elapsed since Freinet was writing, the telephone — the first long-distance communication tool to operate in real time and one which has had an official place in our lives since 1876 — has failed to make its way into schools except as a privilege for the school authorities; it is only in exceptional circumstances that pupils have access to telephones. Yet among the experiences to which children will, in his words, be forced to return are those such as telephoning, letter-writing and note-taking. The fact that these 'technologies' have failed to take their place in contemporary teaching design and planning is clear evidence that the activities taking place in our classrooms are only rarely oriented towards the outside world and that we cannot consider children to be acquiring the relevant skills in using them, which are essential to the learning process. In many cases, textbooks and teachers are the only resources available.

Today, it seems clear to me that new technology is giving rise to new illusions; they have given some people the idea that to introduce new technology into teaching will result in the need completely to change the way in which educational relationships work as well as the attitudes of both pupils and teachers. The economic and social challenges faced by schools undoubtedly require teaching that will initiate pupils into the real functioning of society, which will as a result alienate them less. However, the introduction of IT is not without risks. We can avoid passive behaviour, resulting from dependence which will persist and may be strengthened, only if the new technology introduced is used to support authentic activity, that is, with the aim of coupling the acquisition of knowledge with productive work.

Tackling the problem of the introduction of new technology has to go hand in hand with consideration of the nature of the educational dialogue and of the basis and aims of teaching and training. Discovery of the social universe, self-awareness, and the structuring of the relationship between self and the social universe are

achieved through authentic dialogue and activity. There remains a fundamental tension between the aims of education and the material methods used unless teaching methods change orientation and take greater account of the child's personality. It is, ultimately, the child who has to take on his responsibilities in a society which is increasingly less inclined to allow individuals the leisure to follow paths marked out in advance.

Some observers argue constantly that there is more to IT than word-processing and that we only need to have new technology available in order to use it intelligently. Nevertheless, it should be stressed that any software has a pedagogical logic within it. The term 'multimedia', chosen by the German language society as its word of the year in 1995, is too often used to refer to finished products and is used merely as a figurehead. In practice, it may well be that 'closed' or practice software on CD-ROM or CD-I could take over, which would mean that instead of encouraging pupils to take action, we would be continuing to encourage them to abdicate any responsibility for their own learning and for the knowledge they are acquiring.

Education is based largely on the myth of universal knowledge that we should like to continue to convey and disseminate by means of a computer; it fears any change oriented towards differentiated acquisition of knowledge by means of autonomous productive work.

We have to ask ourselves whether it is not the ultimate absurdity to train young people to use computers but to leave them incapable of interacting with those around them or even simply communicating by telephone. Françoise Dolto said, 'It is not worth having people who look human who are no better at teaching than machines.'(3) It seems to me to be equally true that it is not worth having new technology available unless schools make children more autonomous and more responsible and their activity, as well as their interaction, more authentic.

(1) Freinet, C. (1944), *Oeuvres pédagogiques*, Vol. 2, p. 20, Paris: Seuil.
(2) Op. cit., p. 37.
(3) Dolto, F. (1988), *La cause des adolescents*, p. 224, Paris: R. Laffont.

Didactic strategies and teaching skills for the transition period

Guillaume de Meuter
Fachhochschule Würzburg-Schweinfurt-Aschaffenburg
Germany

Dr Guillaume De Meuter was born in 1950 in South Africa. After completing his schooling, he left the country to study literature, history, linguistics and philosophy in France (Montpellier, Perpignan, Lille) and England (Oxford). After completing his studies, Dr De Meuter travelled widely in South Africa, the United States, Australia and New Zealand for two years before commencing an academic career in Germany. He is currently professor of modern languages at an application-oriented university in the Federal Republic, the Fachhochschule Würzburg-Schweinfurt-Aschaffenburg.

Dr De Meuter is actively engaged in urging a reform of the educational system. He has repeatedly stressed the need to re-examine our value systems and to provide our youth with an ideologically neutral, universally valid, set of existential guidelines — a guiding vision. He is currently writing a book on the subject.

His 'Computer integrated didactics' outlines new ways of tapping the didactic potential of information technology while simultaneously training the metacognitive skills of the learners. He is also working on a number of telematic and ODL projects. Dr De Meuter is the founder of the Centre for Interdisciplinary Research and Cooperation in Education (CIRCE), a didactics think tank.

I. The transition period: an inevitable quandary?

At some point in the future — let us assume that this will be some time between 2015 and 2025 — the current transformation of the educational system will be complete. All the educational establishments in the European Union will be adequately equipped with computers, a plethora of suitable software programs will be available on the market, new teaching methods and learning strategies will have been tested and implemented. We will be living in an information society which will at the same time be an education society.

But what of the interim period?

What strategy should we adopt to assure a smooth transition from the educational system of today — poorly equipped with computers, with our current teaching methods and skills and with the present ponderous infrastructure — to the superior, coordinated, well-equipped and completely overhauled educational system of the information society of tomorrow?

In this paper I will try to put across three crucial ideas:

⇨ Firstly, I wish to emphasise that it is possible for us to effectively implement the new teaching skills and didactic strategies which will be used in the education society of tomorrow* with the resources at our disposal. Effective integral teaching strategies and suitable active learning environments can be created without having fully equipped multimedia labs and hundreds of computers in every school.

After examining WHAT should be taught, I shall briefly sketch HOW this could be taught with the means at our disposal.

(*Since a generic term for this future pedagogic/didactic philosophy and methodology with its concomitant didactic strategies and teaching skills has not yet been coined, I shall — to avoid clumsy paraphrasing and lengthy repetitions — refer to it henceforth simply as computer integrated didactics or CID.)

⇨ Secondly, it is of crucial importance to realise that these CID strategies and teaching skills must be consciously and systematically defined, developed, tested and implemented now — i.e. during the next decades — during the transition period. I shall argue that a concentrated and coordinated effort must be made in this direction on a European level.

⇨ Thirdly, I shall urge that a European centre for computer integrated didactics be founded as soon as possible and shall explain why such a centre is necessary.

II. Two caveats: the need for persepective and the danger of unconscious assumptions

Before, however, launching into an elucidation of the three abovementioned points, I wish to insert a few words of caution; words which will also help explain my roundabout way of tackling the issues at hand.

When analysing a complex issue — and the current reengineering of the educational system clearly belongs to this category — it is absolutely essential to make a conscious effort to keep the whole picture before us — in all its complexity — while discussing the various specialised aspects of the question.

An objective assessment of almost all the debates and publications on various topics — whether they be on applications of information technology, the reform of the educational system, or on political, economic or social issues — reveals that they fail to do this. The result is a serious distortion of the issues at hand and inadequate, partially effective quasi-solutions.

Furthermore, when tackling complex and vital issues, it is also essential to examine one's unconscious assumptions. To illustrate this point, I would like to quote the mathematician and philosopher, Alfred North Whitehead:

'It often happens... that in criticising a learned book of applied mathematics, or a memoir, one's whole trouble is with the first chapter, or even with the first page. For it is there at the very onset, where the author will probably be found to slip in his assumptions. Further the trouble is not with what the author does say, but with what he does not say. Also it is not with what he has assumed, but with what he has unconsciously assumed. We do not doubt the author's honesty. It is his perspicacity which we are criticising.'

Whitehead's warning applies to all current debates on complex issues. The ideas and suggestions are often logically and coherently presented, but are handicapped by a lack of perspicacity, by the numerous unconscious assumptions which are being made.

If we wish, then, to ensure that the present efforts to remould the educational system are as effective as possible, it is absolutely essential to be constantly aware of the two abovementioned potential shortcomings in our reasoning – the failure to consciously keep the whole picture in mind when discussing particular aspects of a question, and the damage to perspicacity generated by unconsciously held a priori assumptions — and to repeatedly examine our ideas and strategies, testing whether they are marred by a lack of perspective or unconscious bias.

III.Three fundamental questions

When talking about education there are three basic questions which we should ask ourselves so as to put the question being discussed into perspective, namely:

WHAT?	**WHY?**	**HOW?**
What is to be taught?	Why is it to be taught?	How is it to be taught?
What is to be learnt?	Why is it to be learnt?	How is it to be learnt?

Most discussions on the implementation of modern media in education focus on the last question: namely, HOW? It only takes a moment of reflection to realise that this is putting the cart before the horse. We must be clear as to WHAT we want to teach and WHY we want to teach it, *and then* we can go to plan HOW we will go about doing so.

A balanced three-pronged approach to the debate is all the more vital because the answers to all three questions have changed radically in the last decades.

This is what the much-vaunted — and, despite an avalanche of publications on the subject, little understood — paradigm shift is all about: it is not simply that information technology has to be introduced into the schools and universities of Europe or that computer literacy will be a prerequisite for competence in the dynamic work milieu of the information society. This is only the tip of the iceberg.

The current paradigm shift goes much deeper — it entails a radical revision and restructuring of our way of life, work environment, value systems, behaviour patterns and — consequently — educational institutions.

Talk about the nature of an open Socratic school, therefore, only makes sense when some form of consensus about the WHAT, the WHY and the HOW of teaching has been achieved.

A brief examination of all three questions in the light of the imperatives generated by the paradigm shift is, therefore, called for. I shall consequently first outline the new elements which should be integrated into the educational system of the informationage and then go on to a discussion of the necessary teaching skills and didactic strategies.

What is to be taught?

The answer to this question can be subdivided into four categories as follows:

1. The transmission of knowledge

- Specialised, subject-specific knowledge
- General knowledge

2. Multiple intelligence

- Logical and analytical intelligence
- Practical, organisational intelligence
- Intuitive, creative intelligence
- Emotional, interpersonal intelligence

3. Metacognitive skills

- Various INTERpersonal capabilities
- Various INTRApersonal character traits

4. IT literacy

- Familiarity with the new information technologies
- Mastery of the essential skills
- IT intelligence

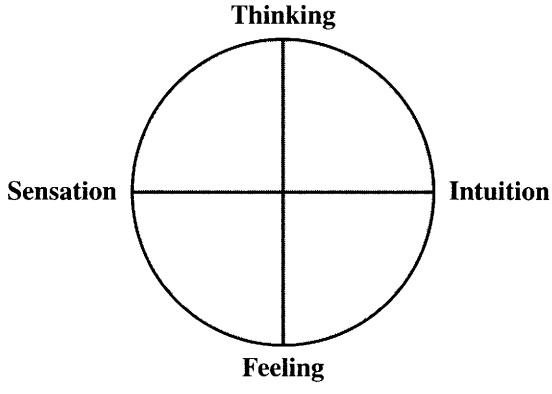
Computer integrated didactics classes are holistic and interdisciplinary: the pupils acquire essential specialised subject-specific knowledge while simultaneously training metacognitive skills which are valuable to them both on a personal and professional level.

From a didactic point of view the advantages of a holistic, interdisciplinary approach cannot be overemphasised. Pedagogues have known for decades that the educational system favours a certain kind of

character constellation, namely the 'thinking' type: the person with well-developed rational and analytical abilities. The fact is, however, that a large percentage of the population does not belong to this type but has quite different propensities. I suggest that we — for the sake of simplicity — refer to the findings of analytical psychology here as a guide.

In his pioneering work on character typology, C. G. Jung describes four main 'functions' which each person possesses and develops to a greater or lesser extent. These are thinking, feeling, intuition and sensation. In each individual one particular function is dominant. In the thinking type it is — as already mentioned — the logical and analytical aspect, whereas interpersonal skills are highly developed in the feeling type. A person who has intuition as his main function is unorthodox, individualistic and very creative. The sensation type is a down-to-earth pragmatist who is good at detailed, accurate work and at applying his knowledge to the solution of concrete problems.

The four main functions according to C. G. Jung



Our society needs all four types — and this will be even more true of the information society of tomorrow. We are desperately in need of creative people who are capable of lateral thinking and who come up with ingenious and revolutionary ideas. We need pragmatists who can implement these ideas, who can organise effectively and work accurately. We need people with strongly developed interpersonal skills to ensure the smooth running of our enterprises, for PR work and to teach us how to get on well with others. How much pain has been caused in the past — and how many problems are still being generated today, both at home and at work — by emotional immaturity! (It is no coincidence that Daniel Goleman's book on emotional intelligence is an international best-seller and that schools and universities around the globe are starting to introduce courses in emotional literacy.)

This being the case, it is time to ask ourselves why people who do not have the one particular character configuration should be put at a serious disadvantage and suffer for years — frequently feeling themselves to be stigmatised and 'dumb', sometimes having their personal development severely impaired — because of an inbuilt bias in the educational system.

This a state of affairs to which computer integrated didactics will put an end. The advent of information technology and its inexorable integration into the educational system will be used as a catalyst to introduce a more balanced and more humane didactic philosophy which — perhaps for this very reason — is also more effective than the methods which have been used in the past.

The conscious training of multiple forms of intelligence is inextricably linked to the deliberate nurturing of metacognitive skills, both **inter**personal and **intra**personal, such as essential communication skills: the ability to express oneself clearly and cogently — both orally and in writing, teamwork capabilities, social skills, empathy, the ability to work independently of supervision, the ability to take decisions, self confidence, a strong sense of personal worth, a sense of purpose, willpower, discipline, integrity and leadership qualities.

The integration of information technology into the educational system will mean that pupils will work regularly with computers, multimedia programmes and various kinds of networks while at school and will acquire the essential IT skills and literacy they will require in their work milieu as adults. At the same time a fifth kind of intelligence will be trained and developed: IT intelligence. This refers specifically to the ability to navigate through vast amorphous networks offering an overabundance of heterogeneous data and swiftly locate the information one is looking for, sifting it out from the rest.

In an information society, these qualities and skills are considered as valuable as — and in some case, more valuable than — specialised knowledge. The transmission of knowledge is no longer, as in the past, the prime duty of the educational system. It remains important — indeed, vital — but our task has become more complicated and demanding because we must learn to think and teach on various levels simultaneously.

This brings us to the next question: how can we integrate all these elements to create a highly effective, holistic educational philosophy and methodology?

How is this to be taught?

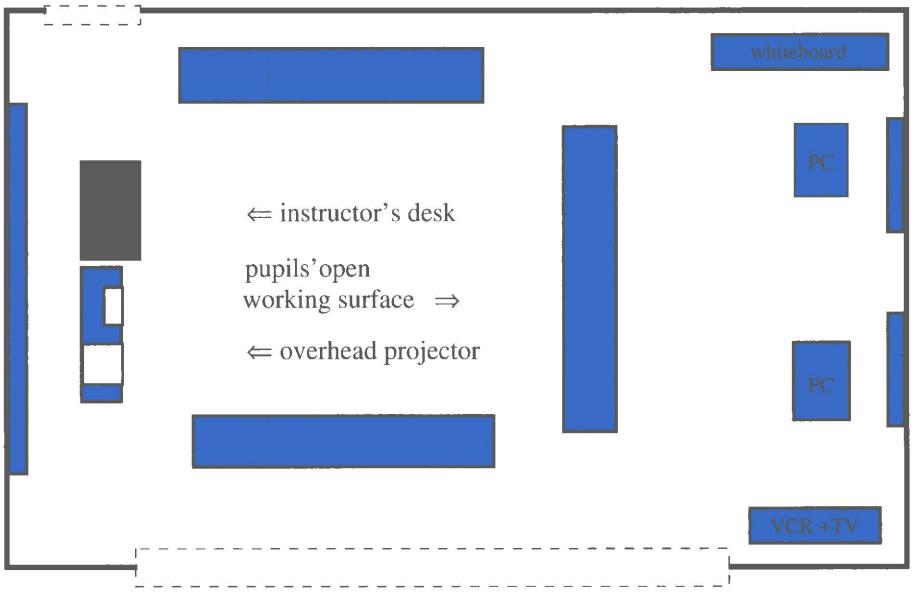
1. Ergonomy: a CID environment

CID strategies can only be implemented effectively in a suitable environment. Ergonomic factors must, therefore, be given serious consideration.

1.1. Equipment

Each classroom in every school should have at least two multimedia PCs. This must be considered a minimum requirement for the transition period (Diagram 1).

Diagram 1: Minimum requirements for CID — 2 PCs per room

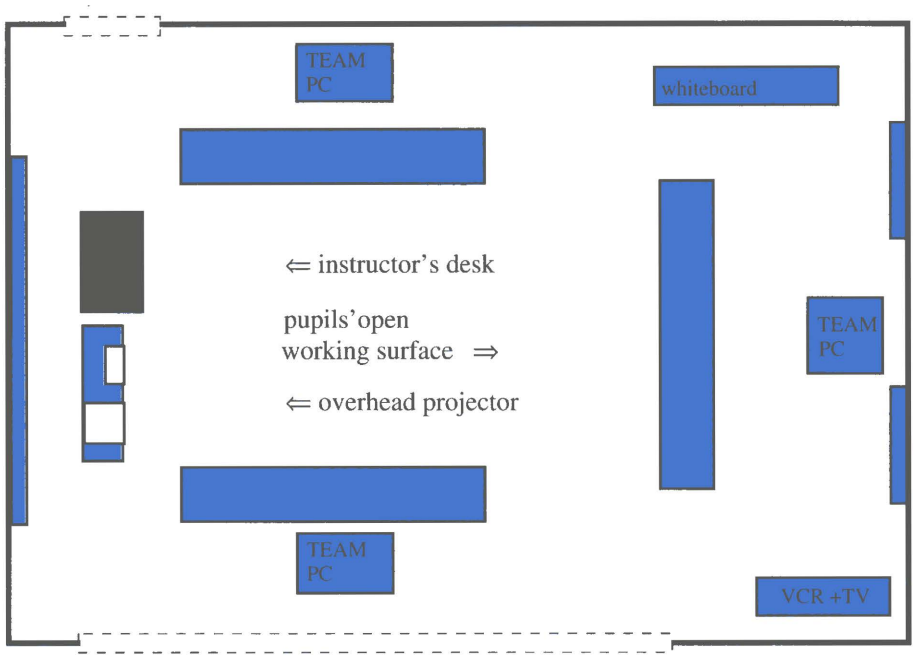


It is far more important for a school to have IT immediately available on a modest level to all the pupils all the time — and therefore to allow the integration, implementation and development of holistic CID strategies at all levels and in all subjects simultaneously — than to equip itself with expensive multimedia laboratories which are available to the pupils for a few hours a week and only for specific subjects.

The hybrid learning environment which is virtually ubiquitous today — one or two multimedia labs which are surrounded by classic classroom environments and teaching methods — is, for obvious reasons, ineffective and counterproductive.

The next stage would be to have one PC for every team of four/five pupils in every classroom. This would allow the learners instant access to IT at a team level and allow the instructor to integrate IT seamlessly into the daily learning environment of the pupils (Diagram 2).

Diagram 2: Compromise solution for CID — 1 PC per team



The final stage — the ultimate CID environment — would be one PC per pupil in every classroom.

The integration of IT into the learning environment is thus deepened and individually tailored exercises, more versatile learning, teaching and testing strategies as well as more flexible modes of IT-based video and audio communication and interaction are rendered possible (Diagrams 3 and 4).

2.1.2. Seating

The seating should be set out so as to form a large U with the desk of the instructor and the blackboards, screens and overhead projector at the open end of the U as in the diagrams. A printer, flat bed scanner, halogen overhead projector, VCR and TV set, and blackboard should be standard equipment in all schoolrooms.

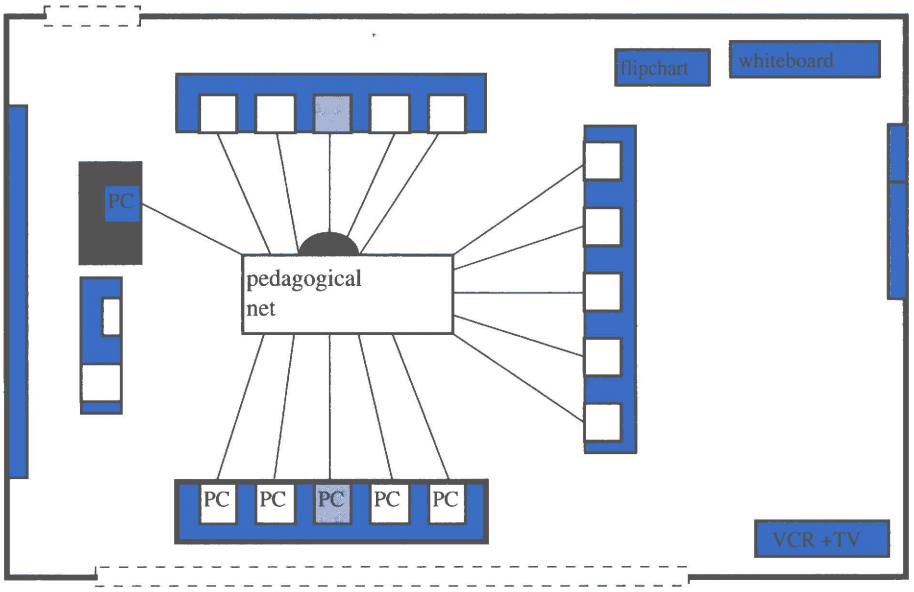
This set-up has certain advantages: it allows the participants to hear each other without difficulty and permits maximum visual contact, which is important for team work and the development of interpersonal skills since the participants should be able to read the body language of their classmates.

2.1.3. CID media lab

Diagrams 3 and 4 depict completely equipped CID media labs which should house a maximum of 25 workstations for the pupils and one control centre for the instructor. The 25 workstations should be split into five separate teams.

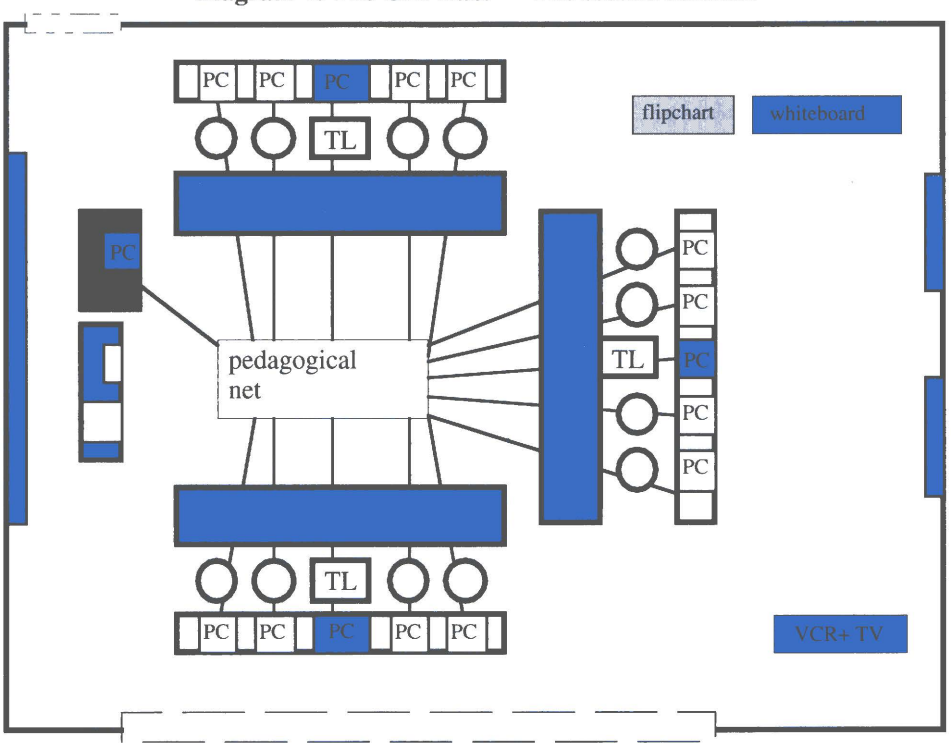
The individual desks should be equipped with multimedia PC workstations and a microphone/earphone headset. The screens of the PCs should be integrated into the desks so as to leave the view of the students unobstructed and the work surface free of cumbersome equipment (Diagram 3).

Diagram 3: The ideal CID lab



Adjoining the main room should be an office for the instructor separated from it by a large glass panel to provide an unobstructed view of the CID centre at all times. A software serving hatch would be of advantage. The instructor's cockpit should also contain a multimedia PC workstation with the screen integrated into the surface. It should be flanked by blackboards which can be raised electrically to reveal large whiteboards behind them. These whiteboards can be complemented by a screen for the halogen overhead projector. A flipchart, laser printer, flatbed scanner, LCD projector and large mobile cabinet containing a VCR and large TV would complete the equipment of the CID lab.

Diagram 4: The CID Lab. — The second solution



TL = Team leader

PC = PC for interteam communication

The institution concerned may, however, already have a fully equipped media lab. In this case, the arrangement illustrated in Diagram 4 is the simplest, and possibly cheapest, way of achieving an acceptable ergonomic configuration. The pupils would be able to sit in an open-U formation while engaged in discussions or using other media and would just have to swivel their chairs through 180° to work on their PCs.

2.1.4. The pedagogical network

The technical core of the CID media lab is the pedagogical network. A pedagogical network consists of simple student switchboards (one for each PC), an instructor's control centre, headsets for the instructor and students and cable links between the individual PCs. It allows versatile audio links — over the microphone which is integrated into the headset — and video links — over the computer screens — between individual PCs. The functions of the net can be summarised as follows:

Audio links

- instructor to class
- single student to class
- instructor to single student
- single student to instructor

Video links

- instructor's screen contents displayed on all the students' screens
- instructor's screen contents displayed on single student's screen
- single student's screen to instructor
- single student to all computers
- automatic scanning of students' screens

Data transfer/control functions (from instructor's control centre)

- control of individual students' computers
- simultaneous transfer of data to all computers
- connection of external programme/peripherals

A pedagogical network is a potentially versatile tool which can allow the participants to communicate over screen and microphone with each other, to share data, information and resources, and to interact flexibly depending on the demands of the moment and the task on hand.

The pedagogical networks currently on the market are, unfortunately, still very expensive, unwieldy and too slow for smooth and effective communication over the multiple video and audio links. Research is urgently needed to improve the performance and ergonomics of such systems and to ensure that future products will be much faster and will offer instructors a valuable CID tool which fully exploits the latent didactic potential of IT.

2.2. Didactic strategies

Having briefly covered the ergonomic aspects, we can now proceed to the didactic strategies proper. No detailed description can be attempted within the framework of this introductory talk. I shall limit myself to establishing general guidelines.

2.2.1. Active learning

- problem-oriented learning
- task-oriented learning
- project-oriented learning

Instead of presenting pupils with predigested facts and ready-made texts and exercises, CID confronts them with a problem. The task is complex and multidimensional. There is no simple yes-no solution, but rather a number of different routes which the students can take — some of which are suitable, whereas others are less so.

The scenario is realistic and practice-oriented. The scenario chosen depends on the target group and the subject matter.

Interdisciplinary cooperation is of seminal importance. Scenarios linking to geography, history, economics, political science, biology, chemistry, physics, modern languages etc. can be developed which offer the learners a fascinating journey of discovery through a multidimensional and complex learning environment where the subliminal interconnections between the various disciplines become apparent.

The scenarios could also allow the learners to play various roles, work individually and in teams, and to gain 'hands on' experience of the everyday activities which are part and parcel of various professions: the tasks, challenges and problems one is confronted with, the skills one requires, the advantages and disadvantages of each, etc.

2.2.2. Holistic learning

Involves a blend of teamwork and individual work:

- searching for individual solutions
- creativity training
- navigating through the data
- selecting and organising
- analysing
- formulating
- discussing and deliberating
- achieving consensus, etc.

The interactive multimedia programme offers the pupils all the information they need to complete the allotted task: masses of data, reports, statistics, articles and videoclips, access to reference sources and the Internet as well as tutorials and case studies.

To solve the task successfully, the learners must analyse the problem carefully, have a number of brainstorming sessions and devise alternate strategies which must be tested for their feasibility, sift through the information available, analyse it and decide on what is relevant and what is not, exchange ideas and discuss possible solutions, etc. They must learn to work in teams, to listen attentively to the ideas of others, to accept criticism and to be critical without becoming emotional, to express themselves clearly and concisely, to present information effectively, etc.

2.2.3. Knowledge on demand

- just-in-time transmission of facts

One serious shortcoming of traditional teaching is the notion that one has to drum knowledge into the pupils' heads and that the instructor is the one who decides what is relevant, what is to be learned and when it is to be learned.

Courses which implement the strategies of computer integrated didactics also constantly confront the learners with new knowledge, but with the difference that they encounter this factual data within the framework of a complex realistic scenario while trying to solve an interesting problem. Given this setting, they wish to — indeed, they have to — absorb and implement the additional information in order to progress. The pupils are free to determine when and how they will internalise this new knowledge, but will discover that they are severely handicapped and cannot solve the problem in question nor communicate effectively if they do not familiarise themselves with the task-specific jargon and linguistic formulations as well as the background theory. They will, therefore, tackle new terms and ideas only when they need them and not before.

They will never have to ask themselves why they have to learn something: the relevance of the material will be blatant. Interest in the subject matter and motivation are guaranteed since they will wish to apply their new-found knowledge immediately in order to work more effectively.

Another advantage of this method is that the pupils use and elaborate the ideas and concepts repeatedly — orally and in writing — within a short time of having learned them and thereby internalise them without any difficulty.

2.2.4. The vital elements

Every instructor knows that motivation and relevance are inextricably linked. If the pupils believe that what they are learning is existentially and personally useful to them, they will be interested in what they are doing, adrenaline will flow, they will be motivated and will learn willingly and effectively. That, at least, is the theory.

Experience has shown, however, that relevance alone does not suffice to optimise the learning process. Most of the courses today are so conceived that the relevance of the subject matter is obvious to the learner and the texts and exercises are presented as attractively as possible. Despite this, many courses are rarely able to spark off true enthusiasm and interest and the overall learning effect remains mediocre.

When developing and implementing new computer integrated didactic strategies, it is absolutely vital that all the basic elements be present. *Relevance* must be linked to *problem-oriented learning, knowledge on demand* and *holistic CID strategies.*

2.3. The instructors' role

- teaching as a team
- organisatory role
- therapeutic role
- coordinatory role
- assessors
- coaches

The term instructor is used here in the plural form deliberately because CID will oblige instructors to work together closely as a team. Even if they are able to procure a more or less complete scenario from a European or national centre which develops and distributes the necessary teaching material, they will have to edit it themselves. The CID scenario will always be made available in the form of graded open access learnware. That is to say the instructors will be offered material which has been carefully prepared, but they will have to decide on its final form. This decision will be a team decision. The actual implementation of the scenario and the assessment of the performance of the students will also involve close team work

The instructors will, therefore, be involved in the development of the interdisciplinary CID scenario they will adopt and will determine its final form and scope. This requires a creative and versatile mind, empathy, a sure feel for the appropriate blend of the various didactic tools, careful preparation and a great deal of thought and work.

Once the pupils are actively involved and are working their way through the material, the instructors have to coordinate their efforts and guide them when they run into difficulties. Knowing when it is necessary to intervene and offer assistance and to be able to judge what the pupils need and how best to offer it to them is not easy and requires practice.

The difficulties the learners run into differ — sometimes subtly, at other times radically — from individual to individual, from team to team, and from class to class. A CID scenario does not allow the instructors to work within a rigid — and cosy — conceptual framework, but rather requires flexible responses which are determined by the exigencies of the current learning situation.

The traditional lesson of 45 or 90 minutes will be replaced by 'learning blocks' which last weeks or months with the learners working their way through the material from different angles, at different speeds, each class coping with its own particular set of tasks, exercises and problems and working with a team of instructors.

It is also obvious that, apart from their specialised knowledge, CID instructors will require a broad spectrum of didactic, psychological and interpersonal skills. The relationship and interaction between instructor and learners will be more complex and more intimate than to date. The role of the instructors will change radically since they will no longer primarily be transmitters of knowledge but rather accompany, guide and support the learners and assist them on their own voyage of discovery. They will also — like a good coach — urge them to improve their performance, point out their weaknesses and strengths and devise training programmes to get rid of the former and hone the latter. In such a context, the personality and the didactic skills of the instructor will be more important than ever.

New learning and teaching strategies will also demand different criteria and tools for assessment of performance and learning. Many have been developed in recent years. There is no dearth of ideas and possibilities, but — here also — clear guidelines must be set out and some form of consensus must be reached on a national and European level.

3. Further prerequisites for success

3.1. The formulation of an integral educational philosophy and methodology

If computer integrated didactics is to be successfully developed and implemented, then the first fundamental prerequisite is the explicit and unambiguous formulation of an integral didactic philosophy and methodology. Consensus as to its contents, aims and strategies must be achieved on a national and European level. This will involve close and effective communication, coordination and cooperation at all levels. Such a task can only be undertaken by a paranational organisation like the European Commission.

3.2. The founding of a European centre for computer intgrated didactics

The second fundamental prerequisite for success is the founding of a European CID centre.

Why?

The reasons are, to my mind, so obvious that it will suffice here to list them very briefly in point form:

3.2.1. The most obvious reason for the need for a European CID centre — and national CID centres which cooperate with it closely — lies in the fact that a new CID curriculum or blueprint must be drawn up on a national and European level as to the form, content and level of difficulty of the various CID scenarios which are going to be developed for the schools and universities.

3.2.2. A CID centre is also essential for the preparation of the multimedia CID scenarios which are going to be used in educational institutions throughout Europe. The preparation of such material is a completely different cup of tea to the preparation of traditional teaching material because of:

- ⇨ the complexity of multimedia CID scenarios. The development of truly effective CID scenarios which take into consideration not only the factual data to be transmitted but also the simultaneous training of metacognitive skills is something which can hardly be done effectively by single individuals or schools with the limited resources and knowledge at their disposal;
- ⇨ the need to meet certain general standards as far as quality and professionalism are concerned;
- ⇨ the financial aspect. Developing complex multimedia scenarios is a very expensive affair;
- ⇨ the interdisciplinary aspect. The decision as to how to achieve an optimal interdisciplinary mode of tuition is something which requires careful thought and just as careful preparation;
- ⇨ the new holistic teaching/learning strategies must constantly take the deliberate nurturing of metacognitive skills into account. This demands meticulous planning.

3.2.3. The existence of a European CID centre would lead to economies of scale on many levels:

- ⇨ by avoiding needless — and expensive — repetition. Cooperation and coordination of efforts through a European CID centre would save an inordinate amount of time and money;
- ⇨ by assuring a certain level of quality and professionalism;
- ⇨ by facilitating the exchange and dissemination of material and by the development of multi-purpose material which can be used by a number of countries.

The CID centre would work closely with groups of teachers throughout the European Union. It would offer schools and universities carefully prepared CID scenarios. These scenarios would be prepared and presented as graded open access learnware systems (GOALS). This means the individual lessons, texts, exercises, hypertext material, video material, etc. can be moulded to the needs of the individual class and instructor team. It can be edited easily. Material can be added, altered or removed. The instructors are handed a CID scenario which has all the essential ingredients, but they can — and will — decide on its final form. The GOALS material can also be constantly adapted to the needs of the moment.

By assuring a certain standardisation in the basic material used and mode of presentation, the exchange of material between schools will be greatly facilitated. Instructors will be able to exchange material and swap ideas. They will be able to learn from the experience of others. This will lead to a steady improvement in the quality of the material used as well as the way it is presented.

A CID centre which guarantees levels of quality and a certain standardisation on the software level — in the modes of preparation and presentation — will make the integration of new material and the steady evolution of the CID scenarios — as far as content, exercises and new hardware is concerned — far more easy than a system where countless schools are all fumbling around trying to do their own thing, each using different authoring programs and completely different scenarios.

3.2.4. A CID centre would assume the responsibility for the distribution of the material produced and of eventual publications.

3.2.5. It would plan and test the integration of new technological developments.

3.2.6. It would coordinate and facilitate cooperation with publishers and software firms.

It is vital to remember that CID scenarios are not computer centred. In fact, the learners should not work directly with computers more than 30 % of the time. The enormous advantage of information technology will be that it will allow us to provide the learners with an interactive multimedia CID scenario which is eminently flexible and to store the immense amounts of data necessary in the form of a databank. It also allows new possibilities like multitrack tuition — where pupils learn at their own pace and do exercises which are tailored to their particular needs — and application sharing — where two or more learners tackle a common task and communicate using computer screen and audiolinks — and the Internet.

Despite the versatility and power of IT, a CID scenario concentrates on the optimal transmission of knowledge and the training of metacognitive skills. This means that the scenario presupposes a multimodal learning environment, which includes traditional work on the blackboard, various kinds of books, overhead projectors, mind-mapping and brainstorming sessions, discussion groups, project work, presentations, field trips, excursions, etc.

Deciding on when and how to use IT and how to integrate it effectively in the general CID scenario is going to be one of the most difficult tasks facing instructors in the coming years. This is all the more the case because the integration of IT will be a continuing process. The first CID scenarios will have to presuppose a minimal integration of IT (Diagram 1) and then gradually develop from there. This means that traditional media will continue to play a vital role in the learning process.

If publishers and software firms are to take part in the dissemination of the CID material, close cooperation between them and a central CID centre is, therefore, a *conditio sine qua non* for the successful development and implementation of the scenarios.

3.2.7. The CID centre would test and evaluate the educational software produced.

3.2.8. It would ensure an increasing standardisation of software norms.

3.2.9. It would carry out research to optimise the ergonomics of the learning environment.

4. The need for a guiding vision

Up to this point I have talked solely about the WHAT and the HOW and have neglected the question WHY.

There is a good reason for this. The question WHY is even more problematic than the questions WHAT and HOW because it goes beyond the surface and deals with the foundations — the basic premises — on which

our society is built. Why we teach what we teach depends — in the final analysis — on the value system of our society.

What few discussions on the remoulding of the educational system seem to realise is that the current paradigm shift is triggering off a fundamental re-evaluation of our value systems. This will have fundamental repercussions at every level of our lives.

When it comes to values, we Europeans are great theoreticians but poor practitioners. We pay lip service to certain values but they are not an integral part of the educational system. There is no conscious effort being made to really teach the young these values so that they become an integral part of their personality and lives. Our youth is living in a spiritual vacuum and we are doing little to help them orientate themselves. We offer them no clear guidelines. On the contrary, the current educational system presents its youth with four contradictory images of humankind:

- ⇨ a religious image of humankind
- ⇨ a biological image of humankind
- ⇨ an economic image of humankind
- ⇨ an ecological image of humankind

I will not attempt an analysis of these images here, but it is clear that they transmit conflicting value systems. It is also a fact that we live these contradictions. It is not surprising, therefore, that our youth is confused and disoriented.

What we desperately need is a clear set of ideologically neutral, universally valid, existential guidelines — a guiding vision which we can offer our youth and which will give their lives meaning and direction.

This is not as difficult as it may seem. Research done by notable institutions — e.g. the Stanford Research Institute — has revealed that a new unified and global image of humankind is already taking shape and the main traits of this integrative image of humankind have already been traced.

We must have the courage to examine these findings and to arrive at some form of consensus as to the image of humankind which we wish to transmit — both implicitly and explicitly — in the educational system of the information age.

The crucial step will be to find ways of deliberately teaching and integrating these values into the personal lives of the young people we are moulding and guiding.

To do this successfully presupposes that we will live them ourselves. Words are, after all, cheap and do not have a lasting effect without the constant presence of a living example who can show the youth how to live.

It is time that we stopped looking back and raising the great figures of the past onto pedestals as ideals to be striven after. Socrates was a monumental figure but our youth cannot relate to him. To them he was an Athenian who lived over 2000 years ago. Our youth needs living heroes and living examples of virtue, excellence and wisdom.

5. A unique opportunity

In this short presentation, I have only been able to provide a rough sketch of the elements of a holistic computer integrated didactic philosophy and methodology. The outline of the didactic strategies and teaching skills was also, perforce, superficial but — although the task may seem daunting — an implementation of the strategies delineated here would ensure a smooth transition of the education system into the information age and would give all those involved in the educational process — ourselves, those we are responsible for, the various government ministries, publishing houses, software firms, the media and the general public — time to adjust to the radical changes which are coming our way.

We have a unique opportunity to tap the vast potential of information technology in a sensible fashion and to remould the educational system into something we can be proud of. Let us not — for lack of courage and insight — fail our youth.

Learning and multimedia

Brigitte Denis
University of Liège
Belgium

Introduction

In every learner, whether adult or child, there is an individual, a (future) citizen or (future) producer, an active member of the economic production system. Here, I shall be focusing on this latter aspect alone, and considering two questions: What are this economic agent's 'learning needs'? and How can new multimedia resources help us to meet those needs?

I. Learning

1. A human privilege

'Human beings have the capacity to learn' (Kolb, 1984, p. 1). Our ability to adapt does not derive solely, as it does in animals, from an early (inherited) adaptation to an ecological niche, but rather, and mainly, from the fact that we each have our own individual adaptation process: learning. This self-constructive capacity is a human privilege.

2. A vital necessity

The exponential growth of information (in some scientific disciplines, the body of knowledge doubles in just 10 years), constant technological progress (hardware and software are becoming obsolete in under five years) and the need to be thoroughly up to date in one's area of expertise — all this means that learning has become an indispensable process that is vital to the effective performance of producers and, therefore, of their undertakings.

3. A threefold explosion of learning needs

This explosion is manifest in three directions: everyone, all the time, everywhere. This raises various problems that give rise to a necessary 'servuction' (see II. 4, below). But, at the same time, new (multimedia) resources are becoming available that can be used to serve the learning process. I shall be analysing the interface of these two phenomena.

II. Problems caused by the explosion of learning needs

1. Prohibitive costs

Since this need for learning concerns all the workers of an enterprise all the time, we reach an impasse that Albertini describes to justify the use of multimedia resources:

'In both initial and continuing training, we have to "process" more and more people without incurring a concomitant increase in cost.

Until now, results in terms of productivity have been poor or even negative. In 1985, the report "Prospective 2005" [Forecast 2005] indicated that training productivity seemed to have improved very little between 1971 and 1982. According to the report, during this period, the "lifelong- and vocational-training market" had quadrupled, with the cost of an hour's teaching rising even more precipitately. This meant that no economy of scale had been achieved.

Our knowledge of initial training leads us to assume that the situation in this field is even worse, particularly if account is taken of the hidden costs of failure at school. Whatever the case, how can we simultaneously ensure that 80 % of a generation is educated to school-leaving certificate level, pay teachers a fair wage, reduce class numbers and, on top of all this, deal with the explosion in higher education without making the most of productivity? Otherwise (1) *we shall be doomed to die well-educated but hungry.'* (1990, p. 3)

The same author concludes elsewhere that:

'Unless we achieve a massive reduction in student/teacher contact time, ... we shall be unable to achieve change — at least, at an acceptable cost. Unless this necessary condition, which is nonetheless not enough in itself, is met, any attempt at reform will be subject to the terrible law of the tyranny of numbers.' (1992, p. 268)

2. Everywhere (just in time or 'zero delay')

It is where (often the workplace) and when a problem arises that we most want to find or be given answers to our questions. It is at this moment that new information can best be integrated in our patterns of behaviour and thinking: we are able to put the new information to use, to test its appropriateness.

The validity of learning 'at the very moment the need arises' is rooted in the psychology of learning. Cognitive psychologists, such as Ausubel (1968), Norman (1982) and others, have described our mental structure as a network of concepts (the knots of the net) that are linked together by relationships (the links between the knots). At times some areas of the network are more 'active' than others. Quillian (1968) has shown that, in this case (for example, when a person is thinking of a particular concept), the closer they are in the person's mental network, the more 'neighbouring' concepts will be activated (2). This is the principle of the irradiation of activity. And it is, of course, this principle that operates when a learner asks him- or herself a question.

3. Just enough or 'zero storage'

'Zero storage' is a method of expressing oneself that is forceful but excessive, because without permanent data (i.e. without an object) in his or her cerebral memory (as opposed to external memory, i.e. written down), a person is unable to 'think'.

This does not, however, lead a person to try to remember as much information as possible. Firstly, because it is impossible; in any case, our attention filters and working memory operate like massive sorting processes, at the end of which very little of what we actually perceive is transferred to and remains in our long-term memory. And secondly, because it is possible, thanks to increasingly powerful and user-friendly (external) archive systems, to retrieve data with much more accuracy.

Limiting memorisation to the vital minimum and developing indexing strategies for the classification and future retrieval of information have become two key skills that lie at the very heart of the memory function.

Thus, the notion of 'zero storage' becomes 'storage in read-write memory reduced to optimal size' and 'storage in external memory kept at maximum accessibility'.

4. Towards 'servuction'

In other fields, the explosion in consumption and in the services associated with it has led to the phenomenon of 'servuction', that is, the involvement of the recipient of a service in the production of that service. This phenomenon is evident in 'self-banking', 'self-tanking' and 'self-services' of all kinds. Similarly, there is an increasing shift towards 'self-teaching', which has also been called (Leclercq, 1994) the self-regulation of learning.

---

(1) In other words, if we do not make the most of productivity.
(2) Electrically.

For many decades, the teacher was seen as being central to the teacher-learner relationship. Now, the situation has been reversed as a result of what Edouard Claparède (1873-1940) called the 'Copernican revolution in education'. It is now the learner who is central to the process. And rightly so. It is increasingly up to the learner to take charge of the various operations involved in the process of regulating his or her training, which used to be delegated to the teacher:

1. (self-)analysis of training NEEDS;
2. setting (own) objectives (PROJECT);
3. drawing up (own) PLANS (when, how, how much, etc.);
4. performing tasks (ACTION);
5. (self-)observation of results achieved (EVALUATION);
6. choosing correction loops (RETRO-PROCESS).

It has been shown elsewhere (Leclercq, 1994) that these regulation loops can lead to a reassessment not only of the action taken (retro-action or R4), but also of the plan (retro-planning or R3), the project itself (retro-projection or R2), and even of the analysis of needs (retro-analysis or retro-diagnosis or R1) and the very instruments or procedure of evaluation (retro-observation).

5. What is a good learner?

Pearn and Downs (in Nyhan, 1991) define competent learners as people who:

- 'know how they learn best;
- look out for information on their performance so that they can improve it;
- accept responsibility for their own learning and development;
- are aware of their training needs and constantly reassess them;
- try different methods of learning;
- question authority and information received;
- make positive use of any mistakes in order to learn and develop greater understanding;
- develop an open and confident attitude towards others rather than a defensive way of thinking;
- become experts in 'fortuitous learning', that is, they are able to draw lessons from everyday life;
- are committed to their own training and development' (cited in Pearn, 1992, pp. 109-110).

6. What is the trainer's role?

In this context, the trainer becomes a 'learning facilitator'. In short, what we have here is the concept of open and flexible (distance) learning. This formula gives the learner a great deal of freedom as regards whole facets of the process: time, content, place, method (e.g. inductive or deductive), resources (media), rhythm or degree of support, etc.

Support for self-training involves the possibility of recourse to increasingly varied instructional resources (Carré, 1992, p. 65). Which is, fortunately, becoming more and more of a reality.

III. The explosion in learning resources

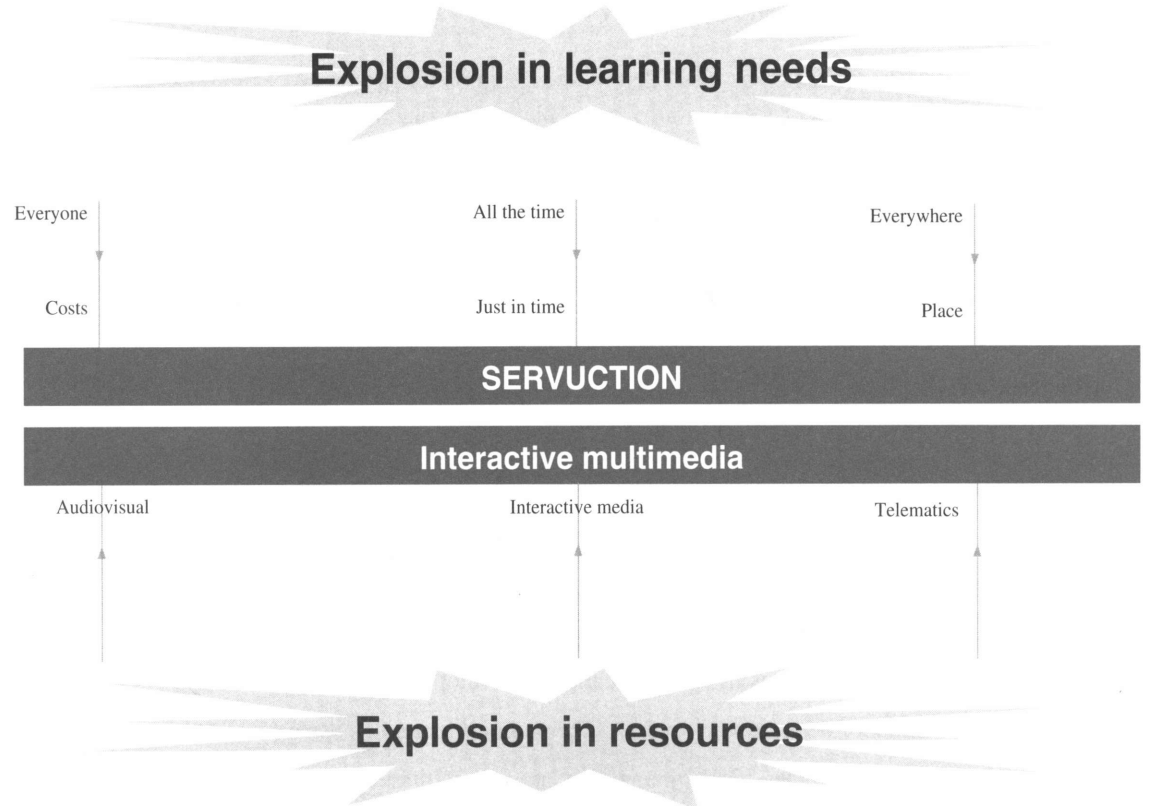
The explosion in learning resources manifests itself in several ways: variety in types of people, resources, institutional forms, media. I shall be concentrating on this latter aspect alone, or rather, on three of its components: audiovisual, interactive and telematic media.

1. The explosion in audiovisual media

Whether it is television and video that are becoming increasingly computerised (teletext, inquiry systems, decoders, 'pay as you view', etc.) or computers that are becoming increasingly 'multimedia' is irrelevant — what we are witnessing is a cross-fertilisation of the two worlds, which are still rich in potential growth.

'The future of audiovisual media lies in the computer and the future of computer-assisted training lies in audiovisual media.' (Albertini, 1992, p. 122)

We can, for example, digitalise and rework sounds or images in accordance with principles that were until recently limited to text processing. There are software packages that can understand the spoken word or handwriting; we can design, produce and distribute interactive, audiovisual business cards; etc.



2. The explosion in interactive media

It has been said that interaction is at the very heart of learning processes. For anyone who knows the works of behavioural, integrative or cognitive psychologists, this is a truism. But we rarely see anyone taking a description of interaction beyond this stage. In particular, there is no 'taxonomy' of interaction. And nor should there be. In the rest of this paper, I shall be trying to demonstrate that interaction must be related to its context, that is, the learning method concerned.

3. The explosion in telematics

This explosion has changed the situation not only as regards storing and consulting information but also as regards teleworking and tele-cooperation in learning. It is a crucial issue, since many authors (Mugny, 1985; Vygotsky, 1967; etc.) have demonstrated the significance of the social dimension in the learning process. Social interaction is an essential element of cognitive change (Newman, 1989). Mugny and Doise, in particular, have shown the importance of socio-cognitive arguments in the building of knowledge. In practical terms, this leads to various applications, such as:

— **groupware,** or software that encourages cooperation;

— **virtual classrooms,** an expression used by Hiltz (1986) to describe systems that operate on the basis of the traditional classroom (teacher and students), but with teacher and students being physically distanced from each other and linked by computer (e.g. video-conferencing) (Derycke, 1991, p. 80). People also speak of **tele-contact hours** and of the visited lecturer (as opposed to the visiting lecturer);

— **electronic theatres,** such as the one at the University of Maryland described by Kent Norman and Leslie Carter (1992), in which the (40) students in a class have (in pairs) use of a computer linked to the lecturer's desk by a local information network (or local area network — LAN).

IV. Why reflect in paradigms?

In philosophy, the word 'paradigm' refers to *'something that is indicated as an example, something to which one refers as exemplifying a rule and which can, therefore, serve as a model. As a practical model to guide human activity and serve as a point of reference, a paradigm differs from an archetype, which suggests the idea of an original ontological priority...*

In Plato, this concept has a pedagogical and propaedeutic meaning: the paradigm is the "easy" object on which one practises before dealing with an object that is similar to the first but more difficult...

In E. Levinas, the paradigmatic method is based on the thesis that "ideas are never separate from the example that gives rise to them"...

*The science historian and epistemologist Thomas Kuhn used the word "paradigm" in a new way to account for the way in which sciences develop. In his wo*rk The structure of scientific revolutions *(1962; French translation, Paris, 1972), he defines a set of concepts that are shared by the international scientific community as a paradigm of science at a given period.'* (Encyclopaedia Universalis, 1990).

If we consider the teaching/learning partnership, their complementarity and interdependence are obvious: the more the trainer intervenes, the less possibility there is for the learner to do so, and the same applies in the case of initiative, etc. To describe the one is essentially to describe the other.

The variations in these partnerships can be described in a multitude of ways, but this would be a waste of time if what we want to do is to provide instruction with a model-to-think-with. Because it is human beings who are considering these issues and, if the model heavily exceeds the capacities of their working memories, it loses one of its essential qualities: being present to the mind at all times. The model (which is not 'the truth' but is nonetheless 'useful') in six paradigms described below is within these human capacities (the magical number seven, with which Georges A. Miller believes our short-term memory is genetically marked).

V. Six teaching/learning paradigms

We learn a great deal without actually seeking to learn, outside any instruction system, simply **by imitation**, by being immersed in the problem because of living in a specific context, even without realising it, and this is latent learning.

We also owe much of what we know to intentional communication, that is, the **transmission** of messages (by the press, radio, books, television, conferences, etc.) to provide us with information (1).

Some areas, and especially those in which it is important to proceduralise and automatise, that is, to establish routines, are mastered more quickly if **systematic practice** takes place under the direction of a good trainer who encourages action, helps to interpret consequences, maintains motivation, in short who guides and, in particular, corrects the trainee in programmed interactions — that is, interactions that are essentially programmed by the trainer.

(1) According to information theory (Shannon and Weaver, 1949), information is 'that which reduces doubt'.

Other fields benefit from a more personal approach (a personal visit to a town has attractions and advantages that are quite different from those of a guided tour), from **free exploration**, from 'consultation', in which it is the learner who takes the initiative, who asks questions, but without altering what he or she is exploring, without creating the knowledge that pre-existed the exploration.

There are cases in which the learner must be able to **experiment**, that is, to manipulate the environment, exhausting and combining all the possibilities he or she deems to be of any significance. In this way, the learner tries to answer a given question, after having formulated and tested various personal hypotheses. Piaget has demonstrated that young children make extensive use of this approach, which adults too often see as simple repetition. Although the child's gestures are (or appear to be) the same each time, the underlying hypotheses are different every time.

Finally, we also learn by **creating anew** (new for us), by constructing, by changing the world around us, by producing concrete works (texts, musical compositions, objects, buildings, plays, films, etc.) — often on the basis of a personal idea, an individual or group project.

VI. The four properties of the model

1. Each paradigm is described below in terms of six features:
   1. the spontaneous (natural) situation;
   2. the systemised process (systemised on the basis of a theory);
   3. learner-side demand;
   4. teacher-side supply;
   5. necessary conditions;
   6. typical places of learning.
2. Two groups of paradigms can be distinguished according to the source of the initiative:
   (a) in the three lower paradigms, the trainer/model takes the initiative and directs operations;
   (b) in the three higher paradigms, it is the learner who takes the initiative.
3. The six paradigms can be divided into pairs:
   (a) imitation of an external model *v* creation of a new, personal model (NB: this model may be collective);
   (b) transmission (of data structured by the transmitter) *v* primacy of structuring by the receiver in exploration;
   (c) application of an external practice plan *v* freedom to devise hypotheses in experimentation.
4. The chosen instructional strategy will comprise a certain combination of these six paradigms. For example:

	Immersion	Self-training	Dialogue	Lesson seminar	Laboratory
Imitation	•			•	•
Transmission			•	•	•
Practice				•	
Exploration	•	•	•		•
Experimentation		•			•
Creation	•	•			

1. **Creation**
2. GUIDED (RE)DISCOVERY
3. 'Let me do it'
4. 'I'm here to help'
5. (Item of construction)
6. Music studio

1. **Trial and error**
2. EXPERIMENTATION
3. 'Let me have a go'
4. 'This is the problem and these are your resources'
5. (Instrument of manipulation)
6. Laboratory

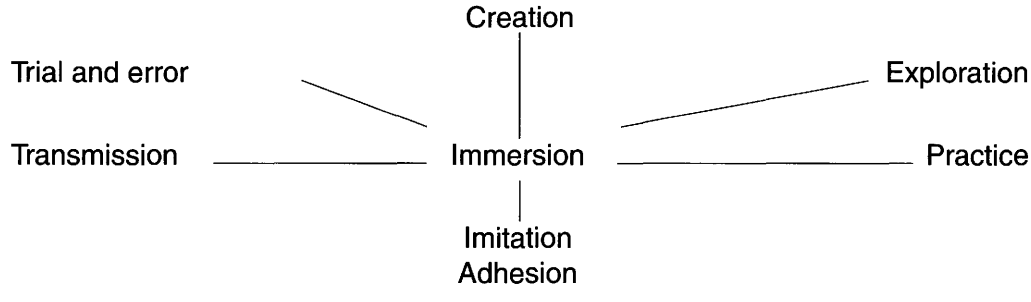
1. **Exploration**
2. QUESTIONING/NAVIGATION
3. 'Let me see...'
4. 'Here's a list of what is available'
5. (Consultable data)
6. Museum, library

1. **Transmission**
2. TEACHING
3. 'Tell me'
4. 'You should know that...'
5. (Informative messages)
6. School, book, video

1. **Practice**
2. COACHING
3. 'Correct me'
4. 'Here is your mistake'
5. (Feedback)
6. Stadium, gym

1. **Imitation**
2. MODELLING
3. 'Show me'
4. 'Watch me'
5. (Motivating models and immersion)
6. Family, street, TV reporting

In short, each of these methods can be represented by a single word. Every instructional strategy (e.g. immersion) is linked to some extent with each method of learning.



VII. Degrees of mediation of learning

It is generally accepted that education and training largely consist of creating artificial situations to accelerate learning whose mastery cannot be entrusted to chance. Very often, education mediates human experience. There is **mediation** when an 'intermediary' makes it possible to conquer:

(a) time, that is, to ensure the permanence of the message, to free it of its transience;

(b) space, that is, to abolish distance, to enable the message to be transportable, to relax it from its 'locality', its proximality;

(c) number (here, the uniqueness of the receiver), to ensure the multipliability of the message so that it can be received by a relatively large number of addressees;

(d) human perceptive limitations caused by the size or speed of objects (magnification, slow motion) — in short, to offer supra-sensoriness.

New technologies can play a role in this in education. It is not a question of replacing all direct experience with mediated experience. It is up to each trainer and trainee to make the 'compromises' that seem the most appropriate in the circumstances (given his/her objectives, his/her partners, his/her resources, his/her constraints).

Two contrasting examples can be used to illustrate this point:

1. role play consists of placing learners 'in a situation', usually without using any media and sometimes even without a predetermined text;
2. by contrast, Megaventure is a television programme for which several scenes have been filmed in advance. When the programme is broadcast, the 'player' makes choices and only some of these scenes are shown.

The purpose of the table below is to provide a broad, but not complete, picture of possible combinations of learning methods and media, with one (or two) examples in each box. We use the following terms:

- IMEDIA (or AMEDIA) for a situation that is not mediated, that is, a situation in which there is no intermediary between the real world and the learner;
- UNIMEDIA for a situation that makes use of just one channel: textual or audio or visual([1]);
- MULTIMEDIA for a situation that combines more channels.

The latter two categories are separated by a whole set of degrees, notably BIMEDIA, which combine two channels (sound and image in a diaporama, or image and text in a comic strip, etc.).

Ressource Approach	**Amedia** or **Imedia**	**Uni Media**	**Multi Media**
IMITATION IMMERSION LATENT LEARNING	In the street In the family In class (e.g. role play) ([2])	Listening to recorded conversations	Cartoons (text + images) Videos, TV serial, 'Megaventure'([3])
TRANSMISSION (EXPLANATORY METHOD)	'Real-life' demonstration, with explanation	Information on the radio Use of text Newspapers, books	TV newscast using 3-D or guided demonstration model
GUIDED or PROGRAMMED **PRACTICE**	Trainer (or expert) with one learner, whom he/she 'coaches'	Oral teaching Programmed teaching (written or aural)	Video + CAT Computer-guided videodisc
EXPLORATION or DOCUMENTARY APPROACH QUESTIONING	Learner questions one who knows	Research using database or hypertext	Navigation in a hypermedia or multimedia database
EXPERIMENTATION SIMULATION or COMBINATORY approach	Personal trial and error Real aeroplane (with co-pilot) Driving school (real car)	Analytical computer simulation, with data and results CAE ([4])	Computer simulation, with graphic representation of results. 'Cognitive window'([5]) Flight simulator Virtual reality
CREATION CONSTRUCTION or use of MINI-WORLDS	'Real-life' manufacture of objects	Creating a database, text, hypertext or design (complex logo)	Construction of a hypermedia or simulation (musical logo), instructional robotics ([6])

([1]) According to the terms used by J. Cloutier in *L'audio Scripto Visuel à l'ère des Self Médias* (1973).
([2]) The shared class (Elliot, 1968).
([3]) Smoking, non-smoking (Resnais).
([4]) Computer-assisted experimentation (see Morel, *Success Stories*, Hudon, (1993); and Rellier and Sourdillat, (1993), in Denis and Baron (eds), (1993).
([5]) Cervera and Nonnon (1993), in Denis (1993).
([6]) Instructional robotics = the construction of small robots and their guidance by computer.

VIII. Mathetic (1) and didactic ambivalences

1. Mathetic ambivalences

When one observes the approach of learners who have resources (documents, an expert, manipulable material, etc.) available to them, it may be noted that they tend to have their own individual way of using a variety of learning methods, to alter their strategy even within a single session.

They may move:

- from *Show me how you do it* (IMITATION)
- to *Explain it to me* (TRANSMISSION)
- to *Correct me and guide me* (PRACTICE – COACHING),

or

- from *Let me research the information* (EXPLORATION)
- to *Let me try, and make my own mistakes* (EXPERIMENTATION)
- to *Let me realise my project* (CONSTRUCTION).

We should remember that the first three strategies place learners in a position of dependence, of reaction, whereas the last three put them in a position of initiative, of control.

2. Mathetic skills

(a) Our hypothesis is that every learner is a (relatively skilled) self-teacher, that is, that every learner has 'mathetic skills'.

Learners have a fairly accurate awareness of their 'zone of proximal development', to use Vygotsky's term (1962). Whether this awareness is mainly cognitive or affective is immaterial: what matters is that learners know what they want or 'are ready' to understand, know or master. It is on the basis of this 'outcome expectancy' (Bandura), that is, on the basis of the best cost/effectiveness ratio of each paradigm, that learners will take any small decisions in their learning process.

(b) In situations in which it is the structure of the mental network that is involved, learners have a partial awareness of their 'areas of imbalance' and an intuition (which is not necessarily correct) of the type of action (listening to another's point of view, comparing their own point of view with it, handling objects, investigating documents, etc,) that might result in a better balance. Learners are also (potentially) the first to note that this balance has been achieved.

(c) Learners 'adjust' the task they give themselves to the optimal degree of difficulty.

By asking the facilitator (teacher) to provide them with indices (in Bloom's terms) or to refrain from doing so, they manage their own level of motivation, according to Atkinson's hypothesis (1964), which states that the more unlikely the chances of succeeding in performing a task (that is, the more difficult the task), the more pleasure is derived from succeeding.

3. Copernican revolution in the paradigms

The functions of teaching (of didactics) are often used as a starting point for defining the functions of self-teaching as 'functions assumed by the learner in the trainer's stead'. We could reverse this reasoning and see the functions of self-teaching as a spontaneous development of the individual, with the teacher simply systemising and 'professionalising' them from the outside. Such spontaneous development has the same functional origin as our (innate and acquired) ability to choose the kind of food we want to eat, etc. In this metaphor, the teacher takes the role of dietician.

---

(1) From the Greek verb 'manthano' [to learn], not to be confused with 'mathematics'.

4. Didactic ambivalence

(a) The teacher's dilemma

Teachers often hesitate when choosing which of these various methods to use. They are concerned to encourage autonomy in the learner and, therefore, tend to use the 'higher' methods. But they are also aware of time constraints: they can 'gain a lot of time' by transmitting their own summary, or by serving as messengers of other people's ideas, thus renouncing the chance of developing their students' transferable self-training skills.

Leclerq (1987) has described elsewhere four 'stages' in the architecture of skills to be developed in learners:

DYNAMIC SKILLS

STRATEGIC SKILLS

KEY SKILLS

SPECIFIC SKILLS

(b) The internal designer/executor conflict

The decision taken is not influenced only by pedagogical considerations. Organisational constraints weigh heavily. Teachers are not machines. On the one hand, their didactic multiskilling (see below) is not complete. On the other hand, their personal equations will also vary over time. The teacher is both the designer and the agent of execution, who is not completely available. Once again, the teacher is not a machine. The selected programme (objectives) may be influenced as much (and sometimes more) by the executor as (than) by the designer, in much the same way as the songs chosen by an artiste for a recital may be determined more by the artiste's taste than by that of the audience (learners/consumers) or the organiser (designer of curriculum/producer).

IX. Mathetic and didactic multiskilling

Before the Copernican revolution in education and training, the trainer, taking the initiative, chose a method, which was imposed on a group of people for a given period (e.g. 30 minutes).

Since the Copernican revolution, which centres on the learner and, therefore, on the learner's initiatives, account has had to be taken of this mathetic ambivalence: learners sometimes want to be allowed to explore in their own way, but they always want somebody to be there to provide them with explanations. They want to be guided and then, immediately afterwards, they want to be able to try for themselves.

In this context, trainers must be able to do everything: to serve as a model (for imitation), provide explanations (for transmission), guide (for practice), organise resources and make them available (for exploration), make manipulable material accessible (for experimentation), facilitate and support projects (for creation).

Mathetic ambivalence must be matched by the didactic multiskilling of the trainer or the training system.

This didactic multiskilling implies solving the problems specific to each teaching/learning paradigm. Interactive multimedia have a major part to play here, as can be seen from a brief description of a few typical problems:

Paradigm	Problem
IMITATION IMMERSION	How to bring things alive, provide models, immerse the learner — all the time and everywhere?
TRANSMISSION EXPLANATION	How to prevent sensory monotony and choose the most appropriate medium?
PRACTICE COACHING	How to adapt to each learner's needs and existing assimilation structures?
EXPLORATION SELF-MEDIATION	How to make encyclopaedic information available in various forms (media), so as to respect the learner's preferred learning style?
EXPERIMENTATION	How to provide a reactive environment using systematic methods of manipulation and observation?
CREATION	How to enable learners to model, construct and analyse their own ideas?

X. Bibliography

Albertini, J. M. (1990), 'Le coût des multimédias et le développement de leur marché', in Barchechats and Pouts-Lajus, S. (eds), *Symposium of European producers of technology-based applications for education and training,* Proceedings of the Delta-Startup meeting at Interlaken, April 1990, Paris, OTE.

Albertini, J. M. (ed.) (1985), *Les jeunes, l'économie et la consommation,* Brussels, Labor.

Allen, W. H. (1975), 'Instructional media research, past, present and future', *AV Comm. Rev.*, vol. 1, pp. 5-18.

Atkinson, J. W. Birch, D. (1970), *The dynamic of action*, New York, Wiley. Atkinson, J. W. (1957), 'Motivational determinants of risk-taking behavior', *Psychological Review*, vol. 64, pp. 359-372. Atkinson, J. W. (1964), *An introduction to motivation*, Princeton, Van Nostrand.

Ausubel, D. (1968), *Educational psychology: A cognitive view*, New York.

Bandura, A. (1977), *A social learning theory*, Englewood Cliffs, New Jersey, Prentice Hall.

Bloom, B. S. et al. (1956), *Taxonomy of educational objectives, Handbook I: The Cognitive Domain,* New York, David Mc Kay.

Briggs, L. J. (1968), 'Learner variables and educational media', *Review of Educational Research*, vol. 2, pp. 160-76.

Brockett, R. and Hiemstra, R. (eds) (1991), *Self-direction in adult learning*, Routledge.

Brown, J. S., Collins, A. and Duguid, P. (1989), 'Situated cognitions and the culture of learning', *Education Researcher*, vol. 18 (2), pp. 32-42.

Byrnes, D. A. and Kiger, G. (1992), 'Prejudice-reduction simulations: Ethics, evaluations and theory into practice', in *Simulation and Gaming*, vol. 23 (4), pp. 457-471.

Carlson, H. and Falk, D. (1990-91), 'Effectiveness of interactive videodisc instructional programs'. *Journal of Educational Technology Systems*, vol. 19 (2), pp. 151-163.

Carlson, H., and Falk, D. (1989), 'Effective use of interactive videodisc instruction in understanding and implementing cooperative group learning with elementary pupils in social studies and social education', *Theory and Research in Social Education*, vol. 17 (3), pp. 241-258.

Carré, Ph. and Pearn, M. (1992), *L'auto-formation dans l'entreprise*, Paris, Editions Entente, 12, rue Honoré Chevalier, 75006 Paris.

Carré, Ph. (1992), 'Les dispositifs pédagogiques', in Carré, Ph. and Pearn, M. (1992)

Charlier and Donnay (1990), *Planifier un cours*, Brussels, De Boeck.

Clark, C. M. and Yinger, R. J., (1979), 'Research on teacher planning: A progress report', *Journal of Curriculum Studies*, vol. 11 (2), 175-177.

Clark, R. E. (1990), 'The contributions of cognitive psychology to the design of technology-supported powerful learning environements, s.l.', University of Southern California.

Clark, R. E. (1991), 'Designing for meaningful learning and transfer' (1991), in Lowijck et al., pp. 91-109.

Cloutier, J. (1973), *L'ère d'Emerec ou la communication audio-scripto-visuelle,* Presses de l'Université de Montréal.

Collins, A. M. and Quillian, M. R. (1969), 'Retrieval time from semantic memory', *Journal of Verbal Learning and Verbal Behavior*, vol. 8, pp. 240-47.

Cronbach, L. and Snow, R. (1977), *Aptitudes and instructional methods: A handbook for research on interactions*, New York, Wiley.

Crossley, K. and Green, L. (1989), *Le design des didacticiels*, Paris, ACL.

Dale, E. (1969), *Audio visual methods in teaching*, New York, Holt, Rinehart and Winston.

De Finetti, B. (1965), 'Methods for discriminating levels of partial knowledge concerning a test item', *British Journal of Mathematical and Statistical Psychology*, vol. 18, pp. 87-123.

Denis, B. (ed.) (1993), 'Control technology in elementary education', Berlin, Springer Verlag, NATO ASI series F: *Computer and sciences*, vol. 116.

Denis, B. Baron, G.-L. (1993), *Regards sur la robotique pédagogique,* Paris, INRP, Technologies nouvelles et education.

Derycke, A. (1991), *Hypermédia et apprentissage coopératif*, in De La Passardiere B. and Baron G., *Hypermédias et apprentissages,* Actes des Premières Journées Scientifiques, 24-25 September 1991 à Chastenay-Malabry, Paris, INRP, MASI, pp. 77-876.

Galbraith, J. K. (1967), *The new industrial state*, New York, The American Library.

Giezendanner, F. (1993), *Machina Carnis*, Privat Docent Thesis, Faculty of Medicine of Geneva.

Guglielmino, L. (1991), *Self-directed learning readiness scale*, in Brockett and Hiemstra R. (eds) (1991).

Henry, G. (1987), *Mesurer la lisibilité des textes*, Brussels, Labor.

Hiltz, S. R. (1986), 'The virtual classroom: using computer mediated communication for university', *Journal of Communication*, vol. 36 (2), pp. 95-104.

Huberman, A. M. and Mikes, M. B. (1984), *Innovation up close: How school improvement works*, New York, Plenum Press.

Kagan, J. and Kogan, N. (1970), 'Individual variation in cognitive processes', in P. H. Musser (ed.), *Carmichael's manual of child psychology*, vol. 1, New York, Wiley.

Kolb, D. (1984), *Experiential learning: Experience as the source of learning and development*, Englewood Cliffs, Prentice Hall Inc.

Kolb, D. A., (1976), *Learning styles and disciplinary differences*, Boston, MA., McBer and Company,.

Leclercq, D. (1987), 'L'ordinateur et les défis de l'apprentissage', in *Horizon*, November 1987 and March 1988

Leclercq, D. (1990), 'Intelligent tutorial and self learning systems', *Proceedings of the International AI Symposium (IAIS 90),* Nagoya, Japan, pp. 127-135.

Leclercq, D. (1994a), *L'approche technologique en éducation et en formation*, STE, Université de Liège.

Leclercq, D. (1994b), 'Les images pour la compréhension et la mémorisation des messages', *Media scope*, 7 May 1994, pp. 22-28.

Leclercq, D. (1983), *Confidence marking: Its use in testing,* Oxford, Pergamon.

Leclercq, D. and Pierret, D. (1989), 'A computerised open learning environment to study intrapersonal variations in learning styles', Delin, in Estes, Heene and Leclercq, D. (eds), *Proceedings of the 7th International Conference on Technology and Education (ICTE)*, Orlando, Florida, pp. 268-272.

Leclercq, D. and Boskin, A. (1990), 'Note taking behavior studied with the help of hypermedia', in Estes, Heene and Leclercq, D. (eds), *Proceedings of the 7th International Conference on Technology and Education*, Brussels: March, 2, pp. 16-19.

Leclercq, D. and Bruno, J. (eds) (1992), *Item banking: Self-assessment and interactive testing*, NATO ARw, Conference in Liège, Berlin, Springer Verlag.

Lowyck, J. and Elen, J. (1990), 'Self-Study packages: Vantage points for a new instructional design', *International Journal of Educational Research, vol.* 14 (6), pp. 565-579.

Lowyck, J. (1991), 'The field of instructional design', in Lowyck et al., (1991) pp. 1-30.

Lowyck, J. de Potter, P. and Elen, J. (eds) (1991), *'Instructional design: Implementation issues'*, Proceeding of the IBM/KU Leuven Conference, La Hulpe, December.

MacDonald, J. B., (1965), 'Myths about instruction, *Educational Leadership*', 22(8), pp. 609-617.

Mager, R. F. (1962), *Preparing instructional objectives,* Palo Alto, Cal., Fearon Publ. Inc.

Mandl and Prenzl, (1991), 'Designing powerful learning environments', in *Lowyck J.* et al. (1991), pp. 69-90.

Milgram, S. (1963), 'Behavioral study of obedience', *Journal of Abnormal and Social Psychology*, vol. 67, pp. 317-378.

Montague, W. E. and Wulfeck, W. H. (1986), 'Instructional systems design', in J. A. Ellis (ed.), *Military contributions to instructional technology*, New York, Praeger.

Mugny, G. (1985), *Psychologie sociale du développement cognitif*, Berne, Peter Lang.

Naftulin, D. H., Ware, J. E. and Donnelly, F. A. (1973), 'The Doctor Fox lecture: A paradigm of educational seduction', in *Journal of Medical Education*, vol. 48, pp. 630-635.

Newman, D. (1989), 'Cognitive change by appropriation', in Robertson S. R., Zachary W. and Black J. B. (eds), (1989) *Cognition, computing and cooperation*, Ablex Publishing Corporation.

Nonnon, P. (1986), *Laboratoire des sciences assisté par l'ordinateur*, Université de Montréal, Faculté des Sciences de l'Education.

Norman, D. (1982), *Learning and memory*, San Francisco, Freeman and Co.

Nyhan, D. (Ed.), (1991), *Developing people's ability to learn*, European Interuniversity Press.

Papert, S. (1980), *Mindstorms: Children, computers and powerful ideas*, New York, Basic Books.

Pask, G. and Scott, B. C. E., (1972), 'Learning strategies and individual competence', *International Journal of Man. Machine Studies,* vol. 4, pp. 217-253.

Pask, G., (1976c), *Conversation theory: Applications in education and epistemology*, Amsterdam, Elsevier.

Pask, G., (1976b), 'Styles and strategies of learning', in *British Journal of Educational Psychology*, 46, pp. 128-148.

Pearn, M. (1992), 'L'organisation autoformatrice', in Carré Ph. and Pearn (1992).

Perret-Clermont, A. N. (1979), *La construction de l'intelligence dans l'interaction sociale*, Berne, Lang.

Peters, W. (producer and director) (1985), *A class divided* (film), Washington DC, Public Broadcast Station Video.

Peters, W. (1971a), *A class divided: Garden City*, New York, Doubleday.

Peters, W. (1987), *A class divided: Then and now,* New Haven CT, Yale University Press.

Peters, W. (producer and director) (1971b), *The eye of the storm* (film), New York, American Broadcasting Company.

Quillian, M. R. (1968), 'Semantic Memory', in Minsky, M. (ed.) (1968), *Semantic information processing*, Cambridge Mass. MIT Press.

Reigeluth, C. M. (ed.) (1983), *Instructional design: Theories and models: An overview of their current status*, Hillsdale, N.J., Laurence Erlbaum.

Riding, R. J. and Calvey, I. (1981), 'The assessment of verbal- imagery learning styles and their effects on the recall of concrete and abstract prose passages by eleven-year-old children', in *British Journal of Psychology*.

Riding, R. J. and Taylor, E. M. (1976), 'Imagery performance and prose comprehension in seven year-old children', *Educational Studies*, 2, pp. 21-27.

Romiszowski, A. J. (1974), *Selection and use of instructional media,* London, Kogan Page, p. 352

Schramm, W. (1977), *Big media, little media: tools and technologies for instructions*, London: Sage Publications.

Skinner, B. S. and Holland, J. (1961), *The analysis of behavior: A programmed textbook*, New York, Mc Graw Hill.

Tyler, R. W. (1949), *Basic principles of curriculum and instruction*, Chicago, University of Chicago Press.

Vygotsky, L. S. (1962), *Thought and language*, Cambridge, MIT.

Yinger, R. J. (1980), 'A study of teacher planning', *Elementary School Journal*, vol. 80, pp. 107-127.

Zahorik, J. A. (1975), 'Teachers' planning models', *Educational Leadership*, vol. 33 (3), pp. 134-139.

Communicating and exchanging experiences through the Net

Alessandro Candeli
IRRSAE
Emilia-Romagna
Italy

Alessandro Claudio Candeli is a member of the documentation service and manager of the Internet site of IRRSAE Emilia-Romagna, the regional authority for training of teachers. He also coordinates the re-training activities on the use of new technologies in regional schools. At European level he is managing a project concerning language education.

1. The 'Kidslink' project

In the last five years a growing number of teachers and schools has been using the Internet in order to communicate and to publish their own works on the WEB pages of the Kidslink-server by the ARCI computer club in Bologna.

At first all the activities were supported by a small SCO UNIX server connected four times a day to the public research network through the National Research Council using the UUCP standard. The server worked as a common BBS. The schools connected themselves with terminal emulators like TELIX, downloading and uploading their files in queue. The connections were very short (2 or 3 minutes) so the telephone expenses were affordable even for low-budget schools.

Three years ago a more powerful LINUX server was installed connected 24 hours a day on a 64 Kb line. The access to Kidslink is now also possible using SLIP or PPP with a normal browser, like Netscape.

2. Experiences with international e-mail

At first, international e-mail in English among Bologna's pupils and students of other cities participating to the Kidslink project was the main activity. The use of Latin never succeeded. The relationships among the classes often became stable and durable. While the complete freedom of students using e-mail has never produced relevant drawbacks, their knowledge of English has certainly improved. E-mail activity is still going on with remarkable success, mainly among Scuola Media's students (aged between 11 and 14). Beside the international e-mail other activities also succeeded: the critique of school library books (Fahrenheit 451 project), the participation in linguistic games, the construction of a detective story by nine-years-old children and the construction of hypertexts.

3. A hypertext built using the Internet network

In 1993 a very interesting experience in this field was realised. Under the direction of the IRRSAE ER, seven schools from the Emilia-Romagna region, far apart from each other but connected to Internet through Kidslink, built, using IBM Linkway, the geographical hypertext 'GEGEO', that, in the end, turned out 26 MB long. About 300 people (both pupils and teachers) worked together throughout a school year. They all used the same template with a navigation bar, similar to the bar later adopted by Netscape. Every school developed its own section, following strictly the rules accepted at the beginning, and communicating almost daily with the other partners through a mailing-list (iper@kidslink.bo.cnr.it). It was therefore possible to face problems,

to correct mistakes in a cooperative way and to share the materials during the construction of the hypertext. A server's area contained the plans of development of each work section and the materials meant to be shared. It contained, for example, the picture of a planisphere which was used to illustrate the climatic zones, the positions of great rivers, the flora, the seismic areas, etc.

At the end of the work, when all the sections were assembled together on the same computer, more than 700 files became one running and consistent hypertext, in the public domain, now used by some schools during geography classes. Anyone with a browser, access to Internet and a little patience can download, via FTP, the six zipped files that constitute the hypertext. (http://kidslink.bo.cnr.it/irsaeer/iper/gegeo.html)

4. From 'Vitruvius' to the HTML

Many hypertexts have been elaborated in high school (14 to 18 year-old students) following the successful 1992-93 Vitruvius hypertext. Done with IBM Linkway, it analyses the durable success of Vitruvio's *De architectura* comparing it with Leon Battista Alberti's *De re aedificatoria*. It has been developed by a fourth-year high school class led by Italian, Latin, and history of art teachers, and one IRRSAE expert: 4 MB of deep analyses of Latin's most important passages, and classical architecture and sculpture images demonstrating the Vitruvius' theory of proportions. 'Vitruvius' and other hypertexts that followed this model can be freely downloaded (FTP) for educational use from IRRSAE's WEB pages on the Kidslink server (http://kidslink.bo.cnr.it/irrsaeer). For two years the success of HTML as a standard public domain language has let people discard old hypertext engines like Linkway, Toolbook, etc. and create HTML hypertexts writable and readable using normal computers of school laboratories, but also publishable on WEB pages. The availability of excellent free hypertext engines such as AOLpress, many training courses in the schools, and the possibility of free publishing of one's works on the IRRSAE WEB pages are boosting the diffusion of this activity in the schools. The history project *Le orme dell'uomo* (Human footprints) has already produced two hypertexts of remarkable importance and quality: 'writing' (http://kidslink.bo.cnr.it/ irrsaeer/ calamo/coper.html) and 'Human habitations' (http://kidslink.bo.cnr.it/irrsaeer/case/index.html). They will soon be followed by other hypertexts: 'Witches'; 'Faenza, from wood to ceramics'; 'The Po river'; 'Theatre: from Menander to Molière'. Hypertextual analyses of suspense short stories were also much appreciated (http://kidslink.bo.cnr.it/ irrsaeer).

5. Games and other experiences

But the participation in international e-mail projects and hypertext-writing are certainly not the only successful activities. The construction of *lipogrammes* and other linguistic games, the composition of short stories forcing the use of some words, the critique of school library books (Fahrenheit 451 project) helped to raise computer popularity among teachers and students.

Without such pleasant experiences many teachers with low level computing skills wouldn't have known how to use computers in their normal activity at school. The feeling of working in a group greater than their school encouraged many hesitant teachers and produced a positive spirit of emulation.

Of great importance have been *technological operators (OTs)* who, when present, contributed to the diffusion of Internet technologies and contents and helped less experienced colleagues to become more and more autonomous and skilful.

The importance of an occupation is perhaps, first and foremost, that of uniting men. There is only one real luxury, that of human relations.

Antoine de Saint-Exupéry

Terre des Hommes (Wind, Sand and Stars)

Which technology for an open Socratic school?

Guy Weets
European Commission
DG III

From scribe to screen

Against a background of trade globalisation, technological innovation and economic upheaval, every society is confronted with profound changes. Europeans must be prepared to cope with this situation and their education systems must help them to do so.

With the emergence of the information society, everyone must upgrade their skills constantly and obtain new qualifications. Tomorrow jobs are at stake, therefore it is important for the tools of the information society to be developed in new learning methods. However the new tools cannot be integrated into teaching practices until the teachers have been trained and teaching methods and systems have been adjusted, which is often a delicate exercise, so it is important now to develop not only the knowledge but the process of learning the tools.

Many teachers are ready to experiment with the new educational tools. The stage is set for widespread use of technology in education and training and we now need to create an environment conducive to its being disseminated through a range of concrete actions at European level to support national and local initiatives.

Political leaders at both Community and national level now realise how much of an educational and cultural challenge the information society presents.

In Europe and throughout the world many countries, such as the United Kingdom, Germany, France, Italy, the Nordic countries and also the United States and Japan, have recently launched initiatives to connect schools to communication networks, train teachers and develop software to meet pedagogical needs. The private sector is also gearing up to equip and network schools in partnership with the authorities.

A variety of research and pilot experiments have shown the value of information society technologies and multimedia teaching. As long as they are geared to people's needs these tools help them to acquire new knowledge and help to develop new, flexible customised and interactive learning methods.

How much technology for the school?

Andrew Folkmanis
European Commission
DG III

1. Introduction

Our society is changing more rapidly than ever before. There are many ways of analysing this dynamic and many factors clearly play a role. Technology is a tool which enables many things to be done faster. The relatively new autonomy of the individual, from democratic rights, to an economy that gives each person sufficient means to operate independently, mean that every competitive arena now has many more actors. And technology ensures that they are more capable than before.

Which technology? Technologies are many and have different effects, depending upon the functions we humans give them. Information technology (IT) is surely one of the most prevalent today, its influence is felt in most aspects of the working environment, at home, embedded into much of the machinery which surrounds us. Today, it does two things — firstly it enhances the functionality of devices, machines, systems, and secondly it connects devices, machines, systems and people. And it keeps on doing this non-stop. Every year, technical journals, echoed more and more by the daily press, write about what PCs and servers can do that they could not do last year, and about the cabling, Internet, World Wide Web and networks that have been put into place to increase the degree of networking in our world. The names of devices change, the focus of network enhancements changes, but the developments continue relentlessly.

We say this is changing our society, and we call it the information society. The main message of this nomenclature is that it affects everyone — it is for society, not just for some specialised groups of people or professionals. In fact, 'two-speed' information society, where some of the population would not have access to computing and networks, is considered a form of social exclusion.

There are a number of ways of expressing the role of the school in our information society. One is taken by the Commission's White Paper on learning, which describes the overall need of today's citizen for learning skills, knowledge and values. Within this framework, there are many specific learning needs, and some of them are associated directly with technology.

Industrial research is perceived to be a key component driving our economies. It is the process of creation of new technologies, and their transformation into devices, machines and systems, which provide the technologically enhanced tools for human activity, which in turn provide the means to create new wealth.

Two skill-sets are needed to ensure that this is useful and safe. Firstly the industrial research skills themselves need to be developed. Our universities and research institutes are the source of these skills, where they are created and nurtured, and used actively for technology creation. Secondly, usage and upkeep skills for the new devices, machines and systems need to be developed. This is necessary to assure that the technology is put to good, effective use and that it remains safe to human beings and their environment. These skills are learnt throughout the schooling and vocational training system, *tout au long de la vie.*

Both of these skill-sets need an underpinning of basic scientific and technological theory, and a sound understanding of how this technology manifests itself in practice. This underpinning is created by our scientific community, but needs to percolate into the basic schooling system, so that this knowledge becomes easily accessible as early as possible. This is one major challenge for our schools today. To absorb and make available new theory and knowledge, but also new practice, its associated skills and values, as it develops and, ever more rapidly, enters serious use in our economies.

The Web for Schools project is one of many projects in Europe networking schools using Internet and World Wide Web. It has begun to address these issues through a pragmatic approach — to put into place the conditions for schools to experiment collaboratively with the potential of these IT and networking tools.

2. IT in the school

Teaching and learning have a proud history. The title of this conference refers to the 'Open Socratic School' and points to the origins of teaching and learning. Over the centuries many methods for teaching and learning have been created and developed. It is not very easy to make a comprehensive list of them, as each discipline has chosen to take up and evolve these methods to their own needs. Some general types can be easily identified, and have been the subject of study by educational sociologists and psychologists: (oral, mental or physical) repetition (rote learning, training), for (simple) acquisition of facts, knowledge or physical or mental skills; experimentation, for deduction of theories and results from empirical observations; study, for deductive and inductive derivation of generalised theories about knowledge or method.

Some intermediate tools have become essential for these teaching/learning processes, beyond just personal interaction. Above all, paper and the book are the accepted means of exchanging information within the learning process, so much so, that as linguistic concepts, books and knowledge are very firmly linked to one another in our understanding.

The intermediate tools which are challenging the book, are electronic media. Already, cassettes, video tapes and television programmes have established themselves in this role. Today, computer-based teaching/learning vehicles, and the Internet/World Wide Web, are coming into the forefront of teaching and learning practice.

While the book, cassette and video tape, were relatively simple devices, needing some vital basic skills for usage (such as reading), there was no real technological challenge inherent in their use. With IT and Internet, this is no longer the case. They are tools which are potentially very valuable, but which require the teacher and student to master the technology. And, in fact, the basic understanding of this technology is an important and relatively new discipline in its own right — computer science or informatics.

Learning is often defined as the acquisition of knowledge. It is clear, however, (Kelly, 1986) that this definition is insufficient. The full learning process incorporates not only the acquisition of knowledge, but also the acquisition of skills and the assimilation of values. Different teaching/learning notions are associated with knowledge, skills and values. Knowledge is studied, skills are trained, values are experienced.

What has been happening over the past few years for IT?

Computer science courses are running in secondary schools across Europe. They offer a mixture of basic theoretical notions and (where possible) some hands-on practice. The main idea behind most school computer science courses is to impart basic knowledge about the discipline, to prepare those students with a potential interest for more intense studies at university. Knowledge is taught. What about skills and values?

Some schools are well-equipped for computing, meaning PCs in the classroom, some degree of networking among those computers at the school, and a means of entering the network outside the school (often Internet) available from at least some of the PCs. In these schools, this computing capability provides the backbone for computer science courses. Implicitly, hands-on experience imparts the skills for manipulating and working with a computer and with a computing network. And there is often enough freedom for pupils to have access after hours and to 'surf' the Internet for limited periods of time.

Nevertheless, a deliberate effort to run courses targeting computer and networking skills for the non-computer-scientist is rare. The result is that, in the student population as a whole, basic knowledge in computer science is growing, but practical usage skills are relatively low. The result is that universities (for disciplines other than computer science) and vocational training colleges have to fill this gap. School-leavers lag behind the world at large in computing and networking skills.

And the third aspect of the learning process, values? Computing is still thought of as a specialist discipline. Arguments for computer skills are acceptable and understood, as these are quite evidently required by further education and employers. But values? The discussion on the information society is just beginning to open our eyes to what this actually means. For some time, the effect of IT in the firm has been studied. It has been established that the effect of IT is profound. Not only are business processes made more efficient, but they change in their very nature, as new orders of speed and efficiency on individual tasks are achieved, and the business process itself can become completely transformed.

The debate about the information society postulates such profound change for our society and economies as a whole. And this means changes in the way humans interact, the way society's structures operate, based on power structures, on collaboration, on organisations, on groups and on the role which information plays. It influences the way our cultures are evolving, it is present in our art-forms and it affects our values and morals.

These changes are aspects of our scientific experience which are not captured in formal philosophical frameworks. They are not things which we learn from a book or with the aid of a teacher. They are things which are assimilated, by experience. So, the role of the school becomes one of facilitating this experience.

If there is a way for students to assimilate the new values associated with the information society, then the way to do this is by experience. And if the schools have the role of facilitation, then the school must offer the environment, including equipment, network, etc., for this experience to be a reality in the school environment.

This may sound rather unstructured. It may also sound rather like a revolution in social values. It is not yet certain that a revolution is happening. Whether it is happening or it is not, the role of the schools must be as an active actor within this change process, not as a detached observer of it. This means that it does not matter how much change in values there is — the school must facilitate the experience. And some form of structure will certainly be imposed on the way computers and the network can or cannot be used, to ensure that limited resources go as far as possible, and that it only occupies an appropriate part of school activity. This, too, needs to be in the spirit of these new tools, or it can act as an inhibitor.

Some schools have done this, and can be a basis for others to do the same. This does not mean that it is a model to copy in all its detail. These early attempts are experiments, and some things will work well, others less well. This is normal. Local cultures and traditions in teaching and school management cannot and should not be discarded overnight. Many of these characteristics will be the strength of a particular school and should be retained under all circumstances. But there should be easy access to these early experiences, and adoption should be an individual choice, of the school, its education authority or board of governors, and its pupils, parents and teachers.

And if this is not done? Again, a lag will emerge, of those pupils/students who have not experienced computing. And they will come into university or employment with very little understanding or patience for those special characteristics of the societal and economic values which apply. And values are much harder to assimilate, need more time and exposure to the phenomenon, than skills. So this lag will be more severe and take longer, more effort, to eliminate.

The learning process for computing is today incomplete. The lags in skills and values are real. And over time this situation will tend to worsen, the longer our schools do not improve this situation. Schools can cease to be the place where these values are imparted, where the skills for computing are acquired, once large numbers of the population begin to understand their children are lacking this essential aspect of education.

3. Web for Schools — An experiment (Van Assche, 1997)

The Web for Schools project is just one of many attempts across the world to network schools on the Internet. Its experience is useful to understand some characteristics of the way this lag in the learning process can be combated.

The Web for Schools project started by carrying out training in 'cyberskills' for 700 teachers, asking them to return 'to school', and create some educational material on the Web with their classes/extra-curricular groups, and meet periodically to compare what they had done. Choice of subject areas for the material and of partnerships/collaborations between schools was left entirely up to the schools, teachers and classes themselves. The project consortium channelled the funding to the schools and provided the training and organisation for the meetings and conferences, as well as support, help services and a common server infrastructure.

Web for Schools can be characterised as schools-driven. It was in the teachers' hands to provide the stimuli for the activity, which they of course did in close collaboration with the school directors, technical staff and of course their classes. The longer-term effects in the schools have yet to be assessed.

The funds provided to the schools were used for travel, computing equipment and communications costs. The travel budget gave the teachers and some pupils freedom to move and meet, to create partnerships and develop projects across borders, using the Web as the communication and also teaching/learning medium.

Focus at meetings and publicity events was on the results, i.e. the educational materials. The schools were encouraged to go for quality, and in fact some limited professional support was provided where this seemed useful. The result was quite high motivation and some elements of friendly competition. The centrepiece of the Dublin conference was a room with 21 project stands, each run by a group of schools, showing their results.

The computing budget offered the means to undertake experimental work, to create educational material. It filled gaps in existing computing at the schools. The communications budget allowed access and purchase of basic Internet services.

The World Wide Web is a computing and communicating environment in which it is easy to get started very quickly. The HTML language (used to programme Web pages, and much of the material made accessible at Web sites) is simple to learn and use. The corollary is that anyone learning HTML, has the need to start working 'hands-on' very quickly. The Web for Schools Web site was working within a few weeks of the start of the project and has supported the schools ever since. It is a single server, with no 'mirror' (copy) sites. Well-placed 'mirror' sites can improve access performance enormously during times of Internet traffic congestion, a frequent phenomenon.

One critique expressed about Web for Schools, is that there is no pedagogical approach underlying the Web for Schools activities. The project has intentionally left the choice of projects and pedagogical approach to the teachers and pupils active in creating educational Web material. Should there have been pedagogical guidelines in choosing and carrying out the projects? I personally doubt whether these would have been useful, and would argue against this in actions undertaken in the near future for the following reasons:

- I believe that the real value and best ways of using new media for education are not yet understood, so any guidelines would be unripe and untested.
- The approach taken by Web for Schools depends upon the will and motivation of the school, the teacher and pupil. This is where the benefits should be obtained, and the best way of achieving this pedagogicaly and organisationally, is to allow those closest to 'the action' to do it the way that best fits into their working, teaching and learning environment.
- The trend away from teaching/training and towards learning, that is autonomy of the pupil/student/learner should mean that knowledge about pedagogical method needs to be in the head of the learner, and course material, teachers/ trainers are chosen according the style of pedagogical method which any particular learner prefers. This style of learning has not yet been instituted in today's schools. Nevertheless, it does stress even further the need for 'bottom-up', i.e. learner choice of pedagogy, NOT pedagogy as a comprehensive guide to the learning process.

This does not mean that there should be no pedagogical observation of what has happened in the project. This will be part of the last phase of the project and can be extremely valuable in providing some insights into how the approach has worked.

Web for Schools has not attempted to address knowledge about computing. It has addressed the skills gap and it has also created an environment of experience which can, over time, result in the assimilation of the values associated with the use of computing. The way to do this, in a nutshell, has been simple — give schools enough resources to become active, do enough to motivate the pupils, teachers and head teachers (a minimum degree of training is probably necessary for this), and do enough to publicise the results, so that there is additional motivation for the most active.

Web for Schools has been for secondary schools only. The Web for Schools participant schools were a mix of schools which already had Internet links and where hands-on computing was already integrated into the classroom and curriculum, with schools whose computing was sparse and some who had no Internet access. But the existence of computing as a curriculum subject in the secondary school made starting the exercise easier, as the teaching staff and heads were reasonably familiar with computing. In the primary school, there are a few examples where computing and even the Internet is used, but we are just at the beginnings.

Some of the simple practical principles of Web for Schools could be reused in the primary school;

- the schools-driven approach is useful to overcome understandable scepticism on the part of the teachers and heads, while minimising interference in 'everyday business' at the school;
- training and meetings were a useful element and created the mutually supportive and motivating climate for the participants, and to focus the work;
- enough resources must be made available, so that schools can bring computing and communications to an adequate level;
- (not very substantial in Web for Schools and should be strengthened) a close assessment of what actually happens at the schools.

Web for Schools, like the many other single projects of this kind, has of course not resolved the much larger issue of resources for equipment and communications. A project funds once-off purchases and services for a limited period. Computing and communications, if deployed seriously in the school, become part of its everyday running budget. This needs serious attention from the schools' authorities.

Web for Schools spent ECU 3.5 million over a period of approximately one year. This is also the amount which the City of Helsinki is proposing to spend each year for computing and Internet in all Helsinki schools. The budget has been shown to be quite realistic and can serve as a reference for future projects.

4. The way forward

It appears that the way forward is conceptually quite simple. It needs the commitment of substantial budget to this effort, and it entails selecting and improving upon approaches which have been tried in practice. And there is at least one approach that one can fall back on, which is good enough.

The hard part, is the magnitude of the task (some 350 000 schools in Europe) and the need to have all interested parties pulling in more or less the same direction. The key factor of any selected approach is that it must succeed in motivating many parties with a common interest in improvements at the school. And thus provide to our pupils not only the knowledge, but the skills and values needed in our new, emerging information society.

5. Bibliography

- Kelly, A.V., *Knowledge and curriculum planning*, Harper, 1986.
- Van Assche F., 'Status of the Web for Schools project', *Context Magazine*, No. 17, 1997.

The application of information technology in education in Spain

Jaime Denis
Ministry of Education and Culture
Spain

Jaime J. Denis has been director of the new technologies programme since July 1996. The new technologies programme (http://pntic.mec.es) has the mandate of harmonising the curricular introduction of information and communication technologies in schools (informatics, audiovisuals, multimedia, telematics, etc.). It is also in charge of the participation of the Ministry in educative and formative national and international projects and has responsibilities in the launching of plans to take advantage of information and communication technologies in the teaching/learning process, including adult training. In particular, the Mentor project is specially relevant in the field of open and distance learning aimed at SMEs.

1. Introduction

The educational system in Spain when considered in large numbers (non-university education) consists of 7.5 million students, taught by about 480 000 teachers, in 20 000 centres. Some 72 % are State run centres and 28 % are private.

Spain is currently completing the transfer of resources to the various autonomous regions and this, of course, includes educational matters. From the 17 autonomous regions, 7 already have full control of resources in educational matters and the remaining 10 will by 1998.

Within the domain of direct management by the Ministry of Education and Culture, matters related to applied information technologies in non-university education are developed under the programme for new information technologies and communications run by the Secretary-General for Education and Vocational Training.

The programme for new information technology and communications was created 10 years ago and has a long and productive history in the design and materialisation of educational projects using information technologies. During this 10-year period, 3 000 educational projects have been carried out. This resulted in the installation of 25 000 sets of computing equipment, 4 800 sets of audiovisual equipment (videocamera, video-recorder and on-line editing equipment) and 30 000 teachers have been trained to use information technology in the classroom.

Within the field of direct management by the Ministry of Education and Culture, these education projects have reached 80 % of secondary education centres and 30 % of primary education centres.

Although Moore's law is apparently favouring us, continual efforts must be made with budgetary matters. Investments made in information technology have a very short life-cycle due to technological obsolescence and every year, together with new equipment, one must direct a substantial part of resources to updating previous programmes and equipment.

Similar actions are being carried out through parallel departments attached to the education councils for the autonomous regions who are fully competent in educational matters. Coordination is assured by frequent contacts and periodic meetings during which experiences are exchanged and lines of action are synchronised.

2. A new conceptual framework

The setting within which these procedures are being developed, is rapidly changing. These changes are particularly relevant on three levels: technology, human resources and organisation, and financial resources.

2.1. Technology

The first area of analysis is the evolution of the technology itself. By imagining and predicting, within reason, the framework for these activities over the next few years, it will no doubt be possible to take the most adequate decisions. With respect to technology, there are various lines of thought:

- ***The convergence of information media***. Texts, graphics, feasible projects, images, sound, video and television are all processed in digital form and with tools that are more and more powerful and integrated. This concept should notably vary the way in which products and services are nowadays generated and distributed.
- ***The gradual increase of the band-width of communications***. The opening of the integrated services digital network into more extensive territory, combined with the availability of a large number of digital television channels, will provide, in the short term, band-widths that carry new kinds of applications in educational matters.
- ***Global connections through Internet***. Access at city rates and from any point in Spain, to servers of integrated information on Infovia-Internet, is a vital change as the ' distance factor' is eliminated.
- ***The loss of technical paramountcy faced with growing importance of content***. In a very competitive market for physical and logical equipment, technology is no longer a barrier to entering this market. The battlefield for the survival game is the content. The capacity to create innovative contents is closely linked to the speed at which an organisation learns.

2.2. Human resources and organisation

The second level of reflection concerns the variation of the organisational structures within which we work and which are marked by five distinct tendencies:

- ***The progressive transfer of powers from the Ministry of Education and Culture to the autonomous regions***. A substantial proportion of the procedures currently being run under the programme for new technologies, will be implemented by the various autonomous administrations over the coming months/years. Our role as financial backers for the infrastructure will be taken over by suppliers of value added services for the educational environment.
- ***The need for coordination between education administrations***. Complex organisations require intense levels of coordination to be efficient. Agreeing on objectives and projects with other departments of the Ministry of Education and Culture as well as with the autonomous regions, is vital if duplication of efforts is to be avoided. Sharing methods and information resources and being orientated towards teamwork amongst people from different organisations, values that are deeply rooted in our organisation's work ethic, provide an obvious advantage.
- ***Geared towards functioning as a network***. The participation in national and international projects as well as coordinating with the autonomous regions, shows that no administration or department works in isolation. One must cooperate and interact in a very dynamic and flexible way with other organisations. Therefore, the programme for new technologies must perceive itself as an extended organisation by opening its structures and procedures to allow efficient interconnections with these organisations.
- ***Life long learning***. The speed at which new knowledge is created is explosive and its impact on our lives is extremely important. The paradigm of training for a few years to apply the acquired knowledge for the rest of our lives has simply disappeared. We will, probably, throughout our lives change profession several times. We should therefore be conscious of the fact that learning is a life long task to which one should dedicate an increasing amount of time. Long-distance learning, based on the use of information technology, will play an increasingly relevant role.
- ***Increased online activities***. Perceptible human resources will become gradually more scarce. This decrease can be compensated for by part-time tasks backed by information technology. This creates a virtual organisation of knowledge at the service of the world of education, an organisation open to learning and to generating an environment that favours learning.

2.3. Financial resources

The third aspect to be studied in depth is the budget. There are three tendencies which will probably be consolidated by the following practical exercises:

- ***Restrictive budget***. The overall budgetary discipline of reducing the public deficit in order to comply with the criteria for convergence with the most advanced countries of the European Union will have a direct impact on the actions foreseen by the programme. This restrictive policy does not look set to change over the next few years.
- ***The transfer of resources to the autonomous regions***. The programme for new technologies has regionalised part of its budget and this, along with the related powers, will be transferred to the autonomous regions.
- ***Financial cooperation between other entities and the different administrative bodies***. It is always difficult to define exactly what resources are allocated to the education sector. In an environment of various different powers, the financing of initiatives must be approached from a joint front. Financial cooperation with other departments of the State administration and the autonomous regions, the European Union, international organisations, Latin American countries and private entities, is fundamental to maintain and stimulate the level of action of the programme for new technologies.

3. General objectives

Due to the previously outlined situation, the Ministry of Education and Culture has re-orientated itself with respect to applied information technologies in the hope of anticipating further changes. Consequently for the school year 1996-97 the objectives are as follow:

1. To redefine the existing lines of action in accordance with technological trends and possibilities, the organisational framework and financial means.
2. To reinforce the creation of innovative products and services, consequently maintaining the lead in the application of information and communications technology to educational matters.
3. To generalise the usage of tools for accessing information and interpersonal communications offered on the Internet, with the help of effective connection to the network by all educational centres.
4. To reinforce educational television by strengthening its financial structures; to improve the degree of coordination between actions and the enhancement of the transmitted contents.
5. To increase the participation of the programme for new technologies in national and international projects; to promote collaboration between other institutes, especially with other departments of the Ministry of Education and Culture and the autonomous regions; to strengthen the level of communications outside the programme procedures.

4. Current actions

To achieve the outlined objectives from the previous point, the programme for new information technologies is developing procedures along the following lines:

4.1. Infrastructures for the Society for Information in Schools

- Access to Internet for all educational centres
- Throw us a line! Lend us a hand!
- The Society for Information in Schools. The school library
- Digital video

4.2. Hypertext contents of educational interest

- Web for centres
- The virtual library of PNTIC
- The Mediatec
- The Programotec
- News service on electronic mail
- Practical offers in companies
- Databases of classroom experiences
- Access to databases of educational interest
- Digital press for the education sector

4.3. Educational multimedia on CD-ROM

- 1997 edition of CD-ROM PNTIC
- Multimedia 'Spanish is easy'
- Multimedia 'Physics: energy'
- Multimedia 'Archaeological museum'
- Competition in multimedia creations

4.4. Educational television

- Latin American educational television association
- Educational television observatory
- Monitoring of the agreement for self-regulation for television

4.5. Long-distance learning

- Course 'From the key to the computer'
- Mentor project

4.6. Participation in European projects

- European telematic network for education
- Trends
- Web for Schools
- G7 Tel*Lingua

4.7. Special attention given to diversity

One of the most emblematic and gratifying tasks of the programme for new technologies, is the application of computing and communications to special educational needs. The foreseen actions in this field for the school year 1996/97 are the following:

Awareness, information and training

Create a long-distance course for teachers on the application of information technology to special educational needs and participate in different seminars, giving courses. Channels of communication with those in the teaching professions will be reinforced through the updating of databases in centres for special educational needs and through the management of the notice board for attention to diversity situated on the hypertext

server of PNTIC. Activities will also be carried out to motivate the interest of private companies into searching for solutions.

Detecting solutions for special educational needs

The search for solutions for special educational needs will be realised through two actions: the national educational software competition run by PNTIC and the identification of physical products and commercial logics.

Push the cooperational development of technical solutions

Through the participation of the programme for new technologies in different projects: Lecto-writing learning systems (ALES), multimedia systems for reinforcing cognitive development (Podeco), rehabilitation of the voice and speech (Hispavoz) and finally the project teletraining for rehabilitation therapists (Teleformacces).

This year, participation in European projects will be centred on long-distance training of people with severe handicaps, using the Internet and by means of an agreement with PROMI to realise a project within the framework of Horizon II/Edit.

Virtual reality: A new tool for an open Socratic school

M. Lurdes Morais Camacho
Ministry of Culture
Portugal

Since October 1996, Maria de Lurdes Andrade Silva Morais Camacho has been active in the Iniciativa Mosaico of the Portuguese Ministry of Culture. In this framework she works as adviser in the areas of multimedia, educational communication and technology and virtual reality and education in the projects Sta. Clara-a-Virtual and Sacra Saturni (virtual reconstructions of a medieval feminine monastery and of the Cape of Sagres). She is also member of the coordinating group of the workshop Sagres and the navigation of electronic seas, along with Derrick de Kerckhove, Allucquère Rosanne (Sandy) Stone, Bruce Damer, Leonidas Ferreira and Paulo Pereira. She represents Iniciativa Mosaico from the Ministry of Culture in the consortium of the Portuguese MIDAS-NET node.

In the past years we have been witnessing, all over Europe, the spread of information technologies. Depending on the countries, they have started being part of our daily life, at home, at work, at school. The magic of communication, through images, sound and text, transformed the world into a global village or, like some people prefer to say, glocal, mixing the global with the local into a new time-space dimension. In the educational domain the integration of these technologies is inevitable, and upon its successful incorporation the future of education in the information society may depend.

1. The introduction of information technologies in the Portuguese education system

In Portugal, the preparation for the information society in schools at an institutional level started with a major national project called *Minerva (Meios Informáticos no Ensino: Racionalização, Valorização, Actualização)* that ran between 1985 and 1994. Its aim was to promote the introduction of and research on information technology in primary and secondary education and involved universities, polytechnics and primary and secondary schools.

It was an experiment with an overall positive balance, although a lot remained to be done. More than 50 000 teachers have attended in-service training sessions, with more than 100 000 students attending classes and workshops regularly. At the primary level only 335 schools have participated in the project, about 4 % of all primary schools. The number of computers per school and the peripheral devices normally used varied, but the worst equipped were the primary schools. The financial investment was channelled in priority to secondary education and the primary level was progressively abandoned.

2. The present situation — the way to the information society

Today the situation has changed. The growing number of computers, namely those with multimedia capabilities, the growth of subscribers to Internet service providers, the number of daily accesses to Web pages, the boom of Internet surfers and the arising of small nets in different areas prove that, besides all the problems, the way to the information society is being prepared. In some schools interesting experiences are taking place, such as the use of telematics for distance communication with foreign schools; better or worse equipped resource centres are being created at schools and, at an institutional level, decisions are being taken aimed at the launch of information society in education.

In the present year, by decision of the Ministry of Science and Technology in collaboration with the Ministry of Education, all public and private schools will have a multimedia computer with Internet access. These schools, along with public libraries, will be interconnected by means of the scientific national net. The Green Paper on the information society (under preparation) defends the existence of a multimedia computer in every classroom by the year 2000. Some weeks ago a new programme for the development of the educational system through the use of information technologies was launched.

The government concerns in this area are the result of some kind of social pressure. Outside primary and secondary schools the situation is quite good: industry, entertainment and home markets are experiencing a strong growth, research and development at universities reached a good level and the interest shown for information technologies is higher than ever. By the end of 1996 more than 150 000 people were connected to the Internet and 6.8 % of the population had access to it. Preferences went to Web surfing, followed by e-mail and then files transfer and newsgroups. Magazines, newspapers, TV and radio reflect this growing demand and they try to provide the information people are looking for through articles, programmes, debates, free CD-ROMs, etc.

But the community feels that schools are not following up this general tendency and its demand for action is the origin of some recent multimedia industry development and government decisions. Initiatives inside ministries such as the Mosaico initiative, a transversal project within the Ministry of Culture that has the Portuguese culture in the information society as its field of action and collaboration or the national initiative of producing a Green Paper on the information society are examples of the institutional response.

In the educational domain there's still a lot to be done but we hope that the abovementioned projects and many others can be the first steps towards an open Socratic school in the information society.

3. Virtual reality — a new tool for an open Socratic school

Virtual reality, due to its characteristics, can become an important educational tool in the information society. Virtual reality is a technology which allows the user to be immersed in a three-dimensional environment created by the computer. Inside the virtual world he can see (using a head-mounted display (HMD) or other device), hear (by means of headphones coupled to the HMD) and manipulate objects using devices like datagloves which transmit him the tactile feedback he needs to feel the world. A tracking system calculates the position of people and objects and orientation inside the world, and interaction in real time is possible depending only upon the power of the equipment in use.

For group experiences other systems exist, such as the CAVE (cave automatic virtual environment), which provides a group of 10 to 12 people with a semi-immersive experience, through the projection of three-dimensional images onto four screens that almost surround users.

3.1. The added-value of virtual reality in education

Virtual reality is a powerful and versatile technology but generally misunderstood. For most people it is associated with games and/or military uses. The truth is that today virtual reality is being used in different areas such as scientific visualisation, telecommunications, medicine, design, architecture, training or handicapped people rehabilitation. The advantages of its use are being recognised by many people.

In the educational domain it is already a working tool at a few schools and laboratories and some applications like, for instance, historical reconstructions or chemical simulations can help to teach students about situations or phenomena they would not understand in another way. It is a technology that reveals a strong potential and for teachers who seek new tools to improve education, virtual reality is a technology and a medium they must be aware of.

Despite its versatility, virtual reality will not replace the existing technologies and tools. It is a strong new one that, like the others, should be at the disposal of teachers, for them to use in the situations they consider appropriate.

There are several reasons for using virtual reality in educational environments, namely in primary schools: practical reasons (to save time and money or in dangerous situations) and instructional reasons (ease of changes in timescale, motivation, discovery learning).

Besides these reasons we cannot forget that virtual reality is not to be used in any situation. Its use must be pertinent, relevant, consistent with users' language, congruent with other media and specially unique, which means you should use it only when you know you cannot do better with other technology.

All teachers know how important motivation is for students learning and how difficult it is, sometimes, to get that motivation. When you enter a virtual environment it is an adventure that is beginning and this sense of adventure, the challenge of this game can be very important for most students to get motivation. So, entering a virtual world can be the first step to get children's motivation. But then it must be kept. Inside a virtual world children discover things, objects, lights, rules and through this discovery they learn, with the help of teachers, a discovery process of their own. They do not receive information and knowledge only from the teacher — a second-hand knowledge. They make the discoveries by themselves and the knowledge they build, because it is based on a first-hand experience, will be more solid and longer lasting. But this is not an unsupported discovery, which would not be a fruitful way of learning, specially for young children, but a guided discovery. In a guided discovery learners receive hints about the rules they have to discover and it is more difficult failing to find what they have to discover.

This construction of knowledge made by students is also based on the practice they have to experiment. In a virtual world objects can be grasped and manipulated, virtual objects can be transported as in the real world and in some way this capability gives back the sense of direct and personal manipulation computers were, somehow, taking away.

A virtual world is a world that only exists inside a computer's memory and this way it can be created just as man wants it, similar or not to the real world. This adaptability and flexibility are two of the biggest trumps of virtual reality. Man can build an environment suited to his needs or to the needs of its future users, the pupils. He has, then, the power to control time and space. In a virtual world students can learn by doing, experiments can be repeated the necessary number of times until the user has learnt what he should or acquired the skills he was supposed to.

A virtual world is a safe world where accidents can happen without harmful consequences; everything is under control and dangerous experiences in the real world can take place inside a virtual environment in a safe way. Within these safe, timeless and adventurous worlds error loses its condition of stigma. Now children do not fear failure any more and through the analysis of their errors and studying repeatedly their own behaviour, students learn why they failed and what they should have done to succeed. So error acquires an educational value and becomes a learning tool.

Having the possibility to create any environment, man is in control of space and has the chance to build foreign and distant worlds, places that no longer exist or have never existed; microworlds where rules are established by teachers in order to show or to teach something to students.

If creation of space can be controlled, it will be possible to design worlds suited to children's particularities: their age, their learning rhythm, etc. The same happens with the building of worlds specially tailored to handicapped students: an environment where blind children can learn and 'see' by hearing and touching, where deaf children can 'hear' watching and manipulating, where a paraplegic can 'move' around although in a virtual way. An environment where colours, lights and sounds can be changed, reinforced or minimised according to the learners' capabilities.

In a world suited to their needs children can develop skills and more easily overcome difficulties. Information can be presented in different ways, making complex ideas and abstract concepts more easy to comprehend since they can be translated into a visual, auditive or tactile language more clear for children to understand. This way, a virtual world can act as a pre-chamber to conceptualisation, where children can develop deductive skills. Creativity, communication, analysis, criticism and verification of hypotheses are other skills whose development can be also promoted with the use of virtual reality.

A virtual world can also be considered as a kind of zone of proximal development in a Vigotskyan way. With the help of virtual reality children can do things they would not otherwise do only by themselves; with this technological support (and teachers' help too) students can overcome this stage of development and jump into another one, in which he or she can develop new skills and learn by him or herself.

Richer and more integrated learnings can be obtained in multidisciplinary worlds, created with the contribution of experts from different areas (computer science, design, psychology, pedagogy, specific curricular subjects such as mathematics, history, geography, etc.). For teachers, participating in the creation of these worlds represents a valuable experience, since the exchange of opinions, ideas and suggestions, the cooperation with colleagues and the additional knowledge from different domains, enriches each one of the participants. For children, the contact with multidisciplinary information aids in the understanding of the existing relationships between subjects, facilitates the building of a more complete and global knowledge, consentaneous with the multiplicity of the information society we are being integrated into.

In a virtual environment children's senses are educated or re-educated; vision, audition and tact are used in a different way inside a virtual world, even if it looks similar to the real one. Students must pay attention to all details, be aware of all cues in order to understand and navigate inside it. In this way, since senses must be more accurate than in the real world, they are more stimulated, refined, re-educated.

Contrary to what many people think, virtual worlds do not have to be lonely worlds; on the contrary, one of the educational values of virtual reality is precisely its capacity of creating shared virtual environments. Today, with information technology we are able to communicate with distant friends and to work with distant colleagues in real time. With virtual reality this capacity can go further since in a shared virtual environment, for work or for leisure, participants can see and interact with one another through their representations, called clones or avatars. This way virtual reality can bring to distant communication some features from face-to-face communication that no other technology can transmit such as facial and body expression. Within this scope, the evolution of VRML (virtual reality modelling language) will be of great importance. VRML being a specific language for Internet, applications developed in each country can easily be accessible to teachers and students in other countries, enabling a living interaction, the development of cooperation and the chance to implement global and transnational projects. VRML will give distance learning a new dimension and we can foresee, maybe in a not so distant future, immersive distant communication, accessible at low prices, allowing hundreds of people to interact, in real time, inside the same virtual space.

In a shared virtual environment collaborative work can be developed in a richer way; children can have contact with colleagues, other teachers, experts or friends living far away and cooperate with them to have richer results. Along with the richness of the interdisciplinary approaches, distant cooperative work will facilitate intercultural exchanges, enlarging horizons and preventing, from childhood, racist and xenophobic behaviour.

3.2. Some implementation possibilities

The use of virtual reality in educational environments does not minimise the role and importance of teachers. On the contrary, teachers become even more important than in traditional education but in a different way. Teachers are no longer the masters who know everything nor the main vehicles of information. They are, or should be, most of all, friends, colleagues, companions, tutors, who work with their students, helping them in their discoveries, their problems, their building of knowledge. Specially for children, teachers are a valuable help in their learning process; teachers are not only models, anchors, friends, but also guides that help them on their first steps towards information society.

For the use of virtual reality teachers need specific training, initial and continuous training; they have to learn how to use the technology, how to integrate it in the educational domain and how to obtain the greatest gains from of its use to the benefit of their students. It is not virtual reality itself that makes the difference but the way it is included in the teaching practice, the way teachers articulate it in the teaching and learning process. But teachers, in most cases, need to be convinced of virtual reality's educational value, just as happened with the use of other technologies. They have to realise benefits it can bring to them and to students, the added

value it can produce. First of all, to be convinced teachers must know that virtual reality exists, how it works, how it can be used and what for, how they can get the necessary training, vital to the successful introduction of virtual reality into schools. To achieve this we need to find the best ways such as books, conferences, exhibitions, demonstration sessions at schools and other appropriate actions promoted at an institutional level. European cooperation is crucial. All over Europe there are examples of good practices that should be known by all those concerned with these issues. Local and particularly successful experiences may be important references to teachers seeking ways of promoting information technology and particularly the use of virtual reality within educational environments. Cooperative projects can be developed, enriching each partner with the contributions of others.

Another very important point is how teachers can obtain the necessary equipment, taking into account the normally low budgets schools usually have. How can schools, specially primary schools, be equipped for the use of virtual reality? The general idea is that virtual reality is an expensive technology, too expensive for schools to afford it. It is true that high-end workstations and even middle-range systems are expensive, but it is possible for low budget schools to have access to low-end VR systems, based on PCs and using simple software, easy to get and to use. The fall in prices that hardware has been experiencing over the past years — a tendency that will be maintained or even accelerated — will facilitate the access to the necessary equipment. But even to buy simple devices, more money than usual must be spent, but the added value virtual reality brings to the teaching and learning process justifies the expenses.

At the same time, interdisciplinary environments cannot only transform learning into a richer, deeper and more global process, but they can also be a good way of saving money, since a single virtual world can be used for different curricular disciplines.

Another way for schools to get the necessary equipment may be, for instance, from the support of industry. Some companies may be interested in placing their equipment inside a large number of schools for free, having as compensation a growth of sales in a short time due to the demand coming from children asking their parents to have at home a PC and other devices similar to those they use at school. A good example of this kind of industry support was NetDay 96 in the United States, a project to establish Internet connections in classrooms and libraries at different schools. The project had the support of the telecommunications and cable TV industry as well as America on-line, Microsoft, Cisco systems and others, who finally discovered that children can be a good investment. If European industry had the necessary intelligence and wisdom, it would invest in schools, since education, even more than information, will be in the future, more precious than gold.

The support of the surrounding community is also very important for the success of the experiences of using virtual reality at schools. Citizens must understand the added value of VR for teaching and learning and a good way of showing it is to open school doors to the community, what I call an open school project. Some parts of the buildings and some equipment can be used at the end of the day or at weekends by teachers, parents and other persons for education, training and other activities, to the benefit of the community. Experts in different subjects, educators and other people, inside and outside the community, in open activities or in more formal classes could place their knowledge and their skills at others' disposal in an open school (physically and mentally), a concept which will be of great importance in the information society.

It is important to bring into schools a technology that within a few years may be a constant presence at home. As happened with TV, videos and computers, children can familiarise themselves with virtual reality through home games where the educational element is absent. Since technology exists and children will become acquainted with it, it would be a wise decision to try to master the educational value of virtual reality and use it to benefit education and the educational industry.

To prepare children for virtual reality from childhood can be a way to prevent a possible type of digital unalphabetism. In the future, many students may have the opportunity to use virtual reality at home, but for those who have not, school must provide them with the skills and tools they may need in the future. Some children of today will be tomorrow's teachers and schools should prevent the gap that surely will exist between students of the next 20 or 30 years who will be brought up in the information society using virtual reality; and teachers who grew up by the end of the 20th century without information technology.

School has the obligation of preparing children for the 21st century, promoting the development of skills vital for the competitive world of tomorrow. If we were not taught at school to read and write, who would buy books?

3.3. Two Portuguese projects for architectonic heritage

In Portugal, apart from the entertainment industry for which virtual reality is not of great interest, some laboratories and research and development centres, specially inside universities, are developing projects involving virtual reality, not specially for children or even with strict educational purposes but with important educational features. The Mosaico initiative from the Ministry of Culture, with whom I am working as an educational adviser is involved, with other partners, namely the Portuguese Institute for the Archaeological and Architectonic Heritage, in two projects that aim to make use of virtual reality for the reconstruction of architectonic heritage. Along with the virtual work other applications will be developed such as CD-ROMs (reference titles and games), Web sites and three-dimensional sites.

One of the projects is aimed at the reconstruction of a medieval feminine monastery in Coimbra called Santa Clara-a-Velha, that floods from the Mondego river have kept submersed for hundreds of years. The place is now being excavated with the help of powerful pumps that extract the water 24 hours a day. Many important discoveries have been made, historically and architectonically valuable discoveries such as the main cloister in a remarkable state of conservation, graves and remains from different stages of occupation; findings that make this place and its excavation method a unique archaeological experience. But there is no solution for the water infiltration and the pumps cannot stay there for ever; so, within a few months, at least part of the convent will be submerged again. So the virtual reconstruction of the monastery is the best solution, allowing the building of structures and space relationships that will physically disappear from our sight. Different models of the monastery will be made, models from different centuries, giving visitors the chance to make a magical trip in time and space. The technological work will be developed by the Centro de Computação Gráfica from Coimbra, which has already a long experience in working with virtual reality.

The other project is the reconstruction of the Cape of Sagres, a mysterious place for hundreds of years and from where the Portuguese navigators sailed on the 15th century. The reconstruction will provide users with historical, cultural, environmental and many other interactive approaches. Trips in time and space will be possible, users travelling from prehistoric occupation to the restoration projects from the 1950s and 1960s of this century. The virtual reconstruction will be made by the Environmental Systems Analysis Group from the New University of Lisbon, a group that has been using VR within the environmental area.

These projects intend to use the CAVE system, allowing groups of persons, pupils and teachers, to have an unforgettable shared virtual experience although semi-immersive. Thanks to the magic of virtual reality, small groups of visitors, led by a guide, will be able to visit and explore the visible and the invisible of these places. Each group can have the most appropriate guide, who will adapt his explanations to the characteristics of the visitors: heterogeneous groups, specialised visitors such as historians, archaeologists or architects, children from primary school or students from other levels of education. Particular attention will be given to students for whom the exploratory adventure, appropriate for the age group and for the educational level, will contribute to the attainment of new knowledge and the development of affective and cognitive skills that a shared but personal experience will make sounder and longer lasting. The personal results of the experience of each visitor will be recorded through the response to a survey that must be simple and approachable but pertinent and consistent. The data coming from the opinions of the students from different educational levels, teachers and the public in general will allow the carrying out of an initial evaluation of the experiment, aimed at correcting errors and improving the system. Along with this, the feedback of persons connected to the area of education will make it possible to obtain important elements of information related to the use of virtual reality in an educational context that will allow evaluation of its relevance for carrying it out in the future. The educational value of this kind of use of virtual reality is obvious and within this experiences teachers keep having a vital role, preparing the action, accompanying children inside the world and working to obtain the best results to the benefit of pupils.

Besides all its potential, virtual reality is not a miraculous formula to change education and make schools, all of a sudden, the wonderful places we would like them to be. There are still many problems to solve: technical, ethical, social, cultural and psychological; problems that still prevent virtual reality from becoming an available technology. For some of these obstacles it is just a question of time to solve them, but we all know that change only occurs when there is a strong will for it to happen. Education is a very sensitive area and new tools are frequently difficult to make acceptable and integrated. Virtual reality has a great potential in the educational domain. It can be a powerful working tool for teachers and students to facilitate the establishment of a new educational paradigm; a paradigm that shifts from transmission to appropriation of knowledge, from simple training to cognitive development, from rules to practices, from solutions to problems; where skills to transform data into information and information into knowledge are the key elements; a paradigm that faces education as a dynamic and creative process, that places students in the centre of teaching and learning activities, considering them autonomous and complete beings, capable of constructing their own knowledge.

Virtual reality is neither the Wicked Witch of the West, sending her technological flying monkeys against little children, nor the fearful Wizard of Oz, with no body, arms or legs, capable of great miracles from his large green throne. It is more like the magic silver slippers that take Dorothy back home or like the little old man behind the Wizard's curtains, a human being using an interface to produce the magic of make believe.

Behind technology there is always man as behind schools there must always be teachers; teachers who should be aware of technological developments and of the arising of new tools that may be of great help in their daily struggle for a better educational system.

Virtual reality can be one of these tools, a brick for the new walls of an open Socratic school, a piece of the Yellow Brick Road that leads to the information society.

Training in new technology for the 21st century in the service of society?

Jean-Bernard Viaud
Chairman of EPI
France

Since 1985, Jean-Bernard Viaud has been working part-time for Mafpen, a French teacher-training body, at Versailles, in a role combining teaching, developing educational software and providing training in information technology and audiovisual methods, and has been running a resource centre on the use of new technology in teaching. He has been General Secretary of EPI (a body concerned with information technology in State-sector education) since 1994 and its Chairman since 1995.

I should like today to speak on behalf of EPI. Statements made at EPI's general assemblies show that, for the past 25 years, it has been campaigning to have new technology integrated into the education system and into initial and in-service training for teachers. I would refer in particular to a number of (French-language) EPI documents: *Pour le développement de l'informatique pédagogique dans le système éducatif* (1990); *Pour une culture générale en informatique à l'école, au collège et au lycée* (1992); *Pour une évolution du système éducatif à l'aube du XXIème siècle* (1994); and *Un défi et une urgence pour le système éducatif: intégrer les technologies modernes* (1996).

1. The current situation

As far as the French education system is concerned, we cannot put forward proposals or recommendations without first assessing the current level of integration of new technologies. EPI's work means that it has the satisfaction of pointing to growth in educational programmes integrating developments in information processing and new technology into the education system. It is true that there have been major innovations and achievements on the ground, yet in most cases these are attributable to local or individual initiatives or, in a few cases, to organisational initiatives. A number of projects are under way, being considered or scheduled, including:

- The development of Renater, which aims to achieve the networking of all secondary schools in France by the year 2000 (currently, 1 000 out of a total of 10 000 are networked). This plan makes no reference to some 6 700 000 pupils at 53 000 primary schools beyond the availability of a website on the Edutel network which makes it possible to consult the documents on official curricula; there are, however, several hundred schools on this network, including the 'Réseaux Buissonniers de Vercors', but these remain localised.
- Provision of help and support on the Internet by means of the promotion and standardisation of open-access pedagogical resources and teaching materials on the Educasources network. The development of this service by the French Ministry of Education's Department of Scientific Information, New Technology and Libraries is still at an initial stage and is being coordinated by Andersen Consulting, which is to launch a pilot version.
- The multimedia operation of France's Channel 5 television station which, once it is operational, will offer subscriptions to hard-disk provision of digitalised educational broadcasts on satellite.
- France Telecom Multimédia, through its subsidiary, Citcom, is developing a range of products and services, distance access to pedagogical resources, creation and dissemination of multimedia support, communication across institution-based networks, and interactive lectures.
- Experiments with interactive television (CNED) in which 20 schools have taken advantage of distance-learning options for such languages as Arabic, Chinese, Italian, Portuguese and Russian.

- The Socrates and Comenius programmes and the information superhighway.
- However, the money available is not yet adequate for the job needing to be done, since programmes, support and resources all need to be developed substantially. For example, the Official Journal of 13 February 1997 defines the outline of the four-year plan for in-service training of school teachers up to the year 2000 but without reference to the use of information and communication technology.

There do seem, then, to be signs of growth, yet the overall picture remains fragmented and insubstantial because of the lack of an adequate voluntarist policy on training, equipment and software. Declarations of intent and official documents are of little use to untrained or under-trained teachers who, moreover, do not have access to the relevant equipment.

Despite some progress and the enthusiasm raised by warm words, then, schools are changing too slowly, and the media regularly — and quite justifiably — criticise the schools' 'enormous need for information technology' and the inadequacy of the budgets, the hardware and curricula. Of the total of FRF 1.1 billion made available for a programme called 'A new contract for schools', only FRF 20 million was devoted to new information and communication technologies, with the bulk of the money being spent on construction, refurbishment and security, among other priorities. It should not, therefore, come as a surprise that a recent survey showed that between 60 and 70 % of teachers in France never, or only very rarely, use information and communication technologies. The reasons cited centre largely around inadequate training.

- There is a problem with initial teacher training in IUFMs, the university departments providing teacher training, where new technology is not built into courses and is therefore not assessed in examinations, while documents and recommendations dating back to 1986 have never been implemented. Official documents covering 1995-99 devote only 18 lines over 12 pages to new technology, and even these are aimed only at raising awareness, not at encouraging teachers to make use of technology in teaching nor even referring to how it could be used. There are one or two modules on offer, but these are optional. The findings of a survey carried out by the quality French daily, *Le Monde*, of young teachers graduating from such institutions show clearly that most newly qualified teachers simply reproduce what they themselves have learned and that most of them are less skilled than are older, more experienced teachers at developing innovative use of new technology.
- Meanwhile, in the area of in-service training, the number of special training centres providing intensive one-year courses has been reduced steadily since 1986 and as a result the number of skilled trainers has also dwindled. At the same time, the funding for Mafpen training centres has been dramatically reduced on several occasions, with some centres even having their funding withdrawn totally. It is impossible for teachers to be trained and sceptics to be convinced if in-service training is restricted to three days a year (with the courses chosen from a pre-set range and subject to the approval of the head of the school concerned), if courses are often inappropriate because of inadequate advance planning, if the participants come with a range of needs that have not been adequately identified in advance, and if the outcome is not properly evaluated and accounted for and not followed up.

The emphasis on information and communication technology in official curricula is inadequate, and even non-existent in some cases. Such curricula do little to encourage use of new technology overall, and in some ways are less forward-looking than in 1985. For example, in the new curricula for 11- to 16-year olds, only two lines out of 112 pages on foreign-language teaching refer to new technology, with reference to the fact that CD-ROMs can be used in the teaching of Portuguese.

As far as hardware is concerned, there is both a quantitative and a qualitative shortfall: there are only around 400 000 computers for some 13 million pupils (compared with 2.5 million computers in individual households), and of these, more than a third are out of date.

In the area of software availability, the problem is often that of a vicious circle: schools have no hardware because there is no software, but they have no software because there is no hardware. The education market is not buoyant since, among other things, it is underequipped. As a result, games-based educational software, often from the United Kingdom or the USA, has become the market leader and is concealing the pedagogical inadequacy of multimedia products that are often little more than barely interactive videos based on binary choices. Marketing has won out over educational quality.

Finally, we have to acknowledge that one of the factors limiting the integration of new technology in schools is the suspicion, or even reluctance, of some teachers. There are various reasons for this: some are not convinced of the effectiveness of machines, especially where human teaching methods have failed (although they are wrong, since experiments conducted in deprived suburban schools have shown that computers can be a way of motivating or remotivating pupils with little or no inclination for academic work), while others are scared of a tool of which they do not feel in control or else fear losing status and even, in the worst case, their jobs. Yet others were disappointed by the 'information technology for all' programme launched in 1985; this aroused enormous enthusiasm, with 100 000 teachers taking a one-week course and a further 300 000 having to be turned away, but was very costly and failed because it was over-hasty and the materials used were too piecemeal. Finally, there are those who are conservative about such innovation.

However, we should beware of considering all those who are reluctant as backward-looking or diehards wedded to the methods of the past. Indeed, their reluctance is one of the key difficulties to be overcome in convincing them to change their methods. The rhetoric surrounding new technology is often euphoric and powerful and presents new technology as a tool that will cause upheaval and radical change in short order. Teachers reluctant to embrace it portray themselves as realists and question the precise, concrete achievements that can be attained with the new technology, some even wondering whether technology is not a liberal Trojan horse invading education or whether it really offers the opportunity to achieve a little more social equality. These colleagues imagine a threefold scenario unfolding: schools without teachers (and it should be borne in mind that in France, one in two government employees is a teacher); the breakdown of the school's role in socialising children by breaking up traditional groupings; and privatisation of education, with each pupil sitting at home in front of a personal computer. At the same time, they are also questioning what information is and what knowledge is, and I shall return to this aspect later, when I talk about the Internet. These colleagues are those who point out that the first technological revolution, the invention of printing, has not yet become universally available to all, with five million French citizens unable adequately to find their way around written materials, and yet we are now embarking on a new revolution, even though multimedia could be seen more as evolution than as revolution. We do have to ask ourselves, however, whether they can continue to resist the spread of new technology, especially those who endorse minimum educational 'baggage' and argue that the role of primary education is to teach a basic survival kit of the 'three Rs'; a national survey carried out in 1996 by the teaching union FSU highlighted the strong expectations and needs of pupils with regard to new technology. It is possible that the impetus will, indeed, come from families and pupils themselves who may force schools to join the mainstream of the world and the society of which they are part.

Until that happens, we are seeing not only growth in illiteracy but also the emergence of a form of 'electronic illiteracy' which is giving rise to a new factor in social exclusion, the two-tier school with 'info-haves' and the 'info-have nots' among their pupils; faced with the technological shortcomings of schools, better-off families buy their own computers (costing up to 30 % of monthly income for those on FF 15 000 a month and up to 42 % for those with incomes of FF 42 000 a month) or pay for their children to attend after-school clubs, often run as franchises of similar United States operations ('Future kids', for example, which now operates in wealthier suburbs of Paris and in Monaco and Nice). The gap continues to widen between children, and between schools and better-off families who have clearly understood the advantage to their children of offering them access to information and communication technologies in the form of computers, multimedia, computer networks and so on.

2. EPI's suggestions and recommendations

(a) Teacher training to be a priority

- In initial training:
  - definition in conjunction with all those concerned, such as academics and researchers, of a new course comprising (a) a modular core, to take account of differing entry levels and to bring students up to a uniform level, comprising acquisition of a basic technological culture for the integration of new

technology in teaching practices and (b) differing combinations of options relating to the teaching of various disciplines;

- training to prepare teachers for rational use of computers and associated technology, for information processing, for a new type of knowledge-building (covering both individual and collective research), for the role of the teacher in new teacher-pupil relationships; and for the practice of innovative and cross-disciplinary procedures. There is a need to professionalise training, and we have moved beyond questioning whether such issues as the loan to trainee teachers of portable computing equipment with integral printers and communication technology or the inclusion and validation of such skills in examinations and recruitment tests are a choice or a necessity.

- In in-service training, there is a need to anticipate change rather than merely react to it, by means of follow-up training provision related to the specific discipline concerned, to enable skills to be updated in the light of changing hardware and software, and to ensure that teachers are monitored. We should perhaps be thinking in terms of one-year training courses.

  Updating of skills and lifelong learning, distance and tailored learning packages, student-centred learning and international academic cooperation will be able to build on diverse structures such as CNED's electronic campus, Socrates, Leonardo, Delta and Unesco's learning without frontiers programme, among others.

- On the ground, the priorities are:
  - to identify, record and recognise at institutional level the skills acquired;
  - to record and reward innovation and the outcome of training with a view to disseminating good practice, making it available to the educational community and convincing those with doubts;
  - to create an information technology discipline and trainer status, with the skills necessary to ensure that resource staff are appointed in every school or sector, so that observation and follow-up are possible as well as assistance towards mutual and self-training and the mentoring of beginners. This would also ensure that equipment could be maintained and developed, a problem area and often the main reason why in many schools computers are not used;
  - time allowances enabling classes to be split, so that both groups and individuals can have access, the former to things like multimedia workstations, networking and large screens and the latter to computers in classrooms or information and documentation centres;
  - information campaigns aimed at the general public, and involvement of parents.

(b) Equipment

Local communities will have to contribute towards meeting the cost of equipment for schools, but will not always have the necessary resources themselves; if disparities between wealthy and poorer regions are to be overcome, there will also be a need for support mechanisms outside the institutions themselves, for sponsorship arrangements with partners from economic life, and for a national fund to assist the poorer regions, perhaps even with help from manufacturers and publishers that benefit from sales and from State subsidies, such as Microsoft.

There are two initiatives of this kind that it may be helpful to quote here, although they have rather different strategies and end-goals. EPI has concluded a partnership agreement with a non-profit-making organisation called 'Actif France' set up by former IBM executives which collects equipment for recycling from companies. The equipment is refurbished and then sold at favourable rates to schools along with software, set-up and on-site support. The profits are ploughed back into setting up companies designed to help the unemployed, those on income support or young people with problems getting into work. The second scheme is run by a major manufacturer in collaboration with a major software publisher and is aimed at leasing equipment and software to educational institutions. The organisation charges a monthly subscription, in return for which it undertakes to maintain and upgrade the hardware and software over a period of three years, after which the client owns them outright.

These examples give a clear illustration of the urgent need to set up a committee to take a forward-thinking look at ways to meet the cost of equipping schools and overcome the problem of increasingly rapid development; microprocessors are doubling in capacity every year, while CD-ROM technology, which is by no means ubiquitous yet, looks to be under threat from DVD-ROM which can take between seven and 25 times as many data. We need to ask ourselves whether the most up-to-date equipment is really necessary when it is needed only for initiation purposes. The raising of the technological stakes is prompting some of those involved to question whether new developments really represent an advance or whether they simply mirror some rather subtle commercial dealings or a strategy used by the decision-makers in some institutions to deflect attention from the fact that the educational system is constantly lagging behind technological development. Audiovisual methods failed and so did the attempt at computerisation, so schools are now launching into a relentless pursuit of numeric networks, the information super-highway and the Internet, but without really questioning their academic content, what they can offer, the training available in their use or their charging policy. It is, nevertheless, clear that the mushrooming of multimedia and new information and communication technology is still at the level more of the hypothetical than of everyday reality. There has never been so much talk of the Internet, yet all the surveys carried out show that France has a lower rate of connection to it than other countries. Of course, France has its own computerised information and communication system, Minitel, and its wide availability is part of the explanation. Moreover, teachers expressing reluctance to import new technology into their classrooms make a valid point when they argue that technological progress does not in itself deal with the question of knowledge. Is it information (or even rumours) or knowledge that is exchanged on the Internet? We are debating the Socratic school, so it would not be out of place here to recall Socrates' suspicion and even hostility towards the new technology of his time — writing — which he believed gave an illusion of knowledge, whereas in his view knowledge could be conveyed only through interaction. We can see, therefore, that there is nothing new under the sun when these issues are being debated, and that is why it is crucial that we train individuals to structure information in such a way that it really does convey knowledge.

The 'electronic school-bag' of tomorrow will contain a computer with communication technology, which pupils will either borrow, as they currently do library books, or buy (although this raises the problem of the most underprivileged pupils), along with electronic aids, such as translation and writing packages. The education system also needs to confront the issues of its continued ignorance of the existence of such tools and hence of their validation for use in examinations; for example, the use of calculators in the school-leaving examination and of other information technology aids is currently restricted to the wealthiest pupils, although the document authorising their use dates from 1986 and concerns itself only with size. It is worth stressing that we are not seeking to ban such aids, as so far, bans have failed to put a halt to progress and change; our concern should be more to anticipate their use.

(c) Official documents and curricula

- We need a schedule of up-to-date curricula, defining the skills, expertise, know-how and know-how about know-how required in line with what is happening outside schools and with the integration and rational use of new technology in various disciplines, and establishing coherence between the policies of primary, secondary and higher education institutions. Curricula must also enable and encourage inventive, creative use to be made of technology with regard to the syllabus. Teachers must be involved in the design of packages rather than in *post hoc* sham consultations on decisions already taken.
- For example, some of the recommendations in Unesco's 1994 'Informatics for secondary education' curriculum, the very interesting report from the Committee on Education and the Economy (1994-96) and even Monique Grandbastien's report on 'New technologies in technical and general education' (still relevant, although it dates from 1990) need to be taken into consideration.

(d) Multimedia products

We lack the tools to produce these ourselves and we have to be realistic about the power of the US publishers in this field. However, even if in most cases we cannot compete with the Americans, we in France must keep control over the content of the software we use by means of a national software workshop which would bring

together designers, teachers grouped together by discipline, researchers and public and private sector publishers to design interactive packages geared towards various specific uses, such as motivation, remedial work or 'teaching by mistakes'.

We also urgently need to formulate a copyright and reproduction policy that would be compatible with the needs of modern education. Some slight progress has been made in this area, but French legislation, dating from 1985, means that we are hampered in pursuing the attractive opportunities opened up by the Rome Convention which came into force in 1987 as well as the privileges granted to teachers in the United Kingdom, the Netherlands, Spain or Italy, to name but four countries. We should bear in mind that over the past decade, Microsoft — which seems set to dominate the market just as Hollywood did with the cinema — has systematically been buying up reproduction rights from all the world's major museums.

(e) An appeal to the political decision-makers

In June 1997, there will be a conference of Education Ministers of the Council of Europe's Member States. I hope that the participants will be interested in the following extract from the declaration made by EPI's October 1996 general assembly, since it is political will that will change society:

'The citizen of the 21st century will be required systematically to use the complex tools of computers and associated technologies. Advertising is based on the notion that these tools are so user-friendly that they dispense with any need for knowledge, yet experience shows that common sense is of little use in this new technological world and that some knowledge, skills, and know-how are indeed needed if we are to avoid difficulties and solve problems.

A country such as France, indeed the whole of Europe, will be able to keep its identity, resist international competition, create employment and release the resources society needs only if it develops high-tech industries requiring a highly skilled workforce. We also need to modernise all our companies, small and medium-sized. We can do this only if we prepare our workforce for the jobs of the future, and these will require skills that can be fostered only if society as a whole has integrated new technology. As we approach the 21st century, this is an absolute necessity. A solid, technological culture is a crucial tool not only in employment terms but also for dealing with an increasingly complex world. Our only solutions lie in intelligence, the raw material of the coming century, and its application to information processing which will become more and more ubiquitous.

The efforts of our education system, whose role is to prepare children for the jobs of tomorrow, need urgently to focus on information and communication technology. Not only have both teachers and pupils fallen behind in training terms, a fact sometimes acknowledged publicly by politicians, but there is also a fundamental social issue to be faced, that of democracy and the liberty of the individual with regard to the information conveyed by modern communication technology. There is little, if any, focus in the training our young people receive to prepare them for the new 'reading skills' needed to make sense of a combination of images, texts, symbols, and sounds or for the training of critical autonomous thought and the skills of synthesis needed to rise above the seductiveness of images and how they are manipulated.

We need at long last to stop fearing that computers and their associated technologies will destroy jobs and create unemployment; even if some jobs are abolished, others will eventually be created to replace them, and in the United States the microelectronic boom has already created more than three million jobs. We need to ensure instead that computers are used to create wealth but also to help us to improve our lives in a society where individuals are spending less and less of their time at work.

The organisation of post-industrial society needs to be reviewed, but this cannot be done in isolation from what is on offer from scientific and technical progress. Few of our political decision-makers seem to have understood the irreversible nature of the use of technology in developed societies, yet any delay in this crucial area increases the risk of economic, linguistic or cultural domination, not only for France but also for the European Community as a whole.'

Finally I should like to draw the following quotation to your attention: 'In saying no to progress and hence to the future, man internalises his past and condemns himself to a dreadful disease'. The author was not Bill Gates, but Victor Hugo. We hope that his message will be understood and acted upon.

Participation, collaboration and problem-solving in an electronic theatre

Véronique Jans
University of Liège
Belgium

Véronique Jans is a member of the Service de Technologie de l'Education (educational-technology service) of the Université de Liège.

I. Context

1. Preparing pupils to live in tomorrow's world

In education, we can no longer be content with providing learners with only 'specific skills' (Leclercq, 1994), that is, knowledge and know-how that relate to specific fields, such as the rules of grammar or how to read music or high-jumping techniques.

Of course, learners still need to acquire up-to-date knowledge but they must also be provided with other types of skills to enrich their potential for action:

- key skills that enable them to acquire more specific skills should they need them: knowing how to read, write, use a telephone, consult reference material, conduct an interview and, now, use a computer with competence, take notes, structure knowledge in order to remember it, make use of memorisation techniques;
- strategic skills, including knowing themselves and recognising themselves as experts in a particular field, as learners, as doers, as people with responsibility, etc. These strategic skills also include being able to analyse difficult situations and come up with the most appropriate response (or 'non-response'). For example, students must also be fully equipped with general working methods (choosing the most appropriate solution for a given situation), particularly so that they can learn;
- dynamic skills: knowing what motivates us and how we relate to the external world and to ourselves — a taste for initiative, independence, learning, perseverance, rigour, etc. In short, wanting to be and knowing how to be (for example, a learner) and seeing oneself as (for example, a learner). (Leclercq, 1994, Chapter 2, p. 25).

Without any doubt, one of the most important roles of continuing training is to help adults to adapt to the unexpected situations they might face. The effectiveness of such training will depend largely on the new types of skills acquired, which go beyond the level of specific skills.

Yet many scientific and popular works have pointed to the impact the first few years of life have on a person's future and indicated the benefits of education from a very young age. It is vital that educational objectives be adapted to present-day requirements right from the outset — at nursery-school level and even in pre-school establishments. And, of course, primary school also has a role to play in enriching each child's potential for action.

2. Teaching in a collective learning environment

The value of individualised teaching and learning is beyond dispute, but the fact is that such individual attention is rarely possible. Most schools offer pupils a collective learning environment, in which it is difficult for individual rhythms to be respected within the institution, so that they can only be expressed outside it (that is, at home).

Of the various facets of 'multi-skilled teaching' (Denis and Leclercq, 1994) that should be at every teacher's fingertips, the transmissive method is the one that teachers very often use: the teacher delivers his or her class to the pupils and asks some questions — and it is the keenest, most attentive or quickest pupil who answers; the others remain passive, do not have the chance to test their skills and become demotivated. In this respect, Leclercq (1996) speaks of 'the negative effect of outstanding pupils on weaker ones'.

In such situations, how can teachers raise and/or maintain motivation in their pupils? How can they monitor their pupils' understanding of a subject? How can they fill the gaps? And what can pupils themselves do to ensure they remain attentive to what they are being told? How can they assess how well they are assimilating what they are being taught?

3. Using computers to 'manage' activities

Computers are often used in class as a tool to provide individualised teaching, and they are a highly effective teaching aid.

Computers can also be used in class to manage the entire class's activities. The computer is there to 'help' the teacher to organise the lesson and bring it alive. By performing certain tasks in the teacher's stead, the computer enables teachers to devote more of their time to facilitating the class and helping pupils who are having difficulties.

It is with this in mind that we have developed the Forum software and class-facilitation package. The aim is to harmonise the constraints (and advantages) of collective teaching, the benefits of the individualised approach and modern technological resources. This application, which is currently being tested at university level, seems possible and appropriate at primary level, provided a few small adjustments are made.

II. Forum

1. The software

The Forum software — designed by Jans and Leclercq (1996) and programmed by Cavenaile (1996) — enables teacher and pupils to communicate directly and interactively during class, via a star network (each pupil with the teacher and vice versa). This has been made possible, in computer terms, by use of the TCP/IP protocol (transmission control protocol/Internet protocol). The system requires that teacher and pupils be in the same room and that each of them has access to a computer linked to a network. It is also possible to group pupils in twos, threes and fours at one computer, thus encouraging collaborative learning.

From the teacher's terminal, teachers can (1) compile a multiple-choice test; (2) transmit the same question to all pupils; (3) see where each answer is coming from and summarise the answers given; (4) transmit this summary to each pupil; and (5) print out the results for each question and/or pupil.

From the pupils' terminals, pupils can (1) answer the question put to them; (2) see their score after each question; and (3) see the summary of the answers given by all the pupils, once the teacher has made it available on the network.

2. Method of use

In practical terms, a Forum class works as follows:

- the teacher begins to explain the subject. After a few minutes, to check that pupils understand what they are being told, the teacher transmits a first question in cyclic mode (the same question appears on each pupil's screen). Each pupil answers the (multiple-choice) question and presses the 'send' button to transmit his or her answer to the teacher's terminal;
- when the teacher feels that pupils have had enough time to answer, he or she can then choose to display on each pupil's screen a summary table indicating the answers selected by all of the pupils. The purpose of this summary is to trigger a class discussion of the question, the various answers chosen, etc.;

- in this way, pupils can be made aware of their knowledge and/or gaps in their knowledge as regards certain material points. They can also deepen their understanding by means of active discussion. Teachers also benefit from the feedback, which indicates pupils' level of understanding and which they can use to regulate their teaching.

It is recommended that computers be arranged in a circle, like an 'electronic theatre', to facilitate class discussions during a Forum session.

3. Initial experiments

We have tested the Forum software and method on several occasions since May 1996, with various student groups at the Université de Liège. Observation of Forum sessions and analysis of the opinions of teachers and students who have participated in these experiments have enabled us to pinpoint the advantages and disadvantages of the system.

Within the framework of the European Electra-Teledu project, a research team from the Service de Technologie de l'Education (educational technology service) of the Université de Liège is working to improve the system, from both the technical and educational viewpoints.

We refer any reader who might be interested in a more detailed description of the Forum software and/or in the results achieved at university level to the following works: Jans V. and Leclercq D. (1996); Jans V. (1996); Jans V., Poumay M. and Baldewyns L. (1996); Baldewyns L. et al. (1996).

In the rest of this paper, we shall suggest some methodological approaches for the use of Forum at primary-school level.

III. Methodological approaches for the use of Forum at primary-school level

1. Collaborative learning

Encouraging pupils to develop cooperation and solidarity in group work is an important objective at primary school.

In January 1997, a very interesting experiment in collaborative learning using Forum took place within the framework of Dr Debry's course on 'Psychopathologie de l'Enfant et de l'Adolescent' (psychopathologies in children and adolescents). Grouped into three per computer, students had to work together to solve a problem by consulting their course notes and discussing it among themselves. Then, once each group had sent its answer to the 'teacher' terminal, an open debate among all the groups made it possible to compare the various points of view and thereby improve everyone's understanding.

It seems to us that this type of approach could easily be used at primary school. Grouping pupils into twos, threes or fours reduces the number of computers required and makes it possible for socio-cognitive arguments to emerge, first within the small discussion groups and then in the class as a whole. Each pupil or group of pupils is thus encouraged to participate and it is no longer only the strongest pupil who speaks out.

With the Forum software, pupils' answers are corrected immediately, which promotes immediate, individual correction. The summary of the entire class's answers is a valuable starting point for collective discussion.

2. Forum as a play activity

Within the framework of a Forum activity at primary school, pupils should be motivated by the principle of the 'game' proposed, which is like a team game, as well as by the fact that they are using computers.

Competition between the teams, as well as the giving of scores, can be used to stimulate group work and collective problem-solving.

3. Awareness of new information and communication technologies

Computers are becoming increasingly omnipresent. They contain large databases, allow information to be processed in many different ways and serve to develop new methods of communication.

This means it is becoming increasingly important to instruct pupils in the use of new information and communication technologies. Knowing how to turn on a computer, use a mouse, understand how a network functions — these are all skills that could be taught at primary school.

4. Solving small problems

'The activities that are most likely to lead to significant and permanent learning in pupils and enable them to transfer what they have learned, in both the long and the short term, are problem-solving activities. These activities are such that pupils must constantly reapply what they have learned in meaningful situations, as well as in a global and, usually, complicated context' (Tardif, 1992, p. 218).

Problem-solving is a complicated activity for children, but it is also a vital and highly educative one. This approach enables children to reapply earlier learning, use their powers of reasoning and develop an analytical, logical and rigorous approach. Problem-solving activities need to be started very early, within the framework of a progression that takes account of the variety of situations and different stages that are part of the method of solution. The essential feature of problem-solving is that the child is faced with a problem situation, an obstacle to overcome, and is obliged to search for the most appropriate approach. From the teacher's point of view, he or she must make sure that the problems being presented to pupils have some meaning for them. In the framework of the lateral methodological skills that pupils need to acquire, more and more emphasis is being placed on information-processing; but what really matters is the significance of this information in the tasks and contexts proposed, and this is heavily dependent upon the nature of the pupils concerned.

In the approach proposed by Forum, pupils must understand the nature of the problem, imagine a solution, seek out any necessary information and share their ideas. This approach is especially rich and serves to develop highly sophisticated classification skills.

All too often, it would appear that multiple-choice questions can be used only to assess simple skills, thus impoverishing the 'overall view of things'. Some people feel that this system of questioning makes it possible to assess only 'knowledge' or even 'recognition'. But well-designed multiple-choice questions actually allow a very much richer assessment than it might appear, provided they are complemented by, for example, systems such as 'solutions générales implicites' (implicit general answers) and 'degrés de certitude' (degrees of certainty) developed by D. Leclercq. Forum software incorporates these techniques.

(a) 'Solutions générales implicites'

School rarely leaves very much room for spontaneity. Rather, one pupil is picked out to answer the question posed and is told when he or she can speak. Such autocratic management of the right to speak is hardly likely to encourage the development of a critical mind or of personal reflection. 'Cognitive vigilance' is a skill that needs to be developed in modern life, which requires individuals to be able to identify problems quickly and come up with possible solutions. To fill this gap, Leclercq suggests 'developing an implicit-request system, in which the trainer presents the student with a 'problem situation', without actually labelling it as such. For example, the teacher might make an intentional error of reasoning, in the hope that students will spot it' (Boxus, 1988).

Leclercq suggests using multiple-choice questions, with some slight adjustments. His technique, called 'Les solutions générales implicites de QCM' (implicit general answers to multiple-choice questions), is described thus: 'The method is to announce, right from the outset and with respect to the entire test, that there are certain answers that are valid for all of the multiple-choice questions set, but that these answers will <u>not</u> be mentioned in the questions themselves. On this basis, a set of other general answers can be envisaged' (Boxus, 1988).

The four implicit general answers proposed by Leclercq are as follows:

6.= none of the answers suggested is correct;

7.= all of the answers suggested are correct;

8.= there are insufficient data to answer the question;

9.= there is an error in the question.

Teaching is still, and will doubtless long remain, an art. But it is an art that is necessarily at the service of end results, and the end results that the implicit-request system can foster are individual freedom, independence, initiative and a sense of responsibility in children. Children must be taught not only to be wary of fixed ideas but also how they can react to them. Asking themselves questions, and daring to ask questions of others, is one of the approaches that can be suggested to them, in order to develop their personality.

'L. Legrand spoke of the pedagogy of surprise. Yes, let us encourage students and teachers alike to develop the habit of questioning everything around them; this active presence in the world will prepare them to be agents of change' (Mialaret, in Crahay and Lafontaine, 1986, p. 363).

Readers who are interested in an experiment in the use of multiple-choice questions with implicit general answers at primary-school level are referred to Jans V. (1994).

(b) 'Degrés de certitude'

In our changing world, individuals are very often required to use their own judgment. The ability to recognise and affirm what one does and does not know is a gauge of clear-sightedness and clear-headedness. Unfortunately, the alternative is often to be unaware of or conceal one's ignorance.

'We begin to become a danger, both to ourselves and to those around us, when we fail to confess our lack of knowledge (of how to fly a plane, of a language, of the effect of a drug, of the time a train leaves). If someone asks us for information, it is simple and effective to confess our ignorance immediately. And then the other person will, of course, ask someone else.' (Leclercq, 1988, p. 314).

Here, we are at the highest level of Bloom's taxonomy of educational objectives (1956), that is, assessment. Learning how to assess oneself is an essential basis for peace of mind and social progress. The challenge is not simply to know oneself better but also, and above all, to live one's life in the habit of acting with an awareness of both cause and effect. This is certainly no easy task. But the ability clearly to assess the realism of one's arguments or the chances of the success or failure of one's actions can be acquired by training. A general method of self-assessment is to use degrees of certainty.

The system of degrees of certainty suggested by Leclercq is described as 'a procedure that comprises asking the student to provide not only an answer but also a degree of certainty (on a scale of probabilities of accuracy), and to note this answer with the aid of a rating scale that takes account of both the quality of the answer and the evaluee's degree of certainty' (Leclercq, 1988, p. 307).

Readers interested in this technique will find further information in Leclercq (1988).

Osterrieth (1981, p. 60) points to several long-standing contradictions in our usual education system, particularly the one '*that entails encouraging children to develop mechanisms of self-deception and dishonesty with themselves, even though personal objectivity and lucidity are included among the list of characteristics of a balanced adult*'.

Offering children the possibility of learning to exercise self-assessment is very enriching. Knowing whether they are sure of themselves or doubt their own statements will help them to develop a sense of responsibility and will thus prepare them for adult life. Some people will feel that selecting a degree of certainty is too difficult a task for children. We disagree. The notion of realism can be fostered at primary school and is very readily understood by pupils if it is presented to them in a simple way. In 1994, we conducted experiments in two middle primary-school classes, with children aged nine and 10 (Jans, 1994).

IV. Conclusions and future prospects

The Forum approach, which has been developed and tested at university level, seems to us to be readily transferable to primary education. 'Obliging' all pupils to reflect on the problem set is a starting point for increasing their involvement in their own learning process and encouraging sociocognitive arguments that are highly beneficial to every pupil's progress. Having the chance to give their opinion on the question and discuss it freely should further motivate children, who might then see school not as a place where they are usually required to be seen and not heard, but as somewhere where they are all free to express themselves and enter into debate. Organising exchanges of ideas should also enable teachers to develop in their pupils the social skills of listening, speaking, negotiating, accepting differences, respecting their fellow human beings, etc. And using Forum enables teachers to have a better overall view of their class, to see the gaps in a more individual way and, therefore, to rectify them more effectively.

The issue of resources inevitably raises its head here. Innovation in teaching methods often means providing classes with new educational tools, and that costs money. In Belgium, however, it may be noted that classes are increasingly being provided with computer equipment. Judicious use of this equipment could justify expenditure — and contribute to the education of our children, tomorrow's adults.

An essential condition for the best possible use of this type of equipment in primary schools is for teachers to be trained appropriately. Only a clear knowledge of the principles that underlie this new method of educational facilitation and assessment will ensure conscious and considered use of the Forum system in primary schools. Drawing up a list of 'good' multiple-choice questions, for instance, is a delicate task — a task that can be made easier by experience, but also by an awareness of specific criteria. Drawing on the recommendations of various United States authors, Leclercq (1986) sets out 20 rules for drafting multiple-choice questions. We shall simply list these rules, and refer readers who are interested in more information to the reference work: 'three rules concerning adjustment to objectives (respect the objective; stick to the objective; do not disrupt learning); three rules concerning the diagnostic value of answers (reveal the pupil's mental process; indicate the error made; specify gaps); six rules concerning drafting the questions (follow the instructions; obey the rules of grammar; do not use any vague terms; avoid all negative forms; keep information and questions separate; group together the elements that are common to all the suggested answers); and eight rules on drafting suggested answers (grammatical independence; semantic independence; use the same words as you have used in the questions; the same level of probability; the same length; the same degree of complexity; the same degree of generality; the same degree of technicality)'.

A future prospect that might be envisaged for teachers who wish to use Forum in primary schools would be that of setting up a bank of questions on the Internet, using Wincheck, the multiple-choice-question software developed by the Service de Technologie de l'Education (STE) (Denis B. et al., 1995; Gilles J. L., 1995). STE already has lengthy experience in this field: we should mention, in particular, the setting-up of a bank of questions at the air force school in Saffraanberg, as well as within the framework of two schemes launched by the Ministry of Education, Research and Training of the French-speaking community in Belgium (Denis B. et al., 1996; Bosmans C. et al., 1997). This means that any teacher preparing a Forum activity for a class could use the Internet to compile a set of questions, selected according to his or her own criteria.

V. Bibliography

Baldewyns, L., Reggers, T., Poumay, M., Orban, M. and Denis, B. (1996), *Functional specifications of Teledu*, CE, Telematic applications program, Electra project, Deliverable D07.02.

Bloom, B. S. et al. (1956), *Taxonomie des objectifs pédagogiques, vol. 1, Domaine cognitif*, traduit par Lavallée, M. (1969), Montréal, Education Nouvelle.

Bosmans, C., Jans, V. and Pauwen, M. (1997), 'Articulation et évaluation des socles de compétences relatifs à l'enseignement des sciences dans le cadre du programme expérimental de physique (2ème degré T)', in *Informations pédagogiques*, Ministère de l'Education, de la Recherche et de la Formation, Administration de l'Organisation des Etudes, Bruxelles (à paraître).

Boxus, E. (1988), *Les QCM à solutions générales au service de l'évaluation à livre ouvert*, Colloque International 'Formation, évaluation, sélection par questionnaires fermés', Université de Liège — Centre de Technologie de l'Education.

Cavenaile, A. (1996), *Forum: un logiciel de communication entre enseignant et apprenants dans un auditoire électronique,* travail de fin d'études en vue de l'obtention du grade de Licencié en Informatique, Université de Liège — Faculté des Sciences Appliquées.

Denis, B. and Leclercq, D. (1994), 'The fundamental IDs and their associated problems', in: Lowyck, J. and Elen, J. (Eds), *Modelling ID research, Proceedings of the first workshop of the special interest group on instructional design of EARLI*, Leuven, pp. 67-86.

Denis, B., Jans, V., Gilles, J.-L. and Boxus, E. (1995), Logiciel Wincheck — Manuel d'utilisation (version provisoire), Université de Liège — Service de Technologie de l'Education, Liège.

Denis, B., Bosmans, C. and Jans, V. (1996), 'Une banque de questions au service de l'évaluation formative dans l'enseignement technique du deuxième degré', in: *Informations pédagogiques*, Ministère de l'Education, de la Recherche et de la Formation, Administration de l'Organisation des Etudes, Bruxelles, vol. 22, January 1996, pp. 23-33.

Gilles, J.-L. (1995*), Entraînement à l'auto-évaluation: une comparaison filles/garçons à l'université*, colloque AIPU, Hull.

Jans, V. (1994), 'Développer la vigilance cognitive à l'école primaire par des QCM à Solutions Générales Implicites', in: Weber, J. and Dumont, B. (1995), *QCM et Questionnaires Fermés*, colloque de l'ESIEE, Marne-La-Vallée, December 1994.

Jans, V. and Leclercq, D. (1996), *Forum: un système d'animation et d'évaluation de grands groupes universitaires*, Colloque de l'Association Internationale de Pédagogie Universitaire, Tunis, November 1996.

Jans, V. (1996), 'Forum-test: un logiciel de communication entre enseignant et étudiants dans un théâtre électronique', *Actes de la Journée d'information et d'échange sur les Initiatives Pédagogiques*, CUPS, Colonster, 22 November 1996.

Jans, V., Poumay, M. and Baldewyns, L. (1996), 'How to animate a group of students in an electronic classroom?' *Placing the student at the centre: Higher education addressing the challenges of the 21st century,* Maastricht University, 20th Anniversary Conference, Maastricht, 20-22 November 1996.

Leclercq, D. (1986), *La conception des questions à choix multiple*, Bruxelles, Labor.

Leclercq, D. (1988), Mesurer la connaissance partielle et le réalisme par les degrés de certitude, Colloque International 'Formation, évaluation, sélection par questionnaires fermés', Université de Liège — Centre de Technologie de l'Education.

Leclercq, D. (1994), *Psychologie éducationnelle agrégation*, Université de Liège — Service de Technologie de l'Education, notes de cours.

Mialaret, G. (1986), 'Réflexions personnelles sur le choix de quelques objectifs pour la formation des enseignants', in: Crahay, M. et Lafontaine, D. (1986), *L'art et la science de l'enseignement*, Bruxelles: Labor, pp. 344-364.

Osterrieth, P. (1981), *Faire des adultes*, Bruxelles, Pierre Mardaga.

Tardif, J. (1992), *Pour un enseignement stratégique. L'apport de la psychologie cognitive*, Montréal, Logiques.

Recommendations

Pier Giacomo Sola,
Amitié

Pier Giacomo Sola, born in 1957, graduated in nuclear engineering at the University of Bologna, with a degree thesis on 'Outline and perspectives of development in the current energetic situation'.

Since January 1988 he has been Director of Scienter — Centre of research and advanced services in training, and since December 1991, he has been President of Amitié, a European association specialising in software and information technologies, initially sponsored by the European Commission in the framework of the Comett programme.

In July 1993 he was selected by the European Commission as an expert for the diffusion of the results of Community research and technological development and their impact on industry, the scientific community and society. He is also involved in the activities of Round Table 8, launched by the European Commission to discuss the problems related to the development of the information society. In 1996 he was appointed as Italian national contact point for the telematics applications programme. He also manages the activities of one of the Italian nodes of the MIDAS-NET network.

Before the final conclusions, it is useful to summarise the main issues which have arisen during the two days of discussion. The following recommendations, developed with the valuable support of Jeff Morgan and Janice Richardson — rapporteurs of the two parallel sessions of the workshop, underline the major items to be taken into account when planning a common European strategy.

1. Soft choice for hardware, hard choice for software

Re-equipping schools will be the major issue for most European countries in the next years: currently only a low percentage of schools is connected to the Internet. Networks and multimedia machines are considered the winning solution in the near future. Even if it is unlikely that any single technology will be the solution for the schools' needs, the current trends rely on Internet and Web technologies, together with CD-ROMs for local storage. The organisation of a distributed network, running around the whole school, with fewer machines in each classroom should be an effective model for primary schools.

On the contrary, designing good software for schools seems to be a major challenge, since also for teachers it is difficult to establish clearly defined specifications for effective applications in schools. For this reason, publishing companies are faced with a difficult task, and they will need specific actions to be able to produce software tailored to suit educational requirements.

2. Take the train for training, teacher

Learning is a question of values, skills and body of knowledge, and information technology is seriously affected by skills shortage. In few European countries IT is a formal part of initial teacher training. This should be a common priority, with specific IT elements needed in initial teacher education. The national systems for teachers' credits should rapidly consider this new aspect. There is indeed a serious problem with the training of teachers who are coming out from the universities with insufficient IT skills. Retraining of teachers already working in the school system should consider incentives to promote personal access to technology, loans of equipment, etc. Teachers should develop 'network literacy', that is a mixture of traditional educational skills of research, analysis, evaluation, synthesis, etc. within a context of using networks and search tools, downloading information and storing it locally.

3. Building pillars on pilots

Three key qualities are essential in bringing about change in current teaching practice: communication, cooperation and coordination, at the level of the school, the State and the European Union. Information and communication technology offers a major advantage over other innovations, such as audiovisual supports which never quite lived up to expectations as a catalyst to hasten evolution in our education systems.

Increasing economic, organisational and technical change means that new skills are needed for the future and they are those of both producers of IT solutions and users. Schools must help turn out more basic IT skills at a general level.

In Europe there are many very interesting projects involving IT and schools, but up to now there was little coordination or resourcing to bring the pilots into the mainstream.

Setting up a European centre could act as the catalyst able to speed-up innovation. This centre should:

- coordinate and stimulate cooperation between European countries — the complementarity and diversity of European Member States offers a valuable resource that remains, at present, relatively unexploited in the field of education;
- assess educational software, to relieve teachers of the time-consuming task of finding the software which corresponds to teaching objectives in terms of curriculum- and age-relevance;
- share research, development and projects, to save time in the quest for better-adapted methods and teaching aids, provide economies of scale, and draw advantage from the diversity in pedagogical approaches existing in the Member States of Europe;
- plan integration of new technological developments;
- lead teachers to discover their European context by opening communication channels between teachers via the information highway and shared training programmes;
- improve linguistic skills of both pupils and teachers through communication with European counterparts in a motivating, learning context.

4. Know yourself

The open Socratic approach recognises that questions, not answers, are the driving force in thinking. It focuses on inquiry-based learning through which children are encouraged to develop on their own; learning to know, to do, to be and to live together. This type of learning requires the class teacher, particularly at the primary school level, having the ability to apprehend the individual needs of every learner, to respect the differences in culture, identity, learning rhythms and aptitudes. Learning activities centred on problem-solving and project-oriented tasks, on exploration, experimentation, creativity, data-handling and team work, call for a wide range of organisational skills and didactic strategies and a large dose of pragmatism in applying them.

If we are moving towards an open Socratic education for all, we must begin by re-examining the underlying philosophy of education in order to clearly determine the role of the school in the information society in which the proclaimed objective is to develop the full potential of every citizen as an independent lifelong learner.

The European Union should encourage the development of a network of experts, researchers, teachers, with the objective to analyse:

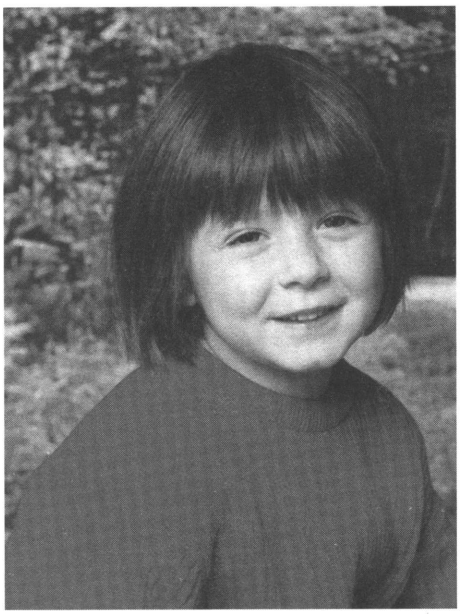
- the concept of 'knowledge' in the education society;
- the different forms of 'intelligence' to be nurtured;
- an interdisciplinary, holistic curriculum that takes into account the updated concept of knowledge and intelligence, that respects individual differences in learning aptitude and rhythms, and corresponds to the need for activities that enable the learner to embark on the road to independent lifelong learning;
- assessment methods.

Once the above points have been clearly defined, this network would be in a position to put forward concrete suggestions as to:

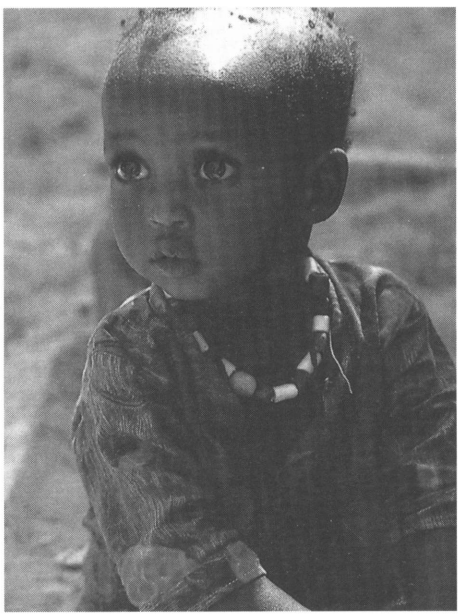
- the teacher's role in an open Socratic classroom in which ICT becomes an integral part of the learning environment;
- teaching paradigms that correspond to educational objectives;
- didactic strategies necessary to implement the new teaching paradigms;
- organisational methods that allow children to get on with their own task of learning to know, to do, to be and to live together.

A good master has only one concern:
to teach his pupils to live without him.

André Gide



Please make Europe a beautiful place for us.



Conclusions

José Rebelo
General Manager
Petrofina

If schools are to carry out the role entrusted to them by society, they must develop in parallel and at the same rate. Education must be equipped with the tools of tomorrow. To meet and regulate the demand created by the media, schools must give their pupils the resources to explore and critically evaluate the world through images, sounds and colour. However, this is only the beginning. The information society portrayed by Jacques Delors in the European Union's White Paper on education and training must be coupled with a learning society if we are to avoid information overload and a superficial culture based on 'zapping' and a 'patchwork' approach.

Sir Christopher Ball, Member of the Royal Society for the Encouragement of Arts, Manufactures, and Commerce, has argued (1) that a learning society is one that meets the following criteria:

- acceptance of lifelong learning;
- learners responsible for their own learning;
- evaluation of progress, not of failure;
- individual and shared abilities and values of equal importance in the pursuit of knowledge;
- learning as a partnership between pupils, parents, teachers, employers and local communities all working together to improve performance (2).

The education system must open up more to the world, offer greater choice and flatten hierarchies. Multidisciplinary learning makes knowledge less hierarchical and current information carriers, such as diskettes, CD-ROMs, networks and databanks, lend themselves to a new form of network learning. 'Learning by heart' is giving way to new connection and association strategies that rely on long-term memory and remain in place throughout the learner's life (3). Teachers are no longer the sole custodians of knowledge, and their power is now based not on their knowledge but on their professional ability to stimulate a hunger to learn in their pupils and to motivate them in their journeys of exploration and investigation.

In the 21st century, IT skills will be crucial for employment of all kinds, whether in industry or the service sector. A scientific and technological culture in IT will be the most reliable way of increasing economic competitiveness, but it will also represent a new means of communication for individuals.

Europe (4) and, more recently, the European Union, has always made efforts to meet the aspirations of its citizens for real democracy in which each individual takes on his or her own responsibilities. It has always focused its efforts on three areas:

- making adequate means of communication and minimum standards, such as reading, writing and calculation, available to all (19th century);
- assisting with the reorganisation of employment and the creation of new types of jobs (1960s);
- regarding continuing education and training as an investment (1970s).

Today, the European Union is facing a new political reality and, in an increasingly complex relational environment, it is crucial that each citizen gains mastery of a fourth mode of communication, namely electronic information. If they are to have total control over their own decision-making processes, citizens will have to sift the wealth of information available to create their own individual knowledge networks by assimilating individually a reasoning process.

---

(1) *RSA Journal*, May 1992, p. 384.
(2) Cochinaux, P. and de Woot, P. (1995), *Moving towards a learning society*, Louvain: CRE-ERT, p. 52.
(3) De Landsheere, V., *L'éducation et la formation*, Paris, PUF, p 55.
(4) Deberghes, D. (1993), 'La formation en Europe', in *Les Annales des Mines*, Paris.

Initial training is no longer a 'finished product' and no longer delivers a 'stock of knowledge' for life. Rather, it forms the basis for long-term learning by encouraging tree-like logic structures through developing inductive and deductive reasoning strategies. If this new reality is not taken into account at European level, electronic information will eventually become an insoluble problem that will permanently widen social inequalities (1).

The decision taken by the Heads of State or Government at the June 1996 Florence summit to open Europe's multimedia industry to the education sector represents an unexpected opportunity. We must seize this chance to help teachers in the art of teaching and to assist them to develop in our children a basic strategy, that of an 'active mode of research reasoning' (2). This will make our children better equipped to face the demands of a society dominated by competition, globalisation of markets and employment, and continual growth in the complexity of the criteria by which decisions are made.

Future generations, faced with these immovable forces of national development, will undoubtedly be better equipped to bring their situational and relational knowledge into play when they take decisions. The driving forces behind national development, 'competition, cooperation and nucleation'(3), will be able to operate naturally, 'allowing Man the time not only to create robots but also to shape children in his own image' (4).

The European Council must therefore, in line with the wishes it expressed at the Florence summit, give the European Union a specific programme for developing the Socratic teacher/pupil relationship by using the new forms of information at all levels of primary education, so as to increase the autonomy and responsibility of each individual citizen and thereby to help to build a new 'European way of life' to serve as an example for the whole world.

(1) Deberghes, D. (1993), *La Formation aux Technologies de l'Information et de la Communication en Europe et la Subsidiarité*, International AFCET Conference, Versailles.
(2) Deberghes, D. (1993), 'De la vie à l'école à l'école de la vie', in *La formation en Europe, Les Annales des Mines*, Paris.
(3) Danzin, D. (1993), *La Croissance Autrement*, Paris, L'Institut de l'Energie.
(4) Deberghes, D. (1986), *Le Temps Partagé*, Paris, Agence de l'Informatique, Ministry of Industry.

Programme of the workshop

Opening plenary sessions
Room M6
24 February 1997

09.15 Welcome and opening speech
Mr Vicente Parajon Collada
European Commission, Deputy Director-General, DG XIII

09.30 **Plenary session 1**
Chairperson:
Mr Vicente Parajon Collada,
Deputy Director-General, DG XIII

Accomplishing Europe through education and training
Prof. Jean-Louis Reiffers
President of European Group on Education, France

Towards a new educational culture
Dr Willem J. Pelgrum
University of Twente, Netherlands

Children of the future
Prof. Tommy Isaksson
University of Falum-Borlänge, Sweden

10.45 Coffee break

11.00 **Plenary session 2**
Chairperson:
Mr Yves Franchet,
Director-General, Eurostat

Conclusions from the first plenary session
Mr Daniel Deberghes
European Commission, DG XIII
Minister Erna Hennicot-Schoepges
Ministry of Education, Luxembourg

The education of Europeans in the metamorphosis of civilisation
Mr André Danzin
Club of Rome

12.45 Lunch

Workshop 1
Room M2
24 February 1997

14.30 **'Which technology for an open Socratic school?'**
Chairperson:
Mr Guy Weets,
European Commission, DG III

Rapporteur:
Mr Jeff Morgan,
National Council of Educational Technology, United Kingdom

How much technology for the school?
Mr Andrew Folkmanis
European Commission, DG III

The application of information technology in education in Spain
Mr Jaime Denis
Ministry of Education and Culture, Spain

Virtual reality: A new tool for an open Socratic school
Dr Lurdes Camacho
Ministry of Culture, Portugal

Training in new technology for the 21st century in the service of society?
Mr Jean-Bernard Viaud
Chairman of EPI, France

Participation, collaboration and problem-serving in an electronic theatre
Ms Véronique Jans
University of Liège, Belgium

17.00 **Round table:**
Chairperson:
Mr Guy Weets,
European Commission, DG XIII

Workshop 2
Room M6
24 February 1997

14.30 **'Which teaching skills for an open Socratic school?'**
Chairman:
Ms Alice Fracchia,
European Commission, DG XXII
Rapporteur:
Ms Janice Richardson,
Consultant in Education Sciences, Luxembourg

Information and communication technology in pupil-activity-centred pedagogy
Mr Pino Fiermonte
Teacher, Ministry of Education, Luxembourg

Didactic strategies and teaching skills for the transition period
Prof Guillaume De Meuter
Fachhochschule Würzburg-Schweinfurt-Aschaffenburg, Germany

Learning and multimedia
Ms Brigitte Denis
Department of Education Sciences, University of Liège, Belgium

Communicating and exchanging experiences through the Net
Prof Alessandro Candeli
IRRSAE Emilia-Romagna, Italy

17.00 **Round table:**
Chairperson:
Ms Corinne Hermant,
European Commission, DG XXII

Final plenary sessions
Room M6
25 February 1997

09.30 **Plenary session 3**
Chairperson:
Mr Yves Franchet,
Director-General, EUROSTAT

Summary of workshop No 1
Mr Jeff Morgan
National Council of Educational Technology, United Kingdom

Summary of workshop No 2
Ms Janice Richardson
Consultant in Education Sciences

Presentation of the Socrates programme
Ms Corinne Hermant
European Commission, DG XXII

11.15 **Round table:**
Chairperson:
Ms Corinne Hermant,
European Commission, DG XXII

12.00 ***Conclusions and recommendations***
Mr André Danzin
Club of Rome

Demonstration of multimedia applications

1. AMTEQ

Flemming Poulsen
AMTEQ
Nygade 1 B
DK-8600 Silkeborg
Tel. (45-86) 80 30 42
Fax (45-86) 80 44 09
E-mail: AMTEQ@post1.tele.dk

2. Aptice

Pino Fiermonte
Aptice
20, rue de l'Ecole
L-3233 Bettembourg
Tel. (352) 51 42 54
E-mail: pino.fiermonte@ci.educ.lu

3. ECHO

Marc Willem
Infopartners
4, Jos Felten
L-1508 Howald
Tel. (352) 401 16 22 21
Fax (352) 401 16 22 34
E-mail: mwillem@vektor.echo.lu

4. Eurostat

Lydia Barreiros
European Commission
Eurostat
Jean Monnet Building
L-2920 Luxembourg
Tel. (352) 430 13 46 67

5. Question Mark

Roland Nyns
Question Mark Logiciels
Rue E. Banning 44
20, rue de l'Ecole
B-1050 Bruxelles
Tel. (32-2) 646 99 49
Fax (32-2) 646 99 59
E-mail: 100663.1252@compuserve.com

Bibliography

Albeda W., 'Vers de nouvelles responsibilités des pouvoirs publiques', in *Annales des Mines*, Paris, 1993.

Ball C., 'Learning pays, interim report', in the *RSA Journal*, April 1991.

Baudé J., 'Rapports d'activités et orientations pour 1995-96', in *La Revue de l'association EPI,* December 1995, No 80.

Bibeau R., 'Attention! Passage étroit — "Autoroute pédagogique"', in *La revue de l'association EPI.,* Paris, September 1995, No 79.

Carnevale A. P., 'Skill and the new economy', in *Gestion 2000*, 1992, No 4.

CERI, *Information technologies and basic learning*, Paris, OECD, 1987.

Cochinaux, P., de Woot, P., *Moving towards a learning society*, Louvain, CRE-ERT, 1995.

Cohen R., *Quand l'Ordinateur Parle*, Paris, PUF, 1992.

Confland D., Ministère de la recherche et de l'espace, DIST. *Annales des Mines*, Paris, May 1993.

Council for Cultural Cooperation: School Education Division, *Innovation in primary education,* Strasbourg, Council of Europe, 1988.

Council of Europe Group Report, 'The role of computers for modelling in science education', in the *Final report of the 45th European teachers' seminar, information technology in science education*, Council of Europe, 1989.

Council of Europe, 'A role for information technology in practical science', in the *Final report of the 45th European teachers' seminar, information technology in science education*, Council of Europe, 1989.

Cox M. J., Johnson D. C., *The impact report*, London, King's College, 1993.

Da Ponte J. P., *Minerva project — Introducing NIT in education*, Depgef, Portugal, 1994.

Daly F., *CD-ROM in education,* UK, NCET, 1995.

Danzin A. — Membre du Club de Rome, *Annales des Mines*, May 1993, December 1994.

Danzin D., *La Croissance Autrement*, Paris, L'Institut de l'Energie, 1993.

De Landsheere G., *L'illetrisme, une menace pour les individus et l'économie du pays,* to be published.

De Landsheere V., *L'Education et la Formation*, France, PUF, 1992.

Deberghes D., 'De la Vie à l'Ecole de la Vie', *Annales des Mines*, Formation en Europe, July 1994.

Deberghes D., 'Quelque soit mon métier, j'utiliserai l'Information, Annales des Mines, May 1993, December 1994.

Deberghes D., Congrès AFCET, 10 June 1993.

Deberghes D., 'De la vie à l'école à l'école de la vie', in *La Formation en Europe, Annales des Mines*, Paris, 1993.

Deberghes D., 'L'information dans l'économie européenne', *Annales des Mines*, Paris, 1992.

Deberghes D., *L'information électronique, vecteur de croissance ou de crise, de la révolution Gutenberg à la révolution Shannon,* Luxembourg, CCE XIII, 1993.

Deberghes D., *La Formation aux Technologies de l'Information et de la Communication en Europe et la Subsidiarité* AFCET International Congress, Versailles, 1993.

Deberghes D., 'La Formation en Europe' in *Annales des Mines,* Paris, 1993.

Deberghes D., *Le Temps Partagé*, Paris, Agence de l'Informatique, Ministère de l'Industrie, 1986.

Deberghes D., Télécommunication, information technologie, *Annales des Mines*, Paris, 1993.

Delacôte G., *Savoir apprendre: les nouvelles méthodes*, Paris, Editions Odile Jacob, 1996.

Delors J. — Président de la CCE, Annales des Mines, May 1993.

Delors J., *L'education — un trésor est caché dedans*, Paris, Editions Odile Jacob, 1996.

Dewey J., *Democracy and education,* New York, The Macmillan Company, 1916.

Donaldson M., *Children's minds,* Glasgow, Fontana Press, 1978.

EPI, 'Dossier de Presse', in *La revue de l'association E.P.I.,* Paris, September 1995.

'Education for Europeans, towards the learning society', Report from the ERT, Brussels, 1995.

Elstgeest J., Harlen W., *Unesco sourcebook for science in the primary school*, Paris, Unesco, 1992.

European Commission, Eurydice, *Key data on education in the EU — 1994*, European Commission (Education, Training and Youth), Brussels, European Commission, 1995.

European Commission, Eurydice, *Key data on education in the EU — 1995*, European Commission (Education, Training and Youth), Brussels, European Commission, 1996.

European Commission, INFO 2000 COM(95) 149 final, 30 June 1996.

European Commission, IV Plan Cadre Recherche et Développement Technologique, Council of 26 April 1994.

European Commission, Leonardo; Council of 6 December 1994.

European Commission, 'Lifelong learning', in issue 4 of *Le Magazine for education, training and youth in Europe*, Brussels, European Commission, 1995.

European Commission, Livre blanc croissance, compétitivité, emploi, — COM(93) 700 final, 5 December 1993.

European Commission, Livre blanc sur l'education, COM(95) 590 final, 29 November 1995.

European Commission, Livre blanc sur l'education et la formation, Brussels, European Commission, 1995.

European Commission, proceedings 'Training concerning electronic information provision', workshop CCE Luxembourg 19 and 20 July 1995.

European Commission, Socrates, Council of 14 March 1995.

European Commission, Vers la Société de l'Information, CCE, 19 July 1994.

Feurzeig W., 'Algebra slaves and agents in a LOGO-based mathematics curriculum', *Instructional science,* 14, 1986.

Finnish Ministry of Education, *Education, training and research in the information society: A national strategy*, Helsinki, Ministry of Education, 1995.

Finnish Ministry of Education, *Education, training and research in the information society: A national strategy*, Helsinki, Ministry of Education, 1995.

Fordham P., *L'éducation pour tous: une vision élargie*, Paris, Unesco, 1994.

Gretsch G., *TEO — Développement et evaluation d'un traitement de texte orale,* Luxembourg, Ministère de l'Education Nationale, 1994.

Haggis S., *L'éducation pour tous: les objectifs et le contexte*, Paris, Unesco, 1993.

Hart B., Holt G., Fletcher C., Tyldesley A., *Extending horizons*, UK, NCET, 1994

International Study Center, TIMSS, *Mathematics achievement in the middle school years*, Boston College, Chestnut Hill, MA, USA.

Isaksson T., *Children of the future*, (unpublished), Sweden, 1995.

Jones C., Directeur TFHREJ à la CCE, Congrès Capital Humain, Eurostat, Luxembourg, November 1991.

Landaburu E., Directeur Général politiques Régionales CCE (article à titre personnel), *Annales des Mines*, November 1991.

Latreille A., Ampère A-M., 'L'homme, la pensée, l'influence', in *Cahiers d'Histoire,* Polymieux, France, Ed., Ste A-M. Ampère, 1975.

Lewis R., 'The contribution of information technologies to learning', in the *Final report of the 45th European teachers' seminar, information technology in science education*, Council of Europe, 1989.

Marbeau V., 'Les perpectives offertes par l'informatique et les technologies de la communication', in *La Revue de l'EPI*, No 79, Paris, EPI, 1995.

McCormick L., *The art of teaching writing*, Heinemann, Portsmouth, 1994.

Merzenich M. M., Jenkins W. M., Johnston P., Schreiner C., Miller S. L., Tallal P,: 'Temporal processing deficits of language-learning impaired children ameliorated by training', in *Science*, USA, 5 January 1996, No 271.

Minister of Cultural Affairs, *Technologies nouvelles dans le domaine de l'information et communication à l'école — concept cadre*, Dusseldorf, Minister of Cultural Affairs of North-Westphalie Rheinland, 1985.

Mitterrand F., *Discours du 150e anniversaire de la mort d'A-M. Ampere*, La Vilette, Paris, 1986.

Nash J. M., 'Zooming in on Dyslexia', in *Time International*, 2 January, 1996.

NCET, *CD-ROM in education*, UK, NCET, 1995.

NCET, *Getting started with information handling,* UK, NCET, 1994.

NCET, *Integrated learning systems — A report on the pilot evaluation of ILS in the UK*, UK, NCET, 1994.

NCET, *Libraries of the future*, as yet unpublished report, Coventry, 1994.

NCET, *Primary science investigations with IT,* UK, NCET, 1994.

OECD, Depgef, *Report of the Minerva project evaluators*, Lisbon, Ministry of Education, 1994.

Ogborn J., 'The role of modelling in science education', in the *Final report of the 45th European teachers' seminar, information technology in science education*, Council of Europe, 1989.

Pantzar E., Pohjolainen S., Ruokamo-Saari H., Viteli J., *Theoretical foundations and applications of modern learning environments*, Finland, Tampereen yliopisto, 1995.

Papert S., *The children's machine: Rethinking school in the age of the computer,* New York, BasicBooks, 1993.

Pelgrum W. J., Plomp T., *The IEA study of computers in education*, UK, Pergamon Press, 1993.

Plaisance E., Vergnaud G., *Les sciences de l'education,* Paris, La découverte, 1993.

Rapport de la Commission Internationale sur l'Education du XXIéme Siècle, Unesco, sous la Présidence de M. Jacques Delors, 1996.

Rousseau, J-J., *Du contrat social*, extract from the *Encyclopaedia Brittanica.*

Russ J., *Histoire de la Philosophie*, Paris, Armand Colin, 1993.

Ségard N. (Minister for Telecommunications), *Technologies et Société: Rapport au Premier Ministre*, Paris, La Documentation Française, 1985.

Unesco, proceedings of a European workshop, Université of Twente, *Information technologies in teacher education*, Paris, Unesco, 1995.

Unesco, *World education report — 1995*, Paris, Unesco, 1995.

Wilson T., University of Sheffield and Ramalho Correia, A. M. INETI/CITI, 'Training information service specialist: the Diploma Msc', *Journal of education for information,* April 1996.

Windham D., *L'éducation pour tous: les conditions requises*, Paris, Unesco, 1994.

Wood D., *How children learn and think*, Oxford, UK, Blackwell, 1988.

List of nodes of the MIDAS-NET network (multimedia information demonstration and support)

AUSTRIA

Coordinator

Techno-Z FH Forschung und Entwicklung
Jakob-Haringer-Straße 5
A-5020 Salzburg
Contact:
Dr Peter A. Bruck
Tel. (43-662) 45 36 78
Fax (43-662) 45 61 74
E-mail: tzsr@dir.FH-sbg.ac.at

Partners

APTA, Austrian Platform on Telematic Applications, Linz.
BIT, Bureau for International Research and Technology Cooperation, Wien.
Techinform, Wirtschaftskammer Österreich, Wien.
Technologie Agentur Techno-Z GmbH, Salzburg.

BELGIUM

Coordinator

Bruxelles Technopole 'Technopol'
Rue Gabrielle Petit, 4 bte 12
B-1080 Brussels
Contact:
Mr Pierre Van Antwerpen
Tel. (32-2) 422 00 20
Fax (32-2) 422 00 43
E-mail: pierre.van.antwerpen@technopol.be

Partners

DGTRE (Gen. Dir. for Technology, Research and Energy), Namur.
Flemish Institute for the Promotion of S&T Research, IWT, Brussels.

DENMARK

Coordinator

DTI EuroCenter Erhvervsfremme Styrelsen
Danish Technological Institute
Gregersensvej — Bygning 1
DK-2630 Taastrup
Contact:
Ms Sanne Plichta
Tel. (45) 43 50 40 00
Fax (45) 43 71 63 60
E-mail: MIDAS@dti.dk

Partners

Danish Library Centre, Ballerup.
Danish Technological Institute, Market Service, Taastrup.
Euro Info Centre Herning, (EIC-DK054), Herning.

FINLAND

Coordinator

VTT Information Service - VTT Tietopalvelu
Technical Research Center of Finland
Vuorimiehentie 5, Espoo
PO Box 2000
FIN-2044 VTT
Contact:
Ms Elisabet Mickos
Tel. (358-9) 45 61
Fax (358-9) 456 43 74
E-mail: elisabet.mickos@vtt.fi

Partners

University of Jyväskylä (ITRI), Information Technology Research Institute Jyväskylä, Jyväskylä.
Develco, The Upper-Savo Development Company Ltd, Iisalmi.

FRANCE

Coordinator

CEC (Centre européen de la communication)
23, Parvis des Chartrons
F-33074 Bordeaux
Contact:
Mr Thierry Ulmet
Tel. (33-5) 56 01 76 76
Fax (33-5) 56 01 76 77
E-mail: midas@cec.fr

Partners

ADBS, Association française des professionnels de l'information et de la documentation, Paris

Coordinator

CCIP (Chambre de commerce et d'industrie de Paris).
27, avenue de Friedland
F-75382 Paris
Contact:
Ms Evelyne Houdard-Duval
Tel. (33-1) 42 89 72 42
Fax (33-1) 42 89 72 10
E-mail: infosdec@ccip.fr

Partners

Assemblée des chambres françaises de commerce et d'industrie, Paris.
Association française pour le commerce et les echanges electroniques, Paris.
Association Telefirm, Paris.
Association Telexport, Paris.

GERMANY

Coordinator

GMD (Forschungszentrum Informationstechnik GmbH)
Dolivostraße 15
D-64293 Darmstadt
Contact(s):
Ms Marlies Ockenfeld
Tel. (49-6151) 86 98 12
Fax (49-6151) 86 98 18
E-mail: ockenfeld@gmd.de

Partners

DGD, Deutsche Gesellschaft für Dokumentation e.V., Frankfurt am Main.
Industrie- und Handelskammer zu Aachen, Aachen.
Infonetz Bayern e.V., Regensburg.
IW, Institut der deutschen Wirtschaft Köln, Köln.
Medien- und Filmgesellschaft Baden-Württemberg mbH, Stuttgart.

Coordinator

TVA Technologie-Vermittlungs-Agentur Berlin e.V.
Wattstraße 11-13
D-13355 Berlin
Contact:
Dr Stephan Buettner
Tel. (49-3046) 302 469
Fax (49-3046) 302 444
E-mail: TVA@bbtt.com

Partners

BTI, Beratungsgesellschaft für Technologietransfer und Innovationsförderung mbH, Dresden.
GMD, Forschungszentrum Informationstechnik GmbH, Berlin.
LITZ, Leipziger Innovations- und Technologiezentrum GmbH, Leipzig.
SET, Sächsische Entwicklungsgesellschaft für Telematik, Leipzig.
THATI, Thüringer Agentur für Technologietransfer und Innovationsförderung GmbH, Suhl.

GREECE

Coordinator

NDC National Documentation Centre
48 Vas. Constantinou Avenue
GR-11635 Athens
Contact:
Mr Filippos Tsimpoglou
Tel. (30-1) 724 90 29
Fax (30-1) 724 68 24
E-mail: ftsimp@iris.ekt.org.gr

Partners

ACCI, Athens Chamber of Commerce and Industry, Athens.
Clotefi SA, Clothing Textile and Fiber Technological Development SA, Athens.
ETAT SA, Food Industrial Research and Technological Development Company SA, Athens.

ICELAND

Coordinator

FII Federation of Icelandic Industries
Hallveigarstíg 1, Box 1450
IS-121 Reykjavík
Contact:
Mr Adalsteinn Magnusson
Tel. (354) 511 55 68
Fax (354) 562 07 58
E-mail: midasajm@rhi.hi.is

Partners

RLO, Research Liaison Office, Reykjavík.
SITF, The Icelandic Forum of IT & T Users, Reykjavík.
VEDA, Vocational Education Association, Reykjavík.

IRELAND

Coordinator

BTiS University of Limerick
Business and Technical Information Service Limited
PO Box 123
Limerick Ireland
Contact:
Ms Martina Flynn
Tel. (353-61) 20 24 28
Fax (353-61) 20 25 72
E-mail: martina.flynn@ul.ie

Partners

Arthouse, Multimedia Centre for the Arts, Dublin.
Irish Interactive Multimedia Association, Dublin.
Multimedia Technologies Ireland Ltd, Limerick.
NUA, Dublin.
Shannon Development, Shannon, Co. Clare.

ITALY

Coordinator

Amitié
Via Val d'Aposa 3
I-40123 Bologna
Contact:
Mr Pier Giacomo Sola
Tel. (39-51) 23 01 07
Fax (39-51) 23 58 90
E-mail: pgs@bologna.nettuno.it

Partners

AIE, Associazione italiana editori, Milano.
Associazione Orlando, Bologna.
Azienda agricola f.lli Filippo e Carlo De Blasio di Palizzi, Villa S. Giovanni (RC).
Cineca, Consorzio interuniversitario per la gestione del centro di calcolo elettronico dell'Italia nord-orientale, Casalecchio di Reno (BO).
FAST, Federazione delle associazioni scientifiche e tecniche, Milano.
G.B. Palumbo & C. Editore SpA, Palermo.

Coordinator

Pitagora S.p.A.
Via G. Rossini, 1
I-87036 Rende (CS)
Contact:
Ms Liliana Le Piane
Tel. (39-984) 83 61
Fax (39-984) 83 62 00
E-mail: lepiane@PITAGORA.it

Partners

AIB, Associazione italiana biblioteche, Roma.
BIC Toscana Scpa, Massa.
Cedcamera, Milan Chamber of Commerce, Milano.
ENEA, Ente per nuove tecnologie, energia e ambiente, Bologna.
Infocamere ScpA, Roma.

LUXEMBOURG

Coordinator

Centre de recherche public Henri Tudor
6, Rue Coudenhove Kalergi
L-1359 Luxembourg
Contact:
Mr Guy Kerger
Tel. (352) 425 99 11
Fax (352) 425 99 12
E-mail: info@midas.lu

Partners

Chambre de commerce, Luxembourg.
CMLUX, chambre des métiers, Luxembourg.
Fondation Promomédia, Luxembourg.

NETHERLANDS

Coordinator

NBBI Project Bureau for Information Management
PO Box 80544
2508 GM The Hague Netherlands
Contact(s):
Mr Frank J. Andriessen
Tel. (31-70) 360 78 33
Fax (31-70) 361 50 11
E-mail: secretariaat@nbbi.nl

Partners

Stichting Euro Info Centrum Midden-Nederland, Utrecht.
Stichting Media Plaza, Utrecht.
TNO, Multimedia and Telecommunications, Delft.

NORWAY

Coordinator

Statskonsult Dir. of public management
Falbesgt. 5, Oslo 1
PO Box 8115, Dep.
N-0032 Oslo
Contact:
Ms Katarina de Brisis
Tel. (47-22) 45 10 00
Fax (47-22) 60 21 11
E-mail: katarina.brisis@Statskonsult.DEP.telemax.no

Partners

Agder Research Foundation (Agderforskning), Grimstad.

Infosøk, Technical University Library of Norway, Trondheim.

The National Institute of Technology (TI), Oslo.

VINN, North Norw. Inst. of Technology and Innovation, Narvik.

PORTIUGAL

Coordinator

INETI (Instituto Nacional de Engenharia e Tecnologia Industrial)
Estrada do Paço do Lumiar
P-1699 Lisboa Codex
Contact:
Prof. Ana Maria Ramalho Correia
Tel. (351-1) 716 51 41
Fax (351-1) 716 47 32
E-mail: midas-pt@citi.ineti.pt

Partners

APM, (Associação Portuguesa de Multimédia), Porto.

Associação para a Promoção do Multimédia em Portugal, (PT SIG-MM), Lisboa.

IM-MC, Estrutura de projecto de apoio à iniciativa «Mosaico», Lisboa.

SPAIN

Coordinator

Asedie Asociación Española de Distribuidores de Información Electrónica
Londres, 17-2
E-28028 Madrid
Contact:
Mr Jaime Tascrid
Tel. (34-1) 726 10 39
Fax (34-1) 726 10 70
E-mail: asediejt@sarenet.es

Partners

Cindoc-CSIC, Centro de Información y Documentación Científica, Madrid.

Coordinator

Fundació Catalana per la Recerca
Passeig Lluís Companys, 23
E-08010 Barcelona
Contact:
Ms M. Domenech
Tel. (34-3) 315 23 23
Fax (34-3) 268 01 01
E-mail: maribel@fcr.es

SWEDEN

Coordinator

Swedish Educational Broadcasting Company (UR)
Tulegatan 7
S-113 95 Stockholm
Contact:
Ing-. Marie Olofsdotter
Tel. (46-8) 784 40 00
Fax (46-8) 612 71 32
E-mail: iol@ur.se

Partners

EIC NUTEK, Swedish National Board for Industrial and Technical Development, Stockholm.

Royal Institute of Technology (KTH), Stockholm.

Swedish Agency for Administrative Development (Statskontoret), Stockholm.

Swedish Institute for Systems Development (SISU), Stockholm.

Swedish TelePedagogic Knowledge Centre (STPKC), Nyköping.

UNITED KINGDOM

Coordinator

Scottish Enterprise
120 Bothwell Street
Glasgow G2 7JP United Kingdom
Contact:
Mr Robin Urry
Tel. (44-141) 248 27 00
Fax (44-141) 221 32 17
E-mail: robin.urry@scotent.co.uk

Partners

aBaCus Partnership, Belfast.

IRTU, The Industrial Research and Technology Unit, Co. Antrim.

Pharos Scientific, Dundee.

University of Dundee, Department of Medical Physics, Dundee.

Coordinator

UK MM-SIG LTD
The Old Office Block
Elmtree Road
Teddington, Middlesex TW11 8ST United Kingdom
Contact:
Mr Neil Sandford
Tel. (44-181) 977 7670
Fax (44-181) 943 33 77
E-mail: mmsig-admin@ukerna.ac.uk

Partners

Coventry University Enterprises Ltd, Coventry.
Yorkshire and Humberside Regional Technology Network, Batley, W. Yorkshire.
Information and Communication Industries Association, Twyford, Berks.
The International Visual Communication Association, London.
Open Learning Foundation Ltd. London.
Welsh Development Agency (WDA), Cardiff.

STATISTICAL NODE

Coordinator

Messageries du Livre
5, rue Raiffeisen
BP 2022
L-1020 Luxembourg

Contact:
Mr Dieter Eixler
Tel. (352) 499 88 88
Fax (352) 499 88 84 44
E-mail: mdl@pt.lu

Partners

INE, (Instituto Nacional de Estatistica), Lisboa, Portugal.
INSEE, Inst. national Statistique et Etudes économiques, Paris, France.
ISTAT, Instituto nazionale di Statistica, Roma, Italy.
Jean De Lannoy, Brussels, Belgium.
Mundi Prensa Libros S.A., Madrid, Spain.
Office for National Statistics, London, United Kingdom.

List of participants

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Norbert Bartos	Technologisches Gewerbemuseum	Wexstraße 19-23	A-1200 Vienna	(43-1) 33 12 63 41	(43-1) 33 12 62 04	bartos@email.tgm.ac.at
Margit Heissenberger	Socrates office	Schreyvogelg. 2	A-1010 Vienna	(43-1) 534 08 39	(43-1) 534 08 50	heissenberger.soc@beb.ac.at
Bart Boelaert	Vlekho Brussels	Gentsesteenweg	B-9620 Zottegem	(32-9) 361 23 47		tigro@www.dma.be
René Caderius Van Veen	Group Eur-BIT EEIG	Karel Martelstraat 22	B-1000 Brussels	(32-2) 2800474		eur-bit@infoboard.be
Antoine Cochet	European Trade Union College	Bld Emile Jacquain 155	B-1210 Brussels	(32-2) 224 05 30	(32-2) 224 05 33	acochet@etuh.lrt.be
Christian Delcorte	MERF	Rue de la Science 43	B-1040 Brussels	(32-2) 2388650		marc.van.riet@skynet.be
Brigitte Denis	Université de Liege	Service Technologie de l'Education Sart Tilman Bat. B 32	B-4000 Liege 1	(32-4) 43 66 20 72	(32-4) 366 29 53	
René Dufour	MERF	Rue de la Science 43	B-1040 Bruxelles	(32-2) 238 86 50		marc.van.riet@skynet.be
Dirk Geens	Vlekho	Koningsstraat 336	B-1030 Brussels	(32-2) 221 12 11	(32-2) 219 78 79	DIRK.GEENS@ping.be
Rolando Guzzi	Institut Solvay	Université Libre de Bruxelles Campus Plaine — CP 231	B-1050 Brussels	(32-2) 650 57 85	(32-2) 650 50 28	
Mary Killeen	European Parents Association	Rue Belliard 23a	B-1049 Brussels	(32-2) 230 37 20	(32-2) 230 37 22	
Francis Lagae		Ernest Claeslaan 8	B-3080 Tervuren	(32-2) 767 37 96	(32-2) 767 04 66	101654.2504@compuserve.com
Roland Nyns	Question Mark Logiciels	Rue E. Banning 44	B-1050 Brussels	(32-2) 646 99 49	(32-2) 646 99 59	100663.1252@compuserve.com
Claire Paulaint	Université Libre de Brussels	Rue de Villers 227	B-6040 Charleroi	(32-71) 60 02 04	(32-71) 60 02 05	CPOULAIN@ulb.ac.be
Michèle Sanglier	Institut Solvay	Université Libre de Bruxelles Campus Plaine — CP 231	B-1050 Brussels	(32-2) 650 57 85	(32-2) 650 50 28	

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Walter Staveloz	Ecsite	Bd. du Tromphe 63	B-1160 Brussels	(32-2) 647 50 98	(32-2) 647 50 98	
Redgy Van Hove	Mercator Hogeschool Gent	Applied Linguistic Department Acaciastraat 6	B-9820 Merelbeke	(32-9) 231 01 90	(32-9) 265 85 31	redgy.maurits.van.hove @poboxes.com
Jean Warnon	Collège Sainte-Gertrude	Faubourg de Mons 1	B-1400 Nivelles	(32-2) 384 76 14	(32-2) 384 76 14	
Hilde Willemsen	GIM SA	Interleuvenlaan 5	B-3001 Heverlee	(32-16) 40 30 39		hilde@gim.be
Ib Krantz	AMTEQ	Nygade 1B	DK-8600 Silkeborg	(45-86) 80 30 42	(45-86) 80 44 09	AMTEQ@post1.tele.dk
Flemming Poulsen	AMTEQ	Nygade 1B	DK-8600 Silkeborg	(45-86) 80 30 42	(45-86) 80 44 09	
Reijo Aholainen	National Board of Education	Hakaniemenkatu 2	FIN-00530 Helsinki	(358-9) 77 47 72 56	(358-9) 77 47 72 47	tiina.wathen@oph.fi
Martti Hellstrom	Aurora Primary School	Lippajärventie 44A	FIN-02940 Espoo			
Erkki Lehtinen	University of Jyväskylä	Continuing Education Centre PO BOX 35	FIN-40351 Jyväskylä	(358-14) 60 37 02	(358-14) 60 25 21	erkkil@jyu.fi
Leena Leskinen	Töölön ala-aste	Väinämöisenkatu 11 A 12	FIN-00100 Helsinski	(358-9) 31 08 65 78		
Ilkka Mäkitalo	University of Jyväskylä	PO Box 35	FIN-040351 Jyväskylä			itmakita@tukki.jyu.fi
Henrik Räsänen	Tampere Technology Centre Ltd	Hermiankatu 14	FIN-33720 Tampere	(358-3) 316 55 57	(358-3) 316 55 52	henrik.rasanen@hermia.fi
Sinikka Salakari	Media Center	Kivitorpantie 5 A 12	FIN-00330 Helsinki		(358-9) 31 08 63 74	sinikka.salakari@edu.hel.fi
Sigge Sandström	Munksnäs lågstadieskola	Locklaisvägen 9	FIN-00330 Helsinki		(358-9) 31 08 66 70	sigge@edu.hel.fi
Kari Sevon		Kijimolankatu 17	FIN-74130 Iisalmi			kari.sevon@iisalmi.fi
Sauli Sohlo	University of Oulu	Department of Teacher Education PO Box 222	FIN-90571 Oulu	(358-8) 553 36 86	(358-8-5533744	ssohlo@ktk.oulu.fi
Lucien Blanc		11, bis Av. de de Suffren	F-75007 Paris	(33-1) 47 34 70 80	(33-1) 41 26 57 60	

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Jean-Pierre Broville	APEC	9, Rue Mazagran Espace Corbin CS 5403	F-54054 Nancy Cedex	(33-3) 83 17 45 04	(33-3) 83 32 41 02	
Marie-Françoise Bruneau	DAFCO	34, bd Lundy	F-51100 Reims	(33-3) 26 61 65 85	(33-3) 26 88 77 96	
André Danzin	Club of Rome	41, Av. Kléber	F-75116 Paris	(33-1) 45 53 70 45		
Martine Deberghes	FAS	Residence Chambord 8, rue Laveran	F-57000 Metz			
François Defoort	EDHEL	58, Rue du Port	F-59046 Lille Cedex	(33-3) 20 15 44 83	(33-3) 20 15 45 01	
Pascal Dupretz	EDHEC	58, Rue du Port	F-59046 Lille Cedex	(33-3) 20 15 45 57	(33-3) 20 15 45 01	
Paul Geburtig	Protagora	9, Rue de la Tour du Diable	F-68100 Mulhouse			
Thierry Girault	APTE	BP 518	F-86012 Poitiers Cedex	(33-5) 49 44 99 00	(33-5) 49 01 86 03	APTE@wanadoo.fr
Bernard Herrgott	LP-CFA 'Roosvelt' - Protagora	17, bd. President Roosevelt	F-68092 Mulhouse			
Etienne Kneipp	Mafpen	20, rue des Roses	F-57510 Loupershouse			
Maria Lara	Eurhorizon — Protagora	Residence Le Clos — B1, rue des Festons	F-84120 Pertuis	(33-4) 90 09 66 68	(33-4) 42 63 14 29	
Fanny Lecuyer	Mairie Wasquehal	217, avenue de l'Hyppodrome	F-59130 Lambersaart	(33-3) 20 89 92 26	(33-3) 20 65 72 05	
Denise Levy	Lycée Michel Angoier	41, rue de la République	F-76260 EU	(33-2) 35 50 52 00	(33-2) 35 50 52 10	
Jean Paul Lornage	AFPA	13, Place du Général De Gaulle	F-93108 Montreuil Cedex	(33-1) 48 70 53 18	(33-1) 48 70 53 74	
Patrick Lutzing	Protagora	14, rue des Bateliers	F-67085 Strasbourg	(33-3) 88 14 31 43	(33-3) 88 14 31 55	
Bernard Miège	Université Stendhal Grenoble 3	Domaine Universitaire 1180, avenue Centrale BP 25	F-38040 Grenoble Cedex 9	(33-4) 76 82 43 21	(33-4) 76 82 43 22	
Jean-Jacques Moine	APFEE	28, avenue du Bois	F-69500 Brun	(33-4) 78 26 87 51	(33-4) 72 15 03 95	

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Bernard Monthubert	FIMEM	60, rue Jules Verne	F-86100 Chatellerault	(33-5) 49 21 16 88	(33-5) 49 85 37 24	bernard.monthubert @freinet.interpc.fr
Florence Morales	City of Metz	2, route de Lorry	F-57050 Metz-Devant les Ponts	(33-3) 87 55 52 29	(33-3) 87 30 77 50	
Bohdan Pawlyszyn	Mairie Wasquehal	38, rue Désiré Caus	F-59290 Wasquehal	(33-3) 20 89 92 26	(33-3) 20 65 72 05	
Nadine Portail	Lycée Libergier Protagora	20, rue des Augustins	F-51100 Reims	(33-3) 26 40 13 79	(33-3) 26 77 63 65	
Laurence Presi	Protagora	14, rue des Bateliers	F-67085 Strasbourg	(33-3) 88 14 31 43	(33-3) 88 14 31 55	
Jean-Louis Reiffers	Institut de la Méditerranée	Palais du PHARO 58, bd. Charles Livon	F-13070 Marseille			
Françoise Segard Hennebelle	Arpeit	La Halle aux Sucres 33, avenue Ieuple — BP133	F-59009 Lille Cedex	(33-3) 20 31 18 18	(33-3) 20 51 94 94	
Véronique Six	Mairie Wasquehal	1, rue Michelet	F-59290 Wasquehal	(33-3) 20 89 92 26	(33-3) 20 65 72 05	
Vincent Spitz	CFA 'J. Geiler'	6, rue B. Grien	F-67085 Strasbourg			
André Stengel	Protagora	14, rue des Bateliers	F-67085 Strasbourg	(33-3) 88 14 91 47	(33-3) 88 14 31 55	
Christophe Stengel	CFA 'J. Geiler'	6, rue B. Grien	F-67085 Strasbourg			
Brigitte Thibault	Ecole des Professeurs Lille	60, bd. Vaubau	F-59016 Lille	(33-3) 20 13 41 20	(33-3) 20 13 41 25	
Jean-Bernard Viaud	Association EPI	13, rue du Jura	F-75013 Paris			
J.P. Weissbeck	TP de France	BP 808	F-57000 Metz	(33-3) 87 74 38 45	(33-3) 87 74 98 37	
	Protagora	BP160 — Lycée Louis Marchal 2, route de la Harott	F-67125 Molsheim	(33-3) 88 49 56 00	(33-3-88 49 56 08	
Hugo Adolph	Landesinstitut für Pädagogik und Medien	Beethovenstraße 26	D-66125 Saarbrucken			

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Stefan Bartz	St. Josef Gymnasium	Klosterstraße 2	D-54675 Biesdorf	(49-6566) 80 60		
Franz Bittner	Organis. Europäischer Jugendbegegnungen	Herrenstraße 8	D-54673 Neuerburg/Eifel	(49-6564) 93 00 03	(49-6564) 93 00 05	EVEA-Neuerburg@t-online.de
Guillaume De Meuter	Fachhochschule Würzburg	Ignaz-Schön-Str. 11	D-97421 Schweinfurt	(49-9721-94 07 05	(49-9721) 940 60	
Monique Jucquois-Delpierre	Heinrich-Heine Universität	Otto-Hahn Straße 131	D-40591 Dusseldorf	(49-211) 811 43 18	(49-211-811 29 17	juquois@uni-dusseldorf.de
Carmen Kloft	Institute for Educational Research	Koblenzer Straße 77	D-53177 Bonn	(49-228) 820 90 37	(49-228) 820 90 38	team@ibf.bn.eunet.de
Matthias Meyer	ITB Institute for Test Dev. and Talent Research Ltd	Koblenzer Straße 77	D-53177 Bonn	(49-228) 820 90 27	(49-228) 820 90 38	meyer@itb.bonn.iz-soz.de
Hermann Wolf Richter	MIT GmbH	Am Zollstock 1	D-61381 Friedrichsdorf	(49-6172) 711 00	(49-6172) 71 00 10	info@mit.de
Kostantinos Basbas	c/o NDC	Vas. Constantinou 48	GR-11635 Athens			
Konstantinos Grigoropoulos	c/o NDC	Vas. Constantinou 48	GR-11635 Athens			
Chrysa Sofianopoulou	c/o NDC	Vas. Constantinou 48	GR-11635 Athens			
George Tsakarissianos	Lambrakis Research Foundation	Paparrigopoulou st. 3	GR-10561 Athens	(30-1) 331 18 48	(30-1) 323 06 68	gtsaka@www.lrf.gr
Eva Von Klebelsberg	Count Kuno von Klebelsberg Foundation	Zsigmondy V. u. 10/a	H-1121 Budapest	(36-1) 249 31 04	(36-1) 249 31 03	
Alessandro Candeli	IRRSAE-ER	Via Ugo Bassi,7	I-40123 Bologna	(39-51) 22 76 69	(39-51) 26 92 21	
Walter Casamenti	Distretto XXII	Via Calanco, 166/C	I-40014 CrevaLcore	(39-51) 98 26 17	(39-51) 98 26 17	cdw@arcim.bo.cnr.it
Simonetta Leonesi	Amitié	Via val d'Aposa, 3	I-40123 Bologna	(39-51) 23 01 07	(39-51) 23 58 90	pgs@bologna.nettuno.it

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Michela Moretti	Amitié	Via val d'Aposa, 3	I-40123 Bologna	(39-51) 23 01 07	(39-51) 23 58 90	pgs@bologna.nettuno.it
Pier Giacomo Sola	Amitié	Via val d'Aposa, 3	I-40123 Bologna	(39-51) 23 01 07	(39-51) 23 58 90	pgs@bologna.nettuno.it
Luca Vitali	La Vita scolastica	Via Iacopone da Todi, 25	I-00137 Rome	(39-6) 827 11 36	(39-6) 810 96 68	
Liliana Zilli	Scuola elementare S. Venanzio F.	Via San Venanzio	I-31049 Valdobiaddene	(39-423) 97 21 12	(39-423) 97 21 12	
Anne-Marie Antony	MENFP/SCRIPT	29 rue Aldringen	L-2926 Luxembourg	(352) 478 51 84		antony@men.lu
José Aviles Juarez	Schola Europaea	23 bd Konrad Adenauer	L-1115 Luxbg-Kirchberg	(352) 432 08 21	(352) 42 94 88	
Pino Fiermonte	Aptice	20 rue de l'Ecole	L-3233 Bettembourg	(352) 51 42 54		pino.fiermonte@ci.educ.lu
Albertine Flammang	Lycée Technique Pour Professions de Santé	Centre de formation d'Esch/Alzette Domaine Schlassgoart/Quartier	L-4289 Esch/Alzette		(352) 546 47 42 40	
Gérard Gretsch	MENFP	29 rue Aldringn	L-2926 Luxembourg	(352) 478 52 11	(352) 46 68 15	
Margaret Hall	GIM SA	9 rue Jean Pierre Sauvage	L-2514 Luxembourg	(352) 42 20 43		margaret@gim.lu
Georges Hengesch	Eurogeo	29 rue des Fleurs	L-3468 Dudelange	(352) 51 79 81	(352) 51 79 81	georges.hengesch@ci.educ.lu
Erna Hennicot-Schoepges	Ministère EducationNationale	29 rue Aldringen	L-2926 Luxembourg	(352) 478 51 86	(352) 46 09 27	
Marc Heyart		94 rue des Muguets	L-2167 Luxembourg	(352) 43 26 06	(352-44 73 52	
Rita Jeanty	Lycée du Nord, Wiltz	3 montée de l'Abbaye	L-9701 Clervaux	(352) 910 60	(352) 910 60	
Pierre Koppes	Lycée du Nord	BP 39	L-9501 Wiltz		(352) 95 77 37	
Monique Laroche-Reeff	MENFP	34 avenue de la Porte-Neuve	L-2227 Luxembourg	(352) 478 52 89	(352) 24 18 84	monique.laroche@ci.educ.lu
Roger Meyrath	Lycée Technique du Centre	106 avenue L. Pasteur	L-2309 Luxembourg	(352) 473 81 11	(352) 46 02 98	roger.meyrath@ci.educ.lu
Nubar Minasyan	NMI — Nouveaux MédiasS Informatiques	9 rue de Contern	L-5215 Sandweiler	(352) 35 88 35	(352) 35 98 86	minasyan@tcp.ip.lu

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Joseph Münster	MENFP	29 rue Aldringen	L-2926 Luxembourg	(352) 478 52 17	(352) 46 09 27	muenster@men.lu
Gaston Nilles	Ville de Luxembourg	29 rue Mathias Hertert	L-1729 Luxembourg	(352) 43 16 56		gaston.nilles@ci.educ.lu
Gaston Nilles	Ville de Luxembourg	29 rue Mathias Hertert	L-1729 Luxembourg	(352) 43 16 56		gaston.nilles@ci.educ.lu
Thomas O'Hagan	Schola Europaea	23 bd Konrad Adenauer	L-1115 Kirchberg	(352) 432 08 21	(352) 42 94 88	
Dimitris Pneumatikos	European School/ Primary Kirchberg	23 bd. Konrad Adenauer 14 rue Léon Thyes	L-2636 Kirchberg			
Romain Rassel	Enseignement Luxembourg	35 rue Ernest Beres	L-1232 Howald	(352) 48 56 70		romain.rassel@ci.educ.lu
Jean-Paul Reeff	MENFP	29 rue Aldringen	L-2926 Luxembourg	(352) 478 51 86	(352) 478 51 98	reeff@men.lu
Janice Richardson	ENSTA	1 rue des Pommiers	L-2343 Luxembourg	(352) 43 18 36	(352) 43 72 02	
Isabelle Schutz	Aptice	20 rue de l'Ecole	L-3233 Bettembourg			
Pierre Seck	Centre Universitaire Luxembourg	162A rue de la Faïencerie	L-1511 Luxembourg	(352) 466 64 42 02	(352) 466 64 45 06	seck@cu.lu
Suzanne Serfozo		1 route d'Esch.	L-1470 Luxembourg			
Alice Stern	Infopartners	4 rue Jos Felten	L-1508 Howald	(352) 29 57 59 32 83		astern@ip.lu
Fernand Tremuth	MENFP/Script	15 rue Dr Berger	L-5670 Altwies	(352) 66 87 68	(352) 67 69 80	fernand.tremuth@ci.educ.lu
Frank Trierweiler	Aptice	BP 126	L-3402 Dudelange			
Jean Weber	MENFP	Script	L-2926 Luxembourg	(352) 478 52 69	(352) 478 51 37	jean.weber@ci.educ.lu
Daniel Weiler	Athenee de Luxembourg	24 bd. Pierre Dupong	L-1430 Luxembourg			daniel.weiler@ci.educ.lu
John Welter	MENFP	47 rue de la Liberté	L-5969 Itzig	(352) 36 01 09	(352) 36 01 09	
André Wengler	MENFP	34 av. de la Porte-Neuve	L-2926 Luxembourg	(352) 478 52 10	(352) 24 18 84	

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Alexis Werne	MENFP	Dept. of Education — 29 rue Aldringn	L-2926 Luxembourg	(352) 478 51 96	(352) 46 68 15	werne@men.lu
Leon Wietor	Lycée Technique Agricole	BP 76	L-9001 Ettelbruck	(352) 82515	(352) 821 70	
Marc Willem	Infopartners	4 Jos Felten	L-1508 Howald	(352) 401162221	(352) 401 16 22 34	
Rune Ramstad	Centre for International University Cooperation	Harald Hårfagres gate 20	N-5020 Bergen	(47-55) 54 67 09		dag.ramstad@siu.no
Dag Solbakken	Hovedgaarden Ungdomsskole	Heggedalsbakken 9	N-1380 Heggedal	(47-66) 79 76 60	(47-66) 79 76 50	dsolbakk@online.no
Marit Stromsoe	Gjelleros School	Karisv. 18	N-2013 Skjetten	(47-63) 84 04 55	(47-63) 84 04 09	gjellsk@login.eunet.no
Maria de Lurdes Camacho	Ministério da Cultura	Iniciativa «Mosaico» Palácio Nacional da Ajuda	P-1300 Lisbona	(351-1) 361 45 00	(351-1-364 98 72	mlc@min-cultura.pt
Fátima Campos	Escola-piloto	Rua do Carrascal Lote 15 1.° - Esq.	P-2725 Mem Martins	(351-1) 921 29 08	(351-1) 926 41 55	tesc0315@mail.telepac.pt
Helena Oliveira	Escola Piloto	Rua do Carrascal Lote 15 1 -E	P-2725 Mem Martins	(351-1) 921 29 08	(351-1) 926 41 55	tesc0315@mail.telepac.pt
Jaime Denis	Ministerio de Educación y Cultura	58 Calle Torre Laguna	E-28027 Madrid	(34-1) 407 87 90	(34-1) 368 07 09	
Carlos San José	PNTIC - MEC	Torrelaguna 58	E-28027 Madrid	(34-1) 408 20 00	(34-1) 368 07 09	csanjose@pntic mec.es
Gunnar Backman	KKS	PO Box 3222	S-10364 Stockholm	(46-8) 54 52 11 00	(46-8) 24 75 09	gunnar.backman@kks.se
Magnus Brattgård	Statskontoret	PO Box 2280	S-103 17 Stockholm	(46-8) 454 47 20	(46-8) 454 46 93	magnus.brattgard @statskontoret.se
Riedjn Esqgaard	Läromästaren	Mistelgatan 7	S-754 37 Uppsala	(46-18) 25 60 51		
Stefan Gustafson	Alvikskolan	Tranebergsvägen 73	S-161 32 Bromma	(46-8) 704 79 00	(46-8) 704 79 07	
Tommy Isaksson		Gammelgardsvägen 4	S-784 44 Borlänge			
Hans Jalling	National Agency of Higher Education	Box 7851	S-103 99 Stockholm	(46-8) 453 71 61	(46-8) 453 71 92	hans.jalling@hsv.se

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Nina Bisschop	Catholic University Nijmegen	Department of Educational Sciences Montessorilaan 3	NL-6525 HR Niljmegen	(31-24) 361 25 62		N.bisschop@ped.kun.nl
Willem J. Pelgrum	University of Twente	OCTO PO BOX 217	NL-7500 Enschede			
Guy Renaud		Laan Van Clingenael 43	NL-2597 La Haye			
Hans Schuurmans	Fontys/PTH-Contract	PO Box 826 Het Eeuwsel 2	NL-5600 AV Eindhoven	(31-40) 247 24 27		j.j.a.m.schuurmans@pth.nl
Jerry Smith	Euraltis B.V.	Herikkruid 20	NL-1441 XH Purmerera	(31-299) 42 00 69	(31-299) 42 00 69	
Alison Banks	Beacon Community College	Crowborough	TN6 2AS East Sussex United Kingdom	(44-1892) 65 34 51	(44-1892) 66 37 63	ab@beacon.e-sussex.sch.uk
Roy Birnie	South Ayrshire Council	Educational Services The Avenue	KA26 9DW Girvan United Kingdom	(44-1465-71 30 08	(44-1465) 71 57 08	
Richard Coton	Shawlands Academy	31 Moss-Side Road	G41 3TR Glasgow United Kingdom	(44-141) 632 11 54	(44-141) 636 10 07	
Anne Haxton	Greenwood Academy	Dreghorn	KA11 4HL Irvine United Kingdom	(44-1294) 21 31 24	(44-1294) 21 19 50	
Jim Hudson	Two Mile Ash (GM) - Middle School	The High Street Two Mile Ash	MK8 8LH Milton Keynes United Kingdom	(44-1908) 56 22 62	(44-1908) 26 37 35	head@tma:school:demon:co.uk
Jeff Morgan	NCET	Milburn Hill Road Science Park	CV4 7JJ Coventry United Kingdom			
Brigid Rooney	St. Joseph's Academy	Grassyards Road	KA1 2BE Kilmarnock United Kingdom	(44-1563) 52 71 97	(44-1563) 54 24 18	
Tony Van der Kuyl	SITC	Moray House Inst. Holyrood Road	EH8 8AQ Edinburgh United Kingdom	(44-131) 558 60 39	(44-131) 557 20 05	mail@sitc.demon.co.uk

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Lydia Barreiros	European Commisssion	Eurostat Jean Monnet Building	L-2920 Luxembourg	(352-430) 13 46 67		
Daniel Deberghes	European Commisssion	DG XIII/E — Jean Monnet Building	L-2920 Luxembourg	(352-430) 13 47 25	(352-430) 13 28 47	
Andrew Folkmanis	European Commisssion	DG III — rue de la Loi 200	B-1049 Brussels			
Alice Fracchia	European Commisssion	DG XXII/A/I rue Belliard 5-7	B-1049 Brussels	(32-2) 296 48 73		
Yves Franchet	European Commisssion	Eurostat — Jean Monnet Building	L-2920 Luxembourg	(352) 430 13 31 07		
Martina Huber	European Commisssion	DG XXII — rue de la Loi 200	B-1049 Brussels	(32-2) 299 20 74	(32-2) 296 62 97	Martina.Huber@dg22.cec.be
Veronique Jensen-Heymans	European Commisssion	DG IX — Bat WAG-CE	L-2920 Luxembourg			
Madeleine Kiss-Schnepf	European Commisssion	Library BP 1907	L-2920 Luxembourg	(352-430 13 28 08		Madeleine.Kiss schnepf@dg10.cec.be
Domenico Lenarduzzi	European Commisssion	DG XXII/A — rue Belliard 5-7	B-1049 Brussels			
José Alberto Millan	European Commisssion	DG XIII/A.6 — rue de la Loi 200	B-1049 Brussels	(32-2) 299 01 16	(32-2) 296 91 31	
Photis Nanopoulos	European Commisssion	Eurostat — Jean Monnet Building	L-2920 Luxembourg	(352) 430 13 24 43	(352) 430 13 47 71	photis.nanopoulos @eurostat.cec.be
Vicente Parajon Collada	European Commisssion	DG XIII — rue de la Loi 200	B-1049 Brussels			
Laurent Probst	European Commisssion	Eurostat Jean Monnet Building EUFO 2174	L-2920 Luxembourg	(352) 430 13 47 85	(352-430 13 25 94	
Michail Skaliotis	European Commisssion	Eurostat Jean Monnet Building EUFO 2174	L-2920 Luxembourg	(352) 430 13 20 11	(352-430 13 44 15	

List of people who requested documentation

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Huguette Clignet	Bureau Réseaux	Rue Rafhay 14	B-4877 Olne	(32-87) 26 75 23		reseaux@pophost.eunet.be
Fabien Durand	Deleg. Paris — Ile de France	Avenue des Arts, bte 6	B-1210 Brussels	(32-2) 223 18 40	(32-2) 223 18 56	
Begona Juarez Perez	Fundacion Galicia Europa	Avenue Milcamps 105	B-1030 Brussels	(32-2) 735 54 40	(32-2) 735 46 78	GaliciaBru@pophost.eunet.be
Isabelle Lenarduzzi		place Marguerite d'Autriche 21	B-1083 Brussels	(32-2) 465 98 33		
L. Pepin	Eurydice	Rue d'Arlon 15	B-1050 Brussels			
Tom Provoost	Hogeschool voor wetenschap en kunst	Departement Architectuur Sint-Lucas Paleizenstraatt 65	B-1030 Brussels	(32-2) 242 00 00	(32-2) 245 14 04	wenkarch@innet.be
Walter Roossens	Hogeschool voor wetenschap en kunst	Birminghamstraat 41	B-1070 Brussels	(32-2) 410 46 31	(32-2) 410 41 34	
C. Santana	Gob. Islas Canarias	Avenue de la Toison d'Or 55	B-1060 Brussels	(32-2) 534 97 33	(32-2) 534 97 34	
Johan Verbeke	Hogeschool voor wetenschap en kunst	Departement Architectuur Sint-Lucas Paleizenstraatt 65	B-1030 Brussels	(32-2) 242 00 00	(32-2) 245 14 04	wenkarch@innet.be
Leon Martinsen	AMTEQ	Nygade 1 B	DK-8600 Silkeborg	(45-86) 80 30 42	(45-86) 80 44 09	AMTEQ@post1.tele.dk
Claus Witfelt	AMTEQ	Nygade 1 B	DK-8600 Silkeborg	(45-86) 80 30 42	(45-86) 80 44 09	AMTEQ@post1.tele.dk
Jean-Claude Andre	Lycée	BP 202 20, av. de Gail	F-67211 Oberrtai			
Jean-Claude Calvel	Protagora	19, rue d' Alsace	F-67380 Lingolshelm			
Rene Cluzel	Unesco	Div. Inf. 7, place de Fontenoy	F-75015 Paris			

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Gasperment	LP-CFA Roosvelt - Protagora	17, boulevard President Roosvelt	F-68092 Mulhouse			
Michel Gerhart	Protagora	Lycée des Palmiers avenue Banco	F-06300 Nice			
J. Yves Gourvès	E-F & D	4, square Roc Egine	F-49100 Angers	(33-2) 41 48 45 40	(33-2) 41 48 45 54	
Colette Grosjean	Protagora	12, rue de Bouxwiller	F-67000 Strasbourg			
Françoise Hastings		8, quai Choiseul	F-54000 Nancy	(33-3) 83 85 31 65	(33-3) 83 37 00 50	
André Lasserre	AFT-IPTL Protagora	Institut Pédagogique	F-60290 Monchy Steloi			
Janique Laudouar	Éducation Nationale	Université Paris 8 8, rue Coustou	F-75018 Paris	(33-1) 42 59 42 19		janique@imaginet.fr
B. Malgorn	Hôtel de la Préfecture		F-57000 Metz			
Jean-Pierre Meline	AUEF Lorraine	2, rue de la Citadelle	F-54000 Nancy	(33-3) 83 37 96 16	(33-3) 83 35 09 92	meline@ciril.fr
Youcher Mentalecheta	Unesco	19, rue Castagnary	F-75015 Paris	(33-1) 48 56 88 27	(33-1) 48 56 88 27	y.menta@unesco.org
Michel Moutrille	DAFCO	60 E, rue du 14 Julliet	F-21300 Chenove			
Jean-Claude Papoz	Office international de l'eau	Direction Générale 21, rue de Madrid	F-75008 Paris	(33-1) 44 90 88 65	(33-1) 40 08 01 45	
Marina Perini		49, rue du Général Compere	F-51000 Chalons en Champagne	(33-3) 26 21 69 14		
Jean Repplinger	Lycée Gutenberg	22, rue de Lixenbuhl	F-67406 Telkirch			
Odile Rojare	Enseignement Supérieur Sainte-Marie	2, rue de l'Alouette	F-93460 Gournay	(33-1) 43 05 39 86	(33-1) 60 09 87 99	
Larisa Shavinina	Inetop	41, rue de Gay-Lussac	F-75005 Paris	(33-1) 43 25 27 03	(33-1) 44 10 79 11	pieron@veham.cnam.fr
Norbert Stoffel	CFA J. Verne	31, rue St. Nicholas BP 126	F-67703 Saverne			

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Brice Tekieli		18, rue Ste Apolline	F-57920 Veckring Kedange s/Canner	(33-3) 82 82 33 12		
Catherine Theodose	Enseignement Supérieur Sainte-Marie	10, rue J. B. Tholozan	F-77600 Bussy St. Georges		(33-1) 60 09 87 99	
Daniel Villars	Protagora	BP 108 Lycée Haut Barr	F-67703 Saverne	(33-3) 88 71 22 11	(33-3) 88 71 29 41	
Thomas Gehr	Rudolf Eberle Schule Protagora	Bippelinger Straße, 3	D-7880 Bad Sackingen			
Edmund Ohlendorf	IWB	Steinmattenstr. 15	D-79194 Gundelfingen	(49-761) 548 33		ohlendor@ruf.uni-freiburg.de
Wolfgang Schmitt-Kölzer	Lernen Förderv.	Max-Planck-Str. 4	D-54516 Wittlich	(49-6571) 285 79	(49-6571) 262 41	0657120802-0001@t-online.de
Johann Schwarz	TC	Zellerstraße 17	D-53175 Bonn	(49-228) 31 62 31	(49-228) 31 62 30	jschwarz2@compuserve.com
Aris Kantas	c/o NDC	48, Vas. Constantinou	GR-11635 Athens			
Maria Karadimitris	Polyglosso	92, Tsimiski Street	GR-54622 Thessaloniki	(30-31) 26 40 20	(30-31) 44 81 96	
Efrossini Kostaki	Hellenic Society for Study & Protection of Monk Seal	18, Solomou Street	GR-10682 Athens	(30-1) 522 28 88	(30-1) 5222450	
John Hurley	Ednet Ireland	Johninstown Maynooth	Kildare Ireland	(353-1) 627 46 11		ednet@iol.ie
Nira Krumholtz	Technion	Israel Institute of Technology	IL-32000 Haifa	(972-4) 822 82 78	(972-9) 955 76 65	ttrnira@techunix.technion.ac.il
Anton Auer	Dialogon coop	Corso Libertà, 42	I-39100 BOLZANO	(39-471) 27 22 61		support@link-bz.comlink.apc.org
Maristella Agosti	Università di Padova	Dipartimento di elettronica e informatica Via Gradenigo, 6/a	I-35131 Padova	(39-49) 827 76 50	(39-49) 827 76 99	agosti@dei.unipd.it

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Luisanna Fodde	Università di Cagliari	Facoltà di economia Viale Fra Ignazio, 72	I-09100 Cagliari	(39-70-6753358	(39-70) 66 84 40	
Paola Schiavo	Accademia nazionale di medicina	Segreteria generale Piazza della Vittoria, 15/1	I-16121 Genova	(39-10) 545 86 11	(39-10) 54 17 61	
Ed Kohl	Centre de Technologie de l'Éducation	BP 2	L-7201 Walferdange	(352) 333 42 03 51	(352) 33 37 97	ed.kohl@cte.lu
Serge Kollewelter	ASTI	10, rue Laval	L-1922 Luxembourg	(352) 43 83 33	(352) 42 08 71	sergekollwelter@ci.educ.lu
Guy Ney	Institution St. Willbrord	25, rue du Village	L-6585 Steinheim	(352) 72 03 13 45		
José Pastor	Infopartners	4, Jos Felten	L-1508 Howald	(352) 29 57 59 34 60		Pastor@ip.lu
Prosper Schroeder	ALIAI	119, av. Diderich	L-1420 Luxembourg			
Merete Bjornstad	Universitetsforlaget AS	Postboks 2959 Toyen	N-0608 Oslo			mbj@scup.no
Brigitte Helene Johnsen	Gjelleros School	Postboks 85	N-2013 Skjetten	(47-63) 84 04 55	(47-63) 84 04 09	bhjohnse@online.no
Tor Arne Wolner	Gjoklep Ungdomsskole	Vestoyvelen	N-3080 Holmestrand	(47) 330 521 17	(47) 330 51 99	Wolner@sn.no
Andrzej Miecznicowski	Technical University of Wroclaw	Department of Chemistry ul. Gdanska 7/9	PL-50-344 Wroclow			miecznik@pwr.wroc.pl
Artur Nunes	Escola n°1 de Algés	Viv. Mar e Sol Av. Jorge V	P-2775 Carcavelos	(351-1) 456 35 70		artur.nunes@ip.pt
Vítor Reia	Universidade do Algarve	Ciências da Comunicação Campus da Penha — ESE	P-8000 Faro	(351-89) 80 35 61	(351-89) 86 46 75	vbaptist@mozart.si.ualg.pt
Vítor Reia-Baptista	Universidade do Algarve	Campus da Penha — ESE	P-8000 Faro	(351-89) 80 35 61		vbaptist@mozart.si.ualg.pt
Angela Ionita	ICI — Research Institute for Iinformatics	8-10, Maresal Averescu Ave.	RO-71316 BUCHAREST	(40-1) 665 60 60	(40-1) 312 85 39	AIONITA@TD1.ICI.RO or AIONITA@U3.ICI.RO

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
	for Iinformatics	Ave.				AIONITA@U3.ICI.RO
Javier Martinez Mendez	Universidad de Murcia	Campus de Espinardo s/n. Apd. 4201	E-30001 Murcia	(34-68) 36 41 52		javima@gaia.fcu.um.es
Francesco Massone		Hornsgatan 151, 3 tr	S-117 34 Stockholm	(46-8) 668 56 29		frmss@hotmail.com
W. Albeda		Bisschopsmolengang 14b	6211 Maastricht Netherlands			
B. De Goei	PRINT	Standaardmolen 52	6003 Ck Weert Netherlands	(31-49) 553 14 65	(31-49) 553 14 65	elpee@pi.net
L. Peeters	PRINT	Standaardmolen 52	6003 Ck Weert Netherlands	(31-49) 553 14 65	(31-49) 553 14 65	elpee@pi.net
Rob Van Nunen		Nieuwstraat 11	6436 BX Amstenrade Netherlands			106057.3305@compuserve.com
Mark Weeting	Hogeschool Limburg	De Keyserstraat 8	6661 GD Elst (GLD) Netherlands	(31-46) 452 81 93		mweeting@telebyte.nl
Pat Barnett	Burley Middle School	Langford Lane	LS29 7TJ Burley in Wharfedale United Kingdom	(44-1943) 86 26 42		school@burleyms.demon.co.uk
Roy Birch	University of Portsmouth	Furze Lane Milton	PO4 8LW Portsmouth United Kingdom			
Rosemary Doherty	Information Ireland	3-5 London Street	BTH8 6RQ Londonderry United Kingdom	(44-1504) 26 68 17	(44-1504) 37 02 98	
Nirjana Herak	Institute of European Trade and Technology	29 Throgmorton Street	EC2N 2AT London United Kingdom	(44-171) 628 97 70	(44-171) 628 76 92	
Gary Jones	University of Reading	Palmer Building Whiteknights	RG6 6AH Reading United Kingdom	(44-118) 931 86 27	(44-118) 931 89 79	G.L.A.Jones@rdg.ac.uk

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Barbara Jones	Manchester Metropolitan University	Humanities Building Rosamond Street West	M15 6LL Manchester United Kingdom	(44-161) 247 61 65	(44-161) 247 63 51	email b.jones@mmu.ac.uk
Ray Lewis	University of Bath			(44-1225) 82 61 67	(44-1225) 82 61 13	edsrl@bath.ac.uk
Lorna Milne	Bournemouth and Pool College	Lansdowne	BH1 3JJ Bournemouth United Kingdom	(44-1202) 20 53 99	(44-1202) 20 54 41	euroga.bpcfe@dial.pipex.com
Jane Mitra		14a Northgate end	CM23 2EU Bishop's Stortford United Kingdom	(44-1279) 50 49 74		
Moira Monteith	Sheffield Hallam University	School of Education Collegiate Crescent	S30 2RF Sheffield United Kingdom			M.C.Monteith@shu.ac.uk
P. Stojovic	BBC — World Service	9 Summerlee Avenue	N2 9QP London United Kingdom	(44-181) 444 17 44	(44-181) 444 17 44	
Gwen Vandervelden	University of Kent	Computing Laboratory Canterbury	CT2 7NF Canterbury United Kingdom	(44-1227) 82 76 19	(44-1227) 76 28 11	G.M.Vandervelden@ukc.ac.uk
Ann Wells	Alloway PS	16, Doonholm Road	KA7 4QQ Ayr United Kingdom	(44-1292) 44 18 02	(44-1292) 44 55 87	
David Womersley	Burley Middle School	Langford Lane	LS29 7TJ Burley in Wharfedale United Kingdom	(44-1943) 86 26 42		school@burleyms.demon.co.uk
Edith Cresson	European Commission	Rue de la Loi 200	B-1049 Brussels			
J.-M. Cuazan	European Commission	222 Boulevard St. Gernain	F-75000 Paris			
Frans De Bruine	European Commission	GD XIII/E — Rue de la Loi 200	B-1049 Brussels			
Alain Dumort	European Commission	GD XXII — Rue Belliard 5-7	B-1049 Brussels	(32-2) 296 64 18	(32-2) 296 62 97	

Name	Organisation	Adresse	Stadt	Telephon	Fax	E-Mail
Jean Noël Durvy	European Commission	GD XIII/D Jean Monnet Building EUFO 2174	L-2920 Luxembourg	(352) 430 13 36 10	(352) 430 13 41 29	
Jack Metthey	European Commission	Rue de la Loi 200	B-1049 Brussels			
Tom O'Dwyer	European Commission	GD XXII — Rue Belliard 5-7	B-1049 Brussels			
Luis Rodriguez-Rosellar	European Commission	GD XIII/C — BU 29 06/20 Rue de La Loi 200	B-1049 Brussels	(32-2) 296 34 06	(32-2) 296 23 92	
Ari Ventouras	European Commission	GD IX Bâtiment WAG-CE	L-2920 Luxembourg			

European Commission

Teaching, learning, information: towards an open Socratic school

Luxembourg: Office for Official Publications of the European Communities

1998 – 171 pp. – 21 x 29.7cm

ISBN 92-828-2414-4

Venta • Salg • Verkauf • Πωλήσεις • Sales • Vente • Vendita • Verkoop • Venda • Myynti • Försäljning

BELGIQUE/BELGIË

Moniteur belge/Belgisch Staatsblad
Rue de Louvain 40-42/Leuvenseweg 40-42
B-1000 Bruxelles/Brussel
Tél. (32-2) 552 22 11
Fax (32-2) 511 01 84

Jean De Lannoy
Avenue du Roi 202/Koningslaan 202
B-1060 Bruxelles/Brussel
Tél. (32-2) 538 51 69
Fax (32-2) 538 08 41
E-mail: jean.de.lannoy@infoboard.be
URL: http://www.jean-de-lannoy.be

Librairie européenne/Europese Boekhandel
Rue de la Loi 244/Wetstraat 244
B-1040 Bruxelles/Brussel
Tél. (32-2) 295 26 39
Fax (32-2) 735 08 60

DANMARK

J. H. Schultz Information A/S
Herstedvang 10-12
DK-2620 Albertslund
Tlf. (45) 43 63 23 00
Fax (45) 43 63 19 69
E-mail: schultz@schultz.dk
URL: http://www.schultz.dk

DEUTSCHLAND

Bundesanzeiger Verlag
Breite Straße 78-80
Postfach 10 05 34
D-50667 Köln
Tel. (49-221) 20 29-0
Fax (49-221) 202 92 78
E-mail: vertrieb@bundesanzeiger.de
URL: http://www.bundesanzeiger.de

ΕΛΛΑΔΑ/GREECE

G. C. Eleftheroudakis SA
International Bookstore
Panepistimiou 17
GR-10564 Athina
Tel. (30-1) 331 41 80/1/2/3
Fax (30-1) 323 98 21
E-mail: elebooks@netor.gr

ESPAÑA

Mundi Prensa Libros, SA
Castelló, 37
E-28001 Madrid
Tel. (34-1) 431 33 99
Fax (34-1) 575 39 98
E-mail: libreria@mundiprensa.es
URL: http://www.mundiprensa.es

Boletín Oficial del Estado
Trafalgar, 27
E-28010 Madrid
Tel. (34-1) 538 21 11 (Libros)/
384 17 15 (Suscripciones)
Fax (34-1) 538 21 21 (Libros)/
384 17 14 (Suscripciones)
E-mail: webmaster@boe.es
URL: http://www.boe.es

FRANCE

Journal officiel
Service des publications des CE
26, rue Desaix
F-75727 Paris Cedex 15
Tél. (33) 140 58 77 01/31
Fax (33) 140 58 77 00

IRELAND

Government Supplies Agency
Publications Section
4-5 Harcourt Road
Dublin 2
Tel. (353-1) 661 31 11
Fax (353-1) 475 27 60

ITALIA

Licosa SpA
Via Duca di Calabria, 1/1
Casella postale 552
I-50125 Firenze
Tel. (39-55) 64 54 15
Fax (39-55) 64 12 57
E-mail: licosa@ftbcc.it
URL: http://www.ftbcc.it/licosa

LUXEMBOURG

Messageries du livre SARL
5, rue Raiffeisen
L-2411 Luxembourg
Tél. (352) 40 10 20
Fax (352) 49 06 61
E-mail: mdl@pt.lu

Abonnements:

Messageries Paul Kraus
11, rue Christophe Plantin
L-2339 Luxembourg
Tél. (352) 49 98 88-8
Fax (352) 49 98 88-444
E-mail: mpk@pt.lu
URL: http://www.mpk.lu

NEDERLAND

SDU Servicecentrum Uitgevers
Externe Fondsen
Postbus 20014
2500 EA Den Haag
Tel. (31-70) 378 98 80
Fax (31-70) 378 97 83
E-mail: sdu@sdu.nl
URL: http://www.sdu.nl.

ÖSTERREICH

Manz'sche Verlags- und Universitätsbuchhandlung GmbH
Siebenbrunnengasse 21
Postfach 1
A-1050 Wien
Tel. (43-1) 53 16 13 34/40
Fax (43-1) 53 16 13 39
E-mail: auslieferung@manz.co.at
URL: http://www.austria.EU.net:81/manz

PORTUGAL

Imprensa Nacional-Casa da Moeda, EP
Rua Marquês de Sá da Bandeira, 16 A
P-1050 Lisboa Codex
Tel. (351-1) 353 03 99
Fax (351-1) 353 02 94, 384 01 32

Distribuidora de Livros Bertrand Ld.ª
Rua das Terras dos Vales, 4/A
Apartado 60037
P-2701 Amadora Codex
Tel. (351-1) 495 90 50, 495 87 87
Fax (351-1) 496 02 55

SUOMI/FINLAND

Akateeminen Kirjakauppa/Akademiska Bokhandeln
Pohjoisesplanadi 39/
Norra esplanaden 39
PL/PB 128
FIN-00101 Helsinki/Helsingfors
P./tfn (358-9) 121 41
F./fax (358-9) 121 44 35
E-mail: akatilaus@stockmann.mailnet.fi
URL: http://booknet.cultnet.fi/aka/index.htm

SVERIGE

BTJ AB
Traktorvägen 11
S-221 82 Lund
Tfn (46-46) 18 00 00
Fax (46-46) 30 79 47
E-post: btjeu-pub@btj.se
URL: http://www.btj.se/media/eu

UNITED KINGDOM

The Stationery Office Ltd International Sales Agency
51 Nine Elms Lane
London SW8 5DR
Tel. (44-171) 873 90 90
Fax (44-171) 873 84 63
E-mail: jill.speed@theso.co.uk
URL: http://www.the-stationery-office.co.uk

ÍSLAND

Bokabud Larusar Blöndal
Skólavördustig, 2
IS-101 Reykjavik
Tel. (354) 551 56 50
Fax (354) 552 55 60

NORGE

NIC Info A/S
Ostenjoveien 18
Boks 6512 Etterstad
N-0606 Oslo
Tel. (47-22) 97 45 00
Fax (47-22) 97 45 45

SCHWEIZ/SUISSE/SVIZZERA

OSEC
Stampfenbachstraße 85
CH-8035 Zürich
Tel. (41-1) 365 53 15
Fax (41-1) 365 54 11
E-mail: uleimbacher@osec.ch
URL: http://www.osec.ch

BÅLGARIJA

Europress-Euromedia Ltd
59, Bld Vitosha
BG-1000 Sofia
Tel. (359-2) 980 37 66
Fax (359-2) 980 42 30

ČESKÁ REPUBLIKA

NIS CR — prodejna
Konviktská 5
CZ-113 57 Praha 1
Tel. (420-2) 24 22 94 33, 24 23 09 07
Fax (420-2) 24 22 94 33
E-mail: nkposp@dec.nis.cz
URL: http://www.nis.cz

CYPRUS

Cyprus Chamber of Commerce & Industry
Griva-Digeni 38 & Deligiorgi 3
Mail orders:
PO Box 1455
CY-1509 Nicosia
Tel. (357-2) 44 95 00, 46 23 12
Fax (357-2) 36 10 44
E-mail: cy1691_eic_cyprus@vans.infonet.com

MAGYARORSZÁG

Euro Info Service
Európa Ház
Margitsziget
PO Box 475
H-1396 Budapest 62
Tel. (36-1) 111 60 61, 111 62 16
Fax (36-1) 302 50 35
E-mail: euroinfo@mail.matav.hu
URL: http://www.euroinfo.hu/index.htm

MALTA

Miller Distributors Ltd
Malta International Airport
PO Box 25
LQA 05 Malta
Tel. (356) 66 44 88
Fax (356) 67 67 99

POLSKA

Ars Polona
Krakowskie Przedmiescie 7
Skr. pocztowa 1001
PL-00-950 Warszawa
Tel. (48-22) 826 12 01
Fax (48-22) 826 62 40, 826 53 34, 826 86 73
E-mail: ars_pol@bevy.hsn.com.pl

ROMÂNIA

Euromedia
Str. G-ral Berthelot Nr 41
RO-70749 Bucuresti
Tél. (40-1) 210 44 01, 614 06 64
Fax (40-1) 210 44 01, 312 96 46

SLOVAKIA

Slovak Centre of Scientific and Technical Information
Námestie slobody 19
SK-81223 Bratislava 1
Tel. (421-7) 531 83 64
Fax (421-7) 531 83 64
E-mail: europ@tbb1.sltk.stuba.sk

SLOVENIA

Gospodarski Vestnik
Zalozniska skupina d.d.
Dunajska cesta 5
SLO-1000 Ljubljana
Tel. (386) 611 33 03 54
Fax (386) 611 33 91 28
E-mail: belicd@gvestnik.si
URL: http://www.gvestnik.si

TÜRKIYE

Dünya Infotel AS
Istiklâl Cad. No: 469
TR-80050 Tünel-Istanbul
Tel. (90-212) 251 91 96
Fax (90-212) 251 91 97

AUSTRALIA

Hunter Publications
PO Box 404
3167 Abbotsford, Victoria
Tel. (61-3) 94 17 53 61
Fax (61-3) 94 19 71 54

CANADA

Subscriptions only/Uniquement abonnements:

Renouf Publishing Co. Ltd
5369 Chemin Canotek Road Unit 1
K1J 9J3 Ottawa, Ontario
Tel. (1-613) 745 26 65
Fax (1-613) 745 76 60
E-mail: renouf@fox.nstn.ca
URL: http://www.renoufbooks.com

EGYPT

The Middle East Observer
41, Sherif Street
Cairo
Tel. (20-2) 393 97 32
Fax (20-2) 393 97 32

HRVATSKA

Mediatrade Ltd
Pavla Hatza 1
HR-10000 Zagreb
Tel. (385-1) 43 03 92
Fax (385-1) 43 03 92

INDIA

EBIC India
3rd Floor, Y. B. Chavan Centre
Gen. J. Bhosale Marg.
400 021 Mumbai
Tel. (91-22) 282 60 64
Fax (91-22) 285 45 64
E-mail: ebic@giasbm01.vsnl.net.in

ISRAËL

ROY International
17, Shimon Hatarssi Street
PO Box 13056
61130 Tel Aviv
Tel. (972-3) 546 14 23
Fax (972-3) 546 14 42
E-mail: royil@netvision.net.il

Sub-agent for the Palestinian Authority:

Index Information Services
PO Box 19502
Jerusalem
Tel. (972-2) 627 16 34
Fax (972-2) 627 12 19

JAPAN

PSI-Japan
Asahi Sanbancho Plaza #206
7-1 Sanbancho, Chiyoda-ku
Tokyo 102
Tel. (81-3) 32 34 69 21
Fax (81-3) 32 34 69 15
E-mail: psijapan@gol.com
URL: http://www.psi-japan.com

MALAYSIA

EBIC Malaysia
Level 7, Wisma Hong Leong
18 Jalan Perak
50450 Kuala Lumpur
Tel. (60-3) 262 62 98
Fax (60-3) 262 61 98
E-mail: ebic-kl@mol.net.my

PHILIPPINES

EBIC Philippines
19th Floor, PS Bank Tower Sen.
Gil J. Puyat Ave. cor.Tindalo St.
Makati City
Metro Manilla
Tel. (63-2) 759 66 80
Fax (63-2) 759 66 90
E-mail: eccpcom@globe.com.ph

RUSSIA

CCEC
60-letiya Oktyabrya Av. 9
117312 Moscow
Tel. (70-95) 135 52 27
Fax (70-95) 135 52 27

SOUTH AFRICA

Safto
5th Floor Export House,
CNR Maude & West Streets
PO Box 782 706
2146 Sandton
Tel. (27-11) 883 37 37
Fax (27-11) 883 65 69

SOUTH KOREA

Kyowa Book Company
1 F1. Phyung Hwa Bldg
411-2 Hap Jeong Dong, Mapo Ku
121-220 Seoul
Tel. (82-2) 322 67 80/1
Fax (82-2) 322 67 82
E-mail: kyowa2@ktnet.co.kr.

THAÏLANDE

EBIC Thailand
Vanissa Building 8th Floor
29 Soi Chidlom
Ploenchit
10330 Bangkok
Tel. (66-2) 655 06 27
Fax (66-2) 655 06 28
E-mail: ebicbkk@ksc15.th.com

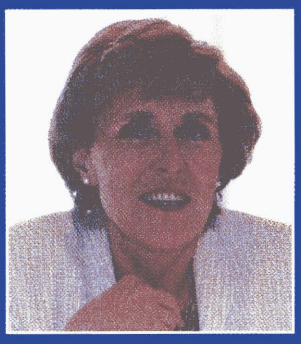
UNITED STATES OF AMERICA

Bernan Associates
4611-F Assembly Drive
MD20706 Lanham
Tel. (800) 274 44 47 (toll free telephone)
Fax (800) 865 34 50 (toll free fax)
E-mail: query@bernan.com
URL: http://www.bernan.com

ANDERE LÄNDER/OTHER COUNTRIES/ AUTRES PAYS

Bitte wenden Sie sich an ein Büro Ihrer Wahl / Please contact the sales office of your choice / Veuillez vous adresser au bureau de vente de votre choix

NB: Country order: EU, EFTA, EU applicant countries, others.



EUROPEAN COMMISSION

Édith CRESSON, Member of the Commission
responsible for research, innovation, education, training and youth

DG XXII/A.1 - Action in the field of education, implementation of Socrates

Contact: A.J. Hingel
Address: European Commission, rue de la Loi 200 (B-7 6/026),
B-1049 Brussels – Tel. (32-2) 296 05 55, fax (32-2) 299 22 31

16

C2-07-97-046-EN-C

OFFICE FOR OFFICIAL PUBLICATIONS
OF THE EUROPEAN COMMUNITIES

L-2985 Luxembourg

ISBN 92-828-2414-4