MONITORING AND EVALUATION OF RESEARCH IN LEARNING INNOVATIONS (MERLIN)

Final Report of project HPHA-CT2000-00042 funded under the Improving Human Research Potential & the Socio-economic Knowledge Base Directorate General Science, Research and Development EUROPEAN COMMISSION

Dr. Mario Barajas
Coordinator of project

Universitat de Barcelona
Dept. de Didàctica i Organització Educativa
Passeig Vall Hebrón, 171
E – 08035 Barcelona, Spain
Fax: +34/93.4035014
Email: mbarajas@ariadna.d5.ub.es
http://www.ub.es/euelearning/

Partners

Dr. Katerina Kikis, Foundation for Research and Technology, Institute of Applied and Computational Mathematics, Heraklion, Greece

Friedrich Scheuermann, University of Innsbruck, Institute for Organisation and Learning, Innsbruck, Austria

Table of Contents

Abstract **2**

1. Executive Summary **3**

2. Background and Objectives of the Project **10**

2.1 The need for the study 10
2.2 Aims and Objectives 11
2.3 Context of the project 13
2.3.1 Definitional considerations 13
2.3.2 The TSER Programme 14
2.3.3 The Joint Multimedia Call 18
2.3.4 The MERLIN cluster 18

3. Methodology and Project Results **20**

3.1 Framework of analysis and methodology 20
3.2 The cluster evaluation approach 24
3.3 The need for indicators of change 24
3.4 Results and findings 25
3.4.1The extend to which TSER tasks were addressed in the projects 25
3.4.2 Pedagogical, organisational and socio-economic dimensions affecting learning in ICT learning environments. Critical indicators of change 26
3.4.3 Other socio-economic indicators of learning innovations 38

4. Conclusions and Policy Implications **43**

4.1 Conclusions 43
4.2 Policy Implications 45
4.3 Call for further research 47
4.3.1 Micro-level research recommendations 47
4.3.2 Strategic research recommendations 48

5. Dissemination and/or Exploitation of results **50**

5.1. Dissemination strategy 50
5.2. Dissemination activities 50
5.3. Exploitation of results and exploitation plans 51

6. Acknowledgements **53**

7. Annexes **54**

Annex A. Scientific publications 54
Annex B. List of project deliverables 55
Annex C. Description of the cluster 56
Annex D. Bibliographic section 69

Abstract

The European Commission funded the *Targeted Socio-economic Research Programme* from 1995 to 1998. MERLIN was a response to the Key Action's (Improving the Socio-Economic Knowledge Base) Call for Evaluation of the TSER Programme. MERLIN's focus was specifically on studying the results of those projects that were involved in ICT-supported learning innovations. The aim was to optimise the results of the research programmes by reviewing a cluster of projects and assisting the Commission in setting up new research agendas for future actions. MERLIN builds on the results of these projects in their different contexts, looking for approaches and indicators of innovation in learning with ICT.

A series of transversal research concerns were posed for all projects relating to: a) new methodological approaches to learning in technology-based learning scenarios and their efficiency; b) institutional/ organisational consequences, including cross-cultural issues to be solved; and, c) contributions of ICT to lifelong learning.

The project results showed that the engagement of ICT in learning alters the traditional teacher-student relation, and, as a result, there are changes in the roles of the principle educational actors. Likewise, the interaction patterns are being affected, as is the role of information management strategies, as it takes a more central role in learning. The emerging roles and interactions as well as the sources of learning affect the organization of the classroom environment. Change of organization in the classroom appears to be caused by the combined effect of the media being used and the teaching approach being applied, that of placing emphasis on the learning processes rather than the outcomes, and on social learning rather than individual learning. In this context the project observed that strategies are oriented towards a) collaborative learning; b) project-based learning; c) self-learning, and, d) communicative strategies to learning.

MERLIN has found that teachers' attitudes towards ICT are connected to socio-cultural, professional and technological barriers (national learning patrimony). The research suggests that the effective implementation of ICT in learning requires that institutional changes to be addressed by all responsible actors. It is necessary to consider the following: development of a culture of collaboration amongst all actors (teachers, students, administrators); flexibility of curriculum; the perception of ICT as a window of opportunities for institutional development; cost-effectiveness, and, the wider access of educational opportunities offered by ICT. Likewise, organisational factors such as institutional barriers need to be considered.

Connected to the dimension "institution" are organisational factors. The project found that a fully embedded innovation within on-going institutional interventions is most likely to be successful. In this model, an institutionalised program of staff training is crucial to the success of innovations. MERLIN has identified parameters for designing teacher training schemes more conducive to the ICT-based learning innovations' requirements.

MERLIN's results suggest that ICT-based innovation in learning: a) enhances student-centred learning approaches; b) facilitates the transformation of teachers traditional roles and functions; c) shifts towards more collaborative and participative forms of learning; and, d) promotes new competencies required for improving teaching and learning.

MERLIN recognised that an agenda for policy articulation in the field of learning innovations with ICT ought to focus in the areas of: a) equal access to educational opportunities; b) cross institutional cooperation; c) institutional transformation; d) organization issues regarding the educational praxis; e) knowledge sharing and knowledge negotiation mechanisms; f) school organization and curricula development; g) provisions for learning on demand; h) teacher's professional development; I) provisions for support to the educational actors; j) knowledge dependencies and gender issues; and, k) lifelong learning policies.

The project proposes that the implications of its research results are dealt with from a micro/macro perspective and recommends that policy should make provisions for further exploration into the areas of: attitudes towards the use of ICT by all educational actors, intercultural differences, cognitive and affective factors, and most important, teaching competencies. The analysis/reflection suggests also the need for in-depth study of people's information seeking behaviours and its relation to the building of knowledge.

The recommendations call also for longitudinal studies to investigate the sustainability and scalability of the recently introduced learning innovations. Likewise, the lack of rich evidence on the issues of equity, exclusion and gender as well the lack of evidence on the affects of ICT-based innovation (in formal school settings) for life long learning suggest that a new policy/research agenda embrace these areas as foci for future research.

Project results have been presented at several international Conferences, and together with contributions of other researchers, MERLIN is about to publish a book with the title "*Learning Innovations mediated by ICT: A socio-economic perspective*".

1. Executive Summary

This document reports on the objectives, activities and results of the TSER Accompanying Measures Project: MERLIN (HPHA-CT-2000-00042). The project was implemented over a period of 20 months (01-01-2001 to 31-08-2002) by a three member consortium.

MERLIN was a response to the Key Action's (Improving the Socio-Economic Knowledge Base) Call for Evaluation of the TSER Programme.

The European Commission funded the *Targeted Socio-economic Research Programme* from 1995 to 1998. The activities of the Targeted Socio-Economic Research programme aimed at "producing new knowledge and elucidating decision-making required in future at decentralised, national or Community level to lay the foundations for sustainable economic and social development of Europe's economies enabling them to withstand international competition and create jobs" (European Commission, 1997).

The TSER programme was subdivided into three research areas. In the area Research on Education and Training the objectives proposed were:

- In the short term to provide a European base of information, knowledge and common references, covering more specifically the European aspects and the European dimension of education and training to researchers and policy makers.
- In the medium term, to build a community of research on education and training in Europe, linked to the developments in educational and cognitive sciences.
- In the long term, to strengthen the contribution of education and training to sustainable development, employment, and innovation in Europe. (European Commission, 1995).

MERLIN's interest within the "Research on Education and Training" area was specifically on studying the results of those projects that were involved in ICT-supported learning innovations. Such projects were identified within the programme TSER and the projects of Joint Multimedia Call with a TSER component[1]. The aim was to optimise the results of the research programmes by monitoring and reviewing projects and assisting the Commission in setting up new research agendas for future actions. MERLIN builds on the results of these projects in their different contexts, looking for approaches to innovation in projects where information and communication technologies play a key role in teaching and learning processes.

In order to facilitate the analysis, a series of transversal research concerns were posed for all projects relating to:

- new methodological approaches to learning in technology-based learning scenarios and their efficiency
- institutional/organisational consequences, including cross-cultural issues to be solved
- contributions of ICT to lifelong learning.

The project's evaluation orientation was that of ***cluster evaluation***. Cluster evaluation is "an evaluation of a program that has projects in multiple sites aimed at bringing about a common general change.… Each project develops its own strategy, to accomplish the

[1] The projects clustered were: a) DELILAH, CL-NET, STTIS, IVETTE, COMPETE, NatCCC-PS (from TSER); b) PEDACTICE, REPRESENTATION, PARLEU-NET, IN-TELE, and NET-LOGO (from the EMMTF Call, with a TSER component).

program goal, uses its own human and fiscal resources to carry out its plans and has its own context" (Sanders, 1997). This orientation was selected for its basic characteristics which are: it is holistic; it is outcome oriented; it seeks generalisable learning; and, it involves frequent communications and collaborations among the partners. Cluster evaluation can be either formative or summative, but it has most frequently been both.

The project's evaluative activity was operationalised on the basis of the ***CIPP*** evaluation model (Stufflebeam, 2000). The CIPP evaluation model provides an appropriate framework for the structuring of the projects and the assessment and evaluation of clustered components. Furthermore, the model has been chosen, due to its strength, to identify policy implications at various levels of project activity. Furthermore, the approach is appropriate to evaluate socio-economic concerns, because integrated in its frame, is the in-depth review of contextual elements.

In this context, the specific research questions set by the project as the frame for capturing key trends regarding ICT in education and training, whose implications define a policy and research agenda, were the following:

1. What are the new methodological approaches to learning in technology-based learning scenarios and what is their efficiency? What are the new co-operative learning processes, cross-curricular skills and role changes configuring technology-based learning innovations? How is effectiveness considered in the different innovations analysed?
2. What were the specific effects of ICT on the innovation from the point of view of institutional/organisational factors, such as organisational changes, staff training, and infrastructures, as well as attitude of actors to the adoption of innovations?

3. How do the outcomes of the project shed light on socio-economic factors, such as lifelong learning, social exclusion, equity, socio-economic strata, and socio-cultural differences?

The MERLIN cluster of projects was designed to study the following: a) pedagogic innovation – as an emergence of Community RTD activity focused on the changing paradigms in learning/teaching; b) institutional innovation – as an emergence of Community RTD activity focused on E&T's contribution to fostering innovation, and c) socio-cultural innovation – as a consequence of the knowledge base generated by the Community RTD supported actions in the area of "new learning approaches".

Through an iterative process (analysis review of projects documentation, and validation by experts in the area of innovation in education), MERLIN evolved with a set of qualitative indicators of change which point out key traits of projects in the areas studied. The indicators found in MERLIN then portray relevant changes of ICT-based learning that are present in the projects clustered.

MERLIN's purpose was not to try to generalise these indicators to all educational contexts and sectors in which ICT use is present, but rather, to shed light on various characteristics found in ICT-based learning innovations. Likewise, MERLIN does not endorse a cause-effect relation; that is, that the changes the indicators have recorded are a result of the projects, but that the indicators were present in the innovations and portray relevant changes of ICT-based learning.

Main results and findings

In terms of the first research concern, the analysis/reflection indicated that the engagement of ICT in learning alters the traditional teacher-student relation, and, as a result there are *changes in the roles* of the principle educational actors. Likewise, the *interaction patterns* are being affected. The project results suggest the need for in-depth study of people's *information seeking behaviours*. The emerging roles and interactions as well as the sources of learning affect the organization of the classroom environment. Change of *organization in the classroom* appears to be caused by the combined effect of the media being used and the teaching approach being applied, that of placing emphasis on the learning processes rather than the outcomes, and on social learning rather than individual learning. The main pedagogical strategies employed in most of the current ICT-based learning is linked to the *constructivist* paradigm.

In this context the research indicated that strategies are oriented towards

- collaborative learning
- project-based learning
- self-learning
- communicative strategies for learning.

The issue of *attitude* is another parameter considered in MERLIN. The project has found that teachers' attitudes towards ICT are connected to socio-cultural, professional and technological factors (national learning patrimony). Teachers have not only of individual attitude, but social and professional attitude as well. The cases suggest that attitudes should be studied/analysed in terms of a) the tools; b) the role ICT plays in teaching; c) ICT's effectiveness in facilitating learning and engaging students; d) the main focus of the institutions; and e) attitudes of students.

The sources at hand (project documentation) were not instrumental in allowing conclusions to be drawn regarding "*affective factors*". The little information that could be drawn suggests that ICT-based learning innovation is strongly linked to the teacher's professional identity, his/her working habits and students' motivation.

The project activity facilitated the identification of *institutional factors* that affect the undertaking of learning innovations in institutions. The research suggests that the effective implementation of ICT in learning requires institutional changes to be addressed by all of the responsible actors. In terms of such requirements one has to consider the following: a) the development of a culture of collaboration amongst all actors (teachers, students, administrators); b) flexibility of curriculum; c) the perception of ICT as a window of opportunities for institutional development; d) cost-effectiveness; e) and the wider access of educational opportunities offered by ICT. Likewise, institutional barriers need to be considered. The project found, for example, that teachers lack personal preparedness and confidence in addressing ICT; At higher education institutions it appears that faculty members themselves often constitute barriers to the innovation by active or passive resistance. It should be noted here that lack of recognition of efforts to implement innovative approaches to learning constitutes still another constraining factor. Connected to the dimension "institution" are *organizational factors*. The project noted that a fully embedded innovation within on-going institutional interventions appears to have the best chance of success. In this model, an institutionalised program of staff training is crucial to the success of innovations. MERLIN has identified parameters for designing *teacher training* schemes more conducive to the ICT-based learning innovations' requirements. Such training ought to be guided by reflection/meta-reflection approaches. A set of basic teaching

competencies are at the heart of the need for training. Among others these are some of the required *ICT-based teaching competencies*:

- understanding the learning potential of educational multimedia and telecommunications tools, critically assessing advantages and disadvantages.
- Practicing ICT teaching and learning strategies: independent responsibility for learning, differentiation of teaching according to audience, process-oriented work, problem-oriented work.
- understanding constructivism, action learning and situated learning, use of students' experiences from everyday life.
- curriculum design, looking at cross-curricular approaches and holistic learning mix classes.
- management skills: information-management (becoming a facilitator), time–management and group-management (co-operative/team learning strategies).

The projects' results contain little data in terms of the effects of learning innovation for the promotion of the *lifelong learning* paradigm. The creation of and the early participation in *communities of practice* (which use ICT to organise activities) are seen as positive approaches, since they can pave the way for actors to get used to learning in these environments, and prepare them for future further learning. The participation in collaborative projects also includes the consideration of learning as a social rather than an individual experience. The spread of online learning within educational organisations opens new ways to reach the target groups of part-time, disadvantaged, continuing education and postgraduate learners in the perspective of lifelong learning. But, policies for the promotion of lifelong learning at all levels are necessary. This is an area that needs to be investigated further.

MERLIN does provide insight into issues of *equality/inequality* in access mainly from the perspective of issues of gender and language and learning patrimony; for example, it was found that girls appear to be more receptive to collaborative learning. But, in general, there is a concern about the lack of a clear definition of exclusion. The dichotomy exclusion-inclusion is sometimes deceiving and should not be limited to the *digital divide problem*.

Although the parameters of *efficiency* and *effectiveness* of learning innovations did not provide the project with rich or meaningful results, all involved parties recognize the need for further research in this aspect of ICT-based learning. In short the project results suggest that ICT-based innovation in learning

- enhances student-centred learning approaches
- facilitates the transformation of teachers traditional roles and functions
- shifts towards more collaborative and participative forms of learning and,
- promotes new competencies required for improving teaching and learning.

Implications for policies

MERLIN recognized that an agenda for policy articulation in the field of learning innovations with ICT ought to focus in the areas of:

- equal access to educational opportunities
- cross institutional cooperation
- institutional transformation
- organizational parameters regarding the educational praxis
- knowledge sharing and knowledge negotiation mechanisms

- school organization and curricula development
- provisions for learning on demand
- teacher's professional development
- provisions for support of educational actors
- knowledge dependencies and gender issues
- lifelong learning policies

Most of the projects were focusing their recommendations on the organisation of the learning environment, but other contextual elements should be taken into account as well, reflecting the wider context of teaching and learning outside the classrooms. The learner's workplace at home and at work should be addressed as well as the overall organisational context of teaching and learning based on different notions from the traditional ones for education.

Apart from the general observations of deficiencies on a local, national and European level, some projects directly address equity related issues. Research suggests inequality in access to ICT products and ICT-based learning activities at various levels (from country to country, from sector to sector, among schools and among students). Such inequalities in ICT access and use are likely to affect students' academic achievement, future job prospects, and prosperity in an information society. This also applies to disadvantaged groups who, due to the continuous introduction of new ICT products and services, may face further exclusion from a wide range of societal activities. In this context, forming and implementing policies that would target disadvantaged groups, schools or geographical areas towards the development of more and enhanced opportunities for ICT access and use for learning are of major importance at European and country level.

Diversity in school curricula in different European countries poses important barriers in developing cross-European school cooperation., Centrally-oriented curricula tend to be less flexible allowing little room for schools, teachers, classes and students to develop educational activities in cooperation with schools from other countries and engage in innovative ICT activities. The need for the development of a common European culture requires the implementation of adaptive curricula that would encourage the educational world to take advantage of new opportunities offered by ICT for communication and collaboration. Language barriers need also to be taken into account.

It is necessary to underline the problem of curricula which are already inflexible and overloaded in many countries. More flexibility and interdisciplinarity is needed for curricula design and application by teachers in order to promote innovative forms of teaching and learning.

With respect to institutional change, the school sector was characterized by the reviewed projects as resistant to ICT innovation. Other projects tackling higher education institutions suggest that institutional change may emerge out of the use of ICT for teaching-learning purposes. Furthermore, collaboration with the corporate sector may also affect institutional change in education. This is a long-term approach to change that needs to be scaffolded and accelerated by relevant policies.

Other policies include creation of institution policies, making institutional regulations, and integration of good practice into the curriculum along with the technology and modelling of appropriate behaviour. Team-oriented educational institutions might cope better with the current demands related to ICT than other more individual-oriented institutions where the exchange of information and collaboration is on a lower level.

In-job training based on learning by doing at different levels depending on ICT experiences should be supported by policies. Teachers' participation in 'communities of practice' where they can exchange ideas, experience and materials should also be encouraged. The integration of innovations in classroom teaching should be promoted by enabling teachers to internalise the different approaches. Therefore, teacher training becomes a crucial aspect for ensuring effective results of any policy measures relating to teaching and learning.

As has been pointed out, the use of ICT for teaching and learning do affect teachers' and students' roles and patterns of interaction in many ways. Such changes towards growing student-centred practices, self-learning and teamwork should further be supported by corresponding educational policies.

On the issue of training provisions, a policy that emerged regarding training organizations is that i) managers should be trained on how to choose; ii) training should be devoted to communities of teachers; iii) there should be better links between the training centres and the teachers' needs.

In this regard, the dimension of teacher training, beyond the level of skill development and technological competence, requires special attention by the educational planners. Teacher training schemes that do not integrate/consider pedagogical aspects of innovation are doomed to failure. Moreover, evaluation competencies are proposed as another issue which needs to be more adequately promoted in teacher training. The evidence studied in MERLIN implies that conventional forms of teacher training appear as insufficient means for sustaining innovation. Actors, such as managers, policy/strategy designers and even parents, need to participate in the building of communities of "innovation sustaining" practices. National and local schemes need to conform to such requirements if wide scale implementation of ICT based teaching/learning is desired.

In dealing with lifelong learning, the use of ICT in education and training can result in increased flexibility between working life and study by bringing learning opportunities to the work place and by bringing working life closer to school. A prerequisite of open learning systems is, however, that educational policy and stakeholders such as educational institutions, libraries and other information sources, as well as industry and commerce, begin to perceive the whole education cycle from the viewpoint of lifelong learning. This requires collaboration and networking among the various parties.

Recommendations for further research

The project proposes that the implications of its research results are dealt with from a micro/macro perspective and recommends that policy should make provisions for further exploration into attitudes towards the use of ICT by all educational actors, including those that resist innovation, and including comparison of geographic areas in the EU.

It would be interesting to support studies for developing pedagogies for learning in the knowledge society with focus on the management of cross-cultural and linguistic issues in the framework of an European education space (e.g. transregional/transnational joint courses and/or learning materials development, transnational joint-student support, transnational collaborative learning, layered approaches of learning platforms, etc.).

With respect to cognitive and affective factors, it would be interesting to support research that pays attention to the emotional aspects of learning in ICT-based

environments, such as those of e-learning. Interesting problems are those related to the extent to which social and learning skills, self-managing skills, and other meta-cognitive capabilities are developed.

Teaching competencies for the knowledge society has emerged as a new need for further research. There should be studies in emerging new competencies, skills and meta-skills of teachers, tutors and other academic staff (as well as managers) for e-learning.

The analysis/reflection suggests also the need for in-depth study of people's information seeking behaviour in ICT-based learning situations and its relation to the building of knowledge.

At the strategic level, the recommendations call for longitudinal studies to investigate the sustainability and scalability of the recently introduced learning innovations. We also need to undertake longitudinal studies of the learning effects arising from learning with ICT (such as learning in new scenarios combining face-to-face and virtual learning): changing habits of study, new assessment components, long-term teaching effects, and promotion of the notion of "classroom observatory" type of activities.

Likewise, there is lack of rich evidence on the issues of equity, exclusion and gender. Some fundamental questions are related to how we can handle new forms of exclusion as a consequence of limited access to technologies of electronic transmission information; and to what the pedagogical factors are that inhibit /promote social exclusion.

We need studies that make the rhetoric of European Life Long Learning more concrete by i) bridging the gap between theory and practice across the different sectors (and different 'patrimonies') of learning; ii) developing a knowledge base on 'what works, for whom and under what conditions', with particular regard to the use of virtual learning (e-Learning) in education and training; iii) consolidating knowledge on new ways of promoting social inclusion (e-inclusion) and integrating social inclusion policies with education and training policies more effectively.

2. Background and Objectives of the Project

2.1 The need for the study

The monitoring and assessment of educational programmes and outcomes remain a crucial issue to be explored. Whereas some projects report positively "significant differences" concerning the learning by using ICT-base learning contexts, the general situation is much more characterised by the "no significant difference" situation. In addition, Windschitl (1998) states a lack of scholarly articles. He claims that a vast majority of published work is just a description of ICT implementation in the classroom.

Depending on the issues to be evaluated and the applied methodologies within the research projects, it remains difficult to distil relevant information out of them and to integrate these into a broader context concerning teaching and learning with ICT.

In the EU funded research context, there have been established similar concerns. Since projects differ in their goals, contents and methodologies connected to the use of ICT, this is not an easy task. Even when the objectives are similar, there is a lack of initiatives and structures combining relevant outcomes in order to generate new knowledge on how ICT promotes innovation in learning and in the educational system as a whole. Besides the efforts made in Europe by different studies and organisations, there is no approach for collecting and analysing data from different projects in order to assess the relevancy of the research done.

The European Commission (1996: xi) has pointed out the importance of ICTs as new tools, techniques and media for delivering education, arguing against a narrow focus on new learning technologies and systems, stressing the importance of the new roles of teachers and strategies for lifelong learning

Nevertheless, according to this report, the main problems associated with that do not seem to rely on the power of ICTs, but on our lack of knowledge about how people learn, and how people acquire and develop a sense of identity, which transcends more national idiosyncrasies and attitudes*: "Fundamental research on learning itself is a high priority, including the ways in which ICT affects learning. This includes such questions as : how people 'learn to learn' instead of just remembering facts...how to develop training methods which would allow the remaining millions of illiterates in the European Union to have access to the written services of the IS?"* (European Commission, 1996, 52).

The issues are even more relevant in the restructuring of the European learning space where, many times the fascination for the newest ICTs blurs the importance of teaching and learning, of institutional, multicultural and multilingual issues, including the social efficiency of the European education and training systems.

In this sense, the possibilities of ICT for the achievement of the strategic goal of improving access and creating a lifelong learning culture for all European citizens has been recognised widely (European Commission, 1998*).*

MERLIN has clustered TSER projects according to specific themes, which allows for appropriate intercommunication and synthesis between them. By reviewing, co-ordinating and disseminating the results of a cluster of the projects, MERLIN sheds

light on the fundamental changes arising from innovative uses of ICT in learning, research trends and policies necessary to valorise the outcomes of TSER, and proposes policy recommendations and a future agenda for investigation.. This will allow elaborating policy briefs for the formulation and development of European policies in this area in order to provide inputs to the Human Potential Programme and to the VI Framework Programme.

Additionally, MERLIN has established a framework for a European-wide discussion which combines results for selected projects with experiences of policy makers. By disseminating results, the researchers and practitioners together with the Commission and the European educational institutions will create synergies for promoting a wider knowledge base for the future. The research done allows for accessing a pool of contrasted scientific results on different technology-based learning innovations already working in Europe, and sheds light on the social implications for preventing social exclusions in the educational systems and promoting lifelong learning.

2.2 Aims and Objectives

MERLIN aimed to monitor/study the process of implementation of a cluster of research projects, supported from the Second and Third TSER Calls of the IV Framework Programme, for the purpose of assessing their results. The projects that would form the MERLIN cluster of projects had to be concerned with ICT in learning and more specifically with the innovative aspects ICT fosters in learning settings and the disturbances/changes that emerge from the integration of ICT in teaching/learning. In this regard the project concerned itself with the changes that emerge due to ICT at the pedagogical and institutional levels and the influence these have on promoting the life long paradigm and effects on other socio-economic variables. The focus of the research was on the specific and cumulative effects of research undertaken and on the process of project implementation in addressing the research policy orientation which these (projects) came as a response to.

MERLIN was primarily an evaluation study that came to respond to the complex question:

What do the research results of the TSER Programme in the area of Innovations in Learning suggest about innovation in learning and what are the effects of innovation? What aspects of innovation have not been adequately researched and which aspects of "innovation" require further attention from the European research-policy-making communities?

The project intended to conduct its analytical work guided by a set of three transversal research questions:

1) What are the new methodological approaches to learning in technology-based learning scenarios and what is their efficiency? What are the new co-operative learning processes, cross-curricular skills and role changes configuring technology-based learning innovations? How is effectiveness considered in the different innovations analysed?

2) What are the consequences for organisations when introducing these new ways of learning, including European cross-cultural issues involved in the process?

3) What are the contributions of ICT to lifelong learning in terms of access to education and training? Does the introduction of ICT stimulate the dual society and thus social exclusion?

In this regard the evaluation objectives in MERLIN were:

- pedagogic innovation – as an emergence of Community RTD activity
- institutional/organizational innovation – as an emergence of Community RTD activity focused on the changing paradigms in learning/teaching
- socio-cultural innovation – as a consequence of the knowledge base generated by the Community RTD supported actions in the area of "new learning approaches".

The evaluation objects in MERLIN, as per the requirements of the evaluation objectives, included:

- the cluster projects as a whole in relation to the programme objectives these came to address
- the individual projects in the clustering
- the services/processes/products developed within projects
- the interaction between the different projects and their environment
- the interaction between the clustered projects and the European Context.

These requirements suggest that the projects under review were clustered according to the specific themes outlined above. Likewise the design of project instrumentation is to be powerful enough as to depict elements and interrelations of the principle themes.

The process which the project proposed for addressing its research concerns was through a frame which includes the actions of

- Review and synthesis of results from final reports produced by a series of projects from the Joint Multimedia Call that have a TSER component, as well as from the 1st. TSER Call (area "Research in Education and Training") dealing with innovative teaching/learning practices mediated by the use of ICT.

- Identification of new teaching methods and practices in a series of TSER projects from the 2nd. TSER Call (area "Research in Education and Training"), grouped in the cluster "Innovations via Technology", by assessing the intermediate and final reports that have been produced, and comparing and contrasting the outcomes with the ones from the projects of the 1st. phase.

- Review of the results of different TSER projects from the 3rd. Call whose objectives include the study of innovative approaches to the use of ICT in teaching and learning, in order to include them in the cluster previously mentioned, assessing progress and contrasting their outcomes with previous projects' results.

- Assembling a group of experts from the above-mentioned TSER projects, who were asked to relate their results to a joint report.

These actions intended to a) contribute to the development of policies in the area studied, by identifying common research trends, issues and policy recommendations among the projects selected, and synthesise the findings relevant to policy making in a draft report with recommendations for dissemination to the wider community of experts and policy makers; b) establish a framework for a European-wide discussion by combining results for said projects with experiences of policy makers throughout the organisation of a workshop in order to prepare final recommendations for a new agenda for research.

Although not explicitly stated, the project aimed through the assessment process to provide tangible outputs that could enhance the effective implementation of ICT in learning both from a research and a policy articulation perspective.

The results of the variety of tasks undertaken that were either of analytical or synthetic nature in MERLIN and the purpose these served in reaching the project's overall objective are described in detail in project documentation D1: *Report on ICT educational issues and methodological framework*, D2: *Report on EMMTF projects*, D3: *Synthesis Report on Innovation Trends in ICT-based Learning*, D4: *Assessment report on 2nd round projects*, D5: *Report on the Thematic Review of TSER supported research results: Indicators on ICT-based learning innovations*, D6: *Joint Report on research issues, new trends, and policy recommendations* and D7: *Final synthesis report on projects' findings, policy recommendations and future research tasks*.

The aim of this report is to inform the reader of the extent to which the work tasks undertaken in MERLIN provided answers to the project's transversal questions posed by the project in relation to the TSER Programme Objectives.

2.3 Context of the Project

2.3.1 Definitional Considerations

The MERLIN perspective to Innovation in ICT-based learning, is reflected in the definition adopted by the project:

Innovation in ICT-based learning may be seen as early adoption and implementation of significant new ICT-based learning theories and practices, in order to improve or reform educational services, educational theory and the educational praxis.

Several concepts on the above statement should be clarified in order for that to become a working definition.

Innovation in ICT-based learning is the result of a process of innovativeness of individuals, groups, organizations or whole societies who transform a new idea or invention into a new way of doing things. Innovativeness in ICT-based learning, in other words, is the creative educational application of ICT inventions. While the use of ICT in education is not a 'new' idea or practice and has become a widespread phenomenon, innovation in ICT-based learning is always a potential because of new ICT inventions and the wide range of possible applications of ICT in learning. What distinguishes invention from innovation is implementation. In this perspective, the "invention" of new educational ICT software is not an innovation *per se*. To become an innovation it should be implemented, in other words become accepted initially by early adopters (innovators) and evolve into practice among a wider group of people. On the other side, one can be innovative without being inventive, for example by applying an existing ICT solution to an educational context in creative ways. The "newness" of an idea or ICT application for learning can be assessed on the basis of "objective" and "subjective" criteria. Firstly, it is the individuals, or groups that perceive and judge an idea or application as "new". ICT-based learning innovations should therefore be assessed on the basis of peoples' perceptions on the magnitude of change that they bring forward. It is also a matter of scale. An application of an ICT learning environment may engage in a classroom, a school, a region or whole educational systems at the national and EU level. Seen from different levels this application may or may not be an innovation. Innovations are also inextricably linked with the concepts of change and risk taking. They are justified on the basis of relative

advantages they have to offer over what is the current practice, but are not value free (economic and technological considerations, as well as educational perspectives adopted play an important role). Furthermore, ICT-based learning innovations challenge individuals, organizations and societies in many different forms. At the personal level they may challenge teachers' and students' perceived role and 'status', adopted theories on teaching and learning, as well as established and "routinised" ways of doing things (educational praxis). At the organizational level, it may challenge management and administration, curriculum philosophy and design, as well as established economic and other priorities. At societal and cross-cultural levels, it may challenge established perceptions and practices on how young people should be and are educated for what purposes, as well as wider social and economic policies. Such challenges affect the rate of the adoption of an innovation.

2.3.2. The TSER Programme

As stated above the goal of the MERLIN project was to monitor and review the results of a cluster of TSER projects from the relevant Calls.

According to the General Programme, "the activities in the Target Socio-economic Research Programme aim at producing new knowledge and elucidating decision-making required in the future at the decentralized, national or Community level to lay the foundation for sustainable economic and social development of Europe's economies, enabling and influenced by inter-play among these three factors: advances in science and technology, human skills and knowledge, and an appropriate socio-economic framework which harnesses the human and technological resources available".

There are three inter-related areas of research and work proposal in the TSER programme. The interest of MERLIN is on the area of "Research on Education and Training", and more specifically on those projects that were involved in ICT-supported learning innovations.

In the area II: Research on Education and Training the objectives of the Programme were:

- In the short term, to provide a European base of information, knowledge and common references, covering more specifically the European aspects and the European dimension of education and training for researchers and policy makers.
- In the medium term, on the basis of the work on these European aspects, to build a community of research on education and training in Europe, linked to the developments in educational and cognitive sciences.
- In the long term, to strengthen the contribution of the education and training to sustainable development, employment, and innovation in Europe.

To reach these objectives, this area was organised around three research themes:

Education and training policies, European dimension and diversity. The objectives of this theme were the identification of different kind of skills to emerge, types of knowledge, and new models of organisation within an enterprise; the multiplication of contacts between people with different cultural backgrounds; and, the development of new forms of communication.

Quality and innovation in education and training. The objective in this area was to answer these questions:

- What methods and criteria do we have to use for evaluation of quality?

- What role do the cognitive conditions and cultural factors play in using informatics and audiovisuals tools for education and training?
- What are the attitudes of the teachers and the trainers to new technologies?

Education, training and economic development.

In the **1st Call** the research tasks involved on innovation approaches to the use of ICT in learning were:

1. Education and training policies, European dimension and diversity

And the tasks related to the innovative approach to the use of ICT in learning are:

- Analysis and reformulation of educational goals in the light of anticipated developments in society at large (progress of technologies, evolution of the labour market, evolution of values in a multi-cultural society, development of new perspective on knowledge) using notably case-study descriptions from various European countries.
- The capacity for change and adaptation of educational systems.

Quality and innovation in education and training

In this area most of the research tasks were related to the ICT themes:

- Research on international transferability of explanatory models of multi-level educational effectiveness.
- Design and evaluation of new kinds of learning environments, taking into account available knowledge concerning cognitive, affective and socio-cultural factors that influence learning processes and school organisational conditions that are supportive to these learning processes; focus on aspects that have not yet been sufficiently studied that are very relevant from a European perspective.
- Scenarios of applications of new approaches to enhance the quality of education, focused on disadvantaged learners in primary education.
- Science and technology teaching as components of general education. Approaches, concepts and methods in science teaching.
- The educational potential of the information society, research on the cognitive aspects of the design and application of new technologies in education and training and projects involved in evaluation and methodologies for new E&T products.

Education, training and economic development.

- Scientific and technological literacy: research on social and cultural aspects of the teaching and mastering of technological knowledge.
- In-company training strategies and the learning organization. Research on the way companies determine their training needs.
- Comparative research on co-operation between universities and corporations aimed at the training of top specialists.

As with respect to the **2nd Call**, all the themes were proposed in the 1st call, too. But the differences were in the number of themes. In this second Call there were fewer points in respect to the first.

In this second Call the important themes related to the innovative approach to the use

of ICT in learning were the same as the second one in Area II: Research on educational and training (E&T):

Effectiveness of policies and actions, European dimension and diversity

- The capacity for change and adaptation of educational systems.

Methods, tools and technologies: quality and innovation in education and training

- Research on the cognitive aspects of the design and application of new technologies in E&T.
- Research on evaluation and methodologies for new E&T products.

Education, training and economic development

- Scientific and technological literacy: research on social and cultural aspects of the teaching and mastering of technological knowledge.

The listed tasks concern major social, economic and technological challenges: labour market needs and unemployment, the demands of the information society, the disadvantaged and socially excluded. Proposals did consider the close links between the sub-areas 1, 2 and 3, and therefore the proposals for research on the following themes would deal with their interdependencies:

E&T, labour market and unemployment. New comparative research is needed to build models which allow better understanding of how European E&T systems and the economies develop in relation to each other. Such cross-European studies would facilitate the continuous updating of skills and qualifications. The linkage between general education and vocational training, as well as the issue of transition from initial education to working life, should be studied. Ways in which life-long learning could be developed as a strategy for increasing the ability for employment/self-employment and learning as an integral part of working life should be researched.

E&T and the information society. A key question is how and under what conditions new Information and Communication Technologies can be introduced into initial and continuing E&T both in a pedagogically appropriate and cost-effective way. There is a great variety of cognitive issues requiring further research; e.g., the learners' ability to master the flood of information and convert it into useful knowledge, and the analysis of learning models and cognitive processes. Furthermore, the issue of access to information, in particular in relation to the third thematic grouping below, should be addressed.

E&T, minorities and disadvantaged groups. Combating inequality and disadvantage is still a principal goal of E&T policies. Issues such as improving access to E&T and support measures for groups facing failure in E&T and the labour market (ethnic minorities, early school leavers without formal qualification, etc.) will have to be addressed. In parallel the ways of enhancing achievements of these groups within the E&T systems and thus increasing their potential for employment should also be developed.

Research in area II should be implemented with flexibility and therefore short-term projects are not excluded. If possible, research activities should aim at defining good transferable practice by describing how the results could be applied (concrete examples, quantifiable research results) and their relevance for the development of E&T policies.

The strategic orientation of the **3rd Call**, as it is documented in Community literature, is slightly different: Whereas the first and second calls for proposals sought to consolidate research activity primarily within the three programme areas, the third call concentrated on issues, described below, which highlight the interplay among the economy, the individual and society, and in so doing exploited the links between the programme's research areas: technological progress; education and training; and, social exclusion and integration. The projects should include coverage of these aspects wherever possible:

Innovation and institutional change

The capacity of economies to develop, innovate and generate employment also depends heavily on the structure of its public and private institutions, both formal and informal, and on the effect of their formal and informal codes of practice. Institutional inertia and outdated practice act as a brake on progress and on the adoption of new technologies and best practice; alternatively, the institutional conditions may provide support for innovation. The introduction of change needs an appreciation of the cultural/gender and historical factors which shape institutions and practices, a reassessment of the relationship between the public and private sector, and a thorough understanding of the impacts of innovation on employment. (A relevant example is the development of genetics and biotechnology, both in terms of science and technology policy and of compatibility with the generally accepted norms of society.)

The following interrelated problem areas and issues indicate where new knowledge is needed:

Lifelong learning and educational goals: Analysis and reformulation of educational goals in the light of anticipated developments in society at large (progress of technologies, evolution of the labour markets, development of new perspectives on knowledge) using notably case-study descriptions from various European countries. Of particular importance is the role of lifelong learning as a prerequisite for societies increasingly based on learning and knowledge; how social and working conditions could promote lifelong learning; and how this could be reflected in the formulation and implementation of educational goals.

E&T, the labour market and economic growth: In modern economies it is recognised that investment in human capital is a precondition for economic growth. The effectiveness and flexibility of the E&T system vis-à-vis labour market demands with a critical view of the role of public policy aims at enhancing human capital as a tool to avoid unemployment; vocational training needs in societies are increasingly based on learning and knowledge; and the role of the social partners in the labour market in developing vocational training systems of high quality and relevance is crucial.

E&T's contribution to fostering innovation: Research on innovation in the E&T system itself and the capabilities of E&T to foster or stimulate an innovation oriented culture in companies and society at large is of high relevance, as are lessons on how E&T systems, whether in collaboration with industry or other users, may develop schemes to support the excellence and high level competence required by innovative societies. This includes new learning approaches directed towards the shift from teaching to learning (collaborative learning, problem-based learning, learning to learn etc). E&T will also have to respond to new challenges emerging from the information society. The E&T sector itself has to address the ICT related issues. It needs to include learning demands stemming from the widespread use of ICT, as well as undergo transformations in order to make the best use of the new technologies and new educational material. The pedagogical and cognitive aspects of the innovative use of

ICT in E&T programmes need more specific investigation, in order, for example, to help improve the use of multimedia products and services, as well as bringing out the appropriate role for cognitive sciences and other approaches in this context. A key aspect of E&T innovation is the integration of new and emerging tools for learning and communication into existing or changing organizational structures, and research will be needed on pedagogical and organizational aspects of learning, with particular attention to the use of multimedia technology and telematic networks and to open and distance learning.

2.3.3 The Joint Multimedia Call

As with respect to the **Joint Multimedia Call** the objective was to "foster synergies across Community programmes". The programmes involved on the Call were: Telematics Applications Programme, Information Technologies Programme, Targeted Socio-Economic Research Programme, The "Socrates" and "Leonardo da Vinci" programmes, and finally the "Ten-Telecom" programme.

The purpose of the call for educational multimedia was to encourage and to stimulate the development of high quality learning, teaching and training multimedia resources, the implementation and deployment of electronic networks in teaching and training in Europe to promote trainer and teacher training in the use of multimedia and to raise awareness of the educational potential of multimedia applications in teaching and learning.

The work plan offered the opportunities to make proposals spanning two different areas: research, technological development and demonstration (RTD&D) actions and activities concerned with education, vocational training and trans-European networks, and implementation activities.

This call was interested in innovative projects and/or those which represent a significant step toward the state of the art and include substantial original work either in the technical applications aspects or the pedagogical approaches. On the other hand the programme looked at technical and/or pedagogical innovation aspects on the projects.

The programme was implemented in the context of validation and demonstration of telematic applications that would best contribute to reinforcement of competitiveness, to the development of employment in the Community and to the efficiency of services of public interest.

2.3.4 The MERLIN Cluster of TSER Projects

As indicated earlier, the projects mentioned below belonging to the 2nd and 3rd TSER Calls of the IV Framework Programme constitute the initial cluster of projects in MERLIN:

- *Computer-Supported Collaborative Learning Networks (CL-NET)*
- *Science Teacher Training in an Information Society*

Additionally, to this First round of projects the *DELILAH* project has been added, which, although belonging to the 1st Call, it in itself holds a methodological approach to the analysis of learning innovations. This can facilitate the analysis/es to be undertaken in MERLIN.

Additionally, the following projects from the EMMTF with TSER component will be analysed during the first round:

- *PEDACTICE, REPRESENTATION, PARLEU-NET, IN-TELE, NET-LOGO*

The synthetic results of this set of projects, through a meta-analytical approach, will be synthesised so as to inform the research of the indicators under which projects of the 3rd TSER Call will be reviewed; these projects are:

- *Implementation of Virtual Environments in Training and Education (IVETTE),*
- *Competence Evaluation and training in Europe (COMPETE)*
- *New Assessment Tools for cross-curricular competencies in the domain of Problem Solving*.

Such a review was intended to inform the development of policies and decisions regarding innovative methods and practices in learning environments mediated by the use of ICT and manifest research areas that require further research investigation and attention.

3. Project results and methodology

3.1. Framework of Analysis and methodology

MERLIN is an evaluation natured project. The project evaluative activity was operationalized on the basis of the CIPP evaluation model (Stufflebeam, 2000) as it provides an appropriate framework for the structuring of the projects and clustered components assessment and evaluation. The Model has been chosen due to its strength in identifying policy implications at various levels of project activity. Furthermore, the approach is appropriate to evaluate socio-economic concerns, as integrated in its frame is the in-depth review of contextual elements.

In the context outlined above and with the principle source of information, MERLIN had to structure its methodology in a way that the requirement of the TSER assessment Call could be effectively achieved. As stated above the Programme objective, and consequently the project objective/axes, called for a response on quality and innovation in education and training and in particular sought answers/evidences or indicators regarding:

- methods and criteria for evaluating the quality of ICT "innovations"
- the role of cognitive and cultural factors in shaping the use of ICT in a given learning context, and
- attitudinal factors towards ICT.

This framework suggests that the investigative process take into consideration dimensions that shape, either as a course or effect, the factor(s) implied in the objective(s). The chart below outlines the principle parameters considered in each of the three areas/objectives of investigation.

Research question	new learning approaches to teaching/learning	consequences for organisations	access to education and training
dimensions	▪ ICT in the classroom ▪ Teacher and studer roles ▪ Teacher-student, student-student interactions ▪ New methodologies ▪ Cognitive aspects	▪ Institutional Change ▪ The role of sta training ▪ ICT infrastructur influenced the output	▪ Life long learning ▪ Social exclusion ▪ Social opportunities ▪ Institutional change ▪ Cultural aspects

The specific questions that MERLIN formulated, on the bases of the parameters implied in the different Programme Calls, and thereafter came to respond to, are outlined below.

Research Question

What are the new methodological approaches to learning in technology-based scenarios and what is their efficiency? What are the new co-operative learning processes, cross-

curricular skills and role changes configuring technology-based learning innovations? How effectiveness is considered in the different innovations analysed?

Classroom level parameters:

- New practices using ICT that change the classroom
- New teacher and student roles associated with ICT in education
- New patterns of teacher-student and student-student interactions
- Changes in the organization of the classroom as a result of using ICT, e.g. extend the school day, break down the walls of the classroom, and involve other actors in the learning process, such as parents, scientists, business people, etc.

Other pedagogical and cognitive parameters:

- New cognitive aspects, and new constructivists approaches (shift from teaching to learning (collaborative learning, problem-based learning, learning to learn, etc.)
- Attitudes of teachers and trainers towards ICT
- Other cognitive, affective and socio-cultural factors that influence learning processes and school organisational conditions that are supportive to these learning processes (the learners' ability to master the flood of information and convert it into useful knowledge and the analysis of learning models and cognitive processes requires further research)

Research Question

What are the consequences for organisations when introducing these new ways of learning, including European cross-cultural issues involved in the process?

Institutional level parameters:

- Main institutional changes described as a result of the introduction of ICT into the existing structures.
- Role of staff training in the projects
- Relation between ICT infrastructures as a whole and the project outputs
- Role of telematics in approaching the needs of the information society, especially with respect to e-learning
- Institutional/organisational change: main actors, adopters and resisters to the adoption of the innovation as identified in the projects

Research Question

How do the outcomes of the project shed light on the following socio-economic parameters?:

- Life long learning. How ICT promoted LLL paradigm
- Social exclusion. Did ICT promote social exclusion or rather did new social opportunities? Equity issues: for instance, in the projects are there any identified changes in the gaps in academic performance among subpopulations defined by gender, citizenship, entry level ability, socio-economic strata?.
- Socio-Cultural aspects of using ICT

In summary the focus of analysis for the MERLIN project-cases was on

- pedagogic innovation – as an emergence of Community RTD activity
- institutional/organizational innovation – as an emergence of Community RTD activity focused on the changing paradigms in learning/teaching

- socio-cultural innovation – as a consequence of the knowledge base generated by the Community RTD supported actions in the area of "new learning approaches".

The primary source of information in MERLIN was documentation produced by the eleven case projects. In principle the Final Project Reports were used, although other key project deliverables were also reviewed. The Final Reports studied/reviewed were those of projects:

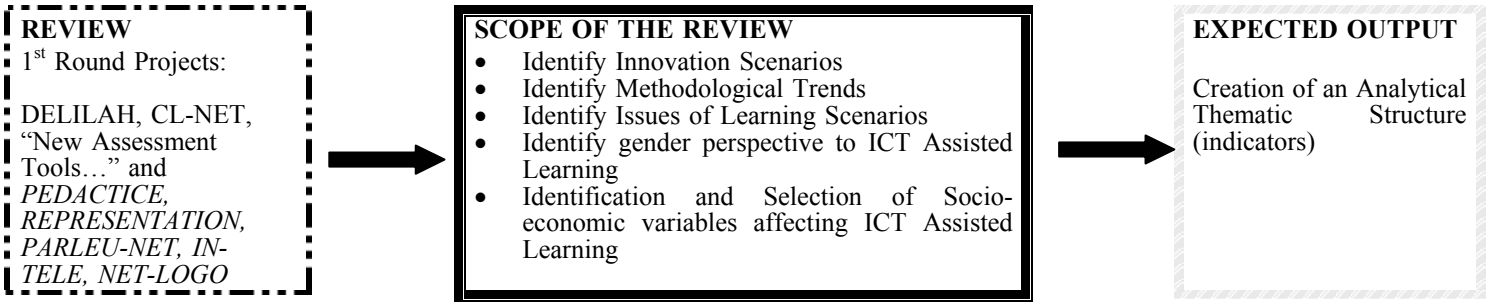
- *DELILAH* (1st TSER Call)
- *PEDACTICE* - EMMTF with TSER component
- *REPRESENTATION* - EMMTF with TSER component
- *PARLEU-NET* - EMMTF with TSER component
- *IN-TELE* - EMMTF with TSER component
- *NET-LOGO* - EMMTF with TSER component
- *Computer-Supported Collaborative Learning Networks (CL-NET)* - 2nd TSER Call
- *Science Teacher Training in an Information Society (STTIS)* – 2nd TSER Call
- *Implementation of Virtual Environments in Training and Education (IVETTE)* - 3rd TSER Call,
- *Competence Evaluation and training in Europe (COMPETE)* - 3rd TSER Call
- *New Assessment Tools for cross-curricular competencies in the domain of Problem Solving* - 3rd TSER Call.

The project had to identify the methodological trends, and prevailing learning scenarios that are used/have emerged from the use of ICT and thereafter make recommendations for policy, following an iterative process which involved participants of the clustered case-projects. This process was in line with the project's deductive methodological approach and could lead to the building of MERLIN's research and evaluation tools.

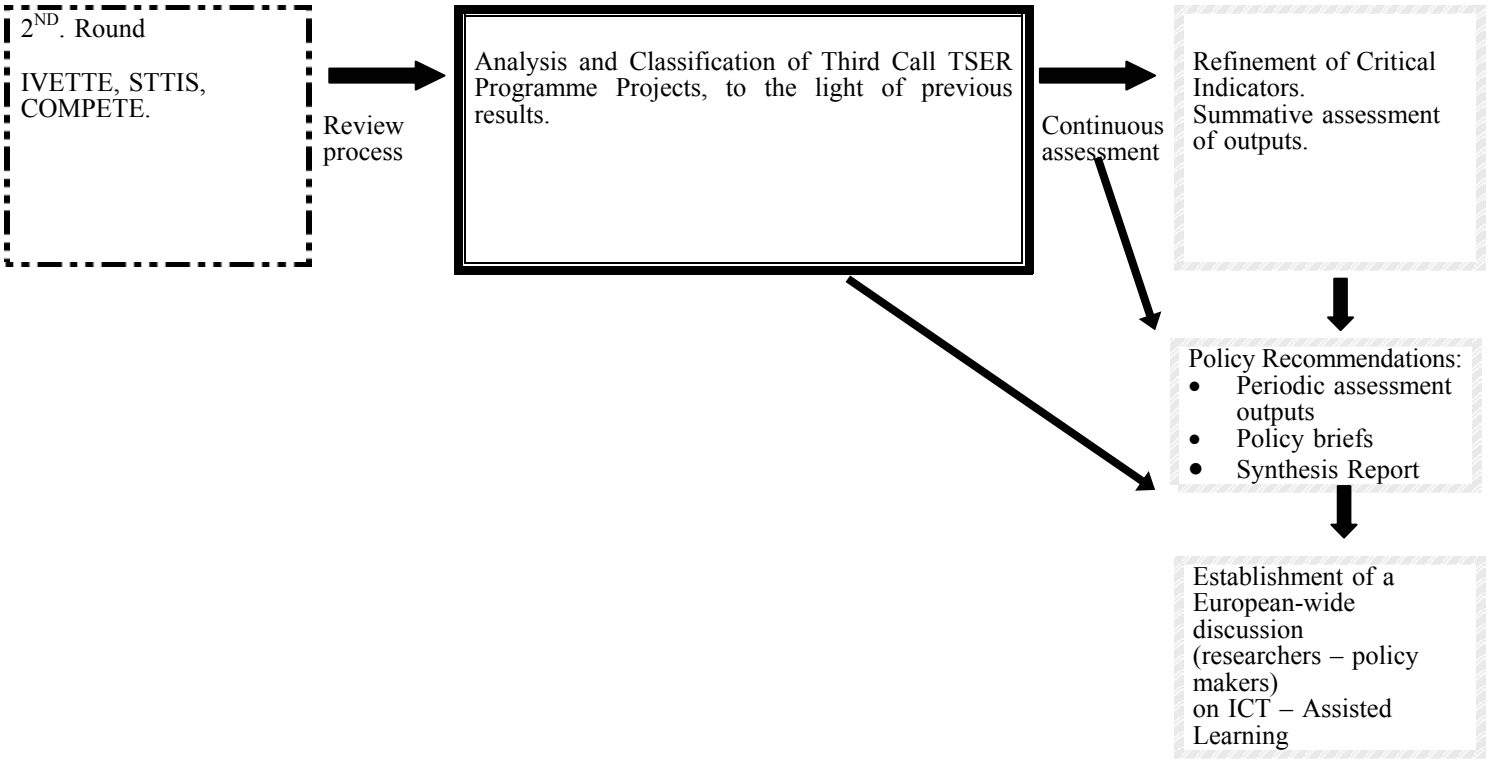
The building of tools within the project followed a three-step approach: a) Definition of an analytical framework and identification of parameters for in-depth study, b) Construction of research instruments with continuous refinement and validation, and c) Definition of indicators of change. The identification and formulation of the "indicators of change" manifest the meta-evaluative and reflective nature of MERLIN's methodological approach. *Meta-analysis* integrates the outcome estimated from multiple studies to arrive at an overall or summary judgement on the evaluation questions. The aim was, through a critical review of the outputs of the research projects of similar thematic orientation (Innovation in ICT-Assisted Learning), to activate a discourse between the "projects" (project outputs) and policy makers (via policy recommendations).

A visual representation of the approach is given below:

STAGE 1



STAGE 2



The section that follows discusses the building of instruments and process followed in achieving the Project objectives.

3.2. The cluster evaluation approach

The project is of the view that the reader of this document should bear in mind the meaning it gives to two key concepts that shaped its methodological orientation and is reflected in its outputs.

The project's evaluation orientation is that of ***Cluster Evaluation***, a relatively recent evaluation approach. Cluster evaluation is one kind of programme evaluation. As J.R. Sanders states "It is evaluation of program that has projects in multiple sites aimed at bringing about a common general change. Each project develops its own strategy to accomplish the program goal, uses its own human and fiscal resources to carry out its plans, and has its own context" (Sanders, 1997).

Cluster evaluation addresses the following questions:

1. Overall, have changes occurred in the desired direction? What is the nature of these changes?
2. In what types of settings have what types of change occurred, and why?
3. Are there insights to be drawn from the program failures and successes that can inform future initiatives?
4. What is needed to sustain desired changes?

The said orientation was selected amongst alternatives (i.e. analyses of project level evaluations and use of visits-to-make judgements) for its basic characteristics, which are: that it is holistic, it is outcome oriented, it seeks generalizable learning, and it involves frequent communications and collaborations among the partners. Cluster evaluation can be either formative or summative, but it has most frequently been both.

3.3 The need for indicators of change

According to Dale (1998), indicators can be defined as "a brief and concise expression about a phenomenon that is studied, used as an approximation of the phenomenon." They are useful for evaluation progress and are often proxies for changes taking place.

Dealing with a complex programme that looks at the study of innovations using ICT tools is a problematic task. We are familiar with quantitative indicators for monitoring and evaluating programmes, and these indicators can help us to assess progress, to make comparisons across countries, time, etc. But, when we deal with emergent innovations, we are in a territory of uncertainty. Emergent innovations, given their not very well defined characteristics, require, in our opinion, qualitative indicators of change.

Qualitative indicators might define phenomena that occur in learning innovations, pointing out the main dimensions of change. They might not be generalisable, but they would shape the innovations by investing them with characteristics that could be found in similar innovations that occur in the same or in similar contexts.

On the other hand, the fact that we are able to describe indicators of learning innovations does not necessarily mean that the changes indicators point out are a cause-effect result of the use of ICT. Causality is the result of many factors and requires an in-depth and focused study.

Through an iterative process (analysis review, and validation by experts in the area of innovation in education), MERLIN came about with a set of qualitative indicators which point out key traits of projects in the areas studied.

Our purpose was not to try to generalise these indicators to all educational contexts and sectors in which ICT use is present, but to shed light on innovative characteristics found in ICT-based learning innovations. Likewise, MERLIN does not endorse a cause-effect relation; that is, that the changes the indicators have recorded are a result of the projects, but rather that the indicators were present in the innovations and portray relevant changes of ICT-based learning.

3.4 Results and findings

With this in mind, we outline in the following section the main ***qualitative indicators*** found in each of the dimensions investigated which correspond to the areas analysed.

3.4.1 The extent to which TSER tasks were addressed in the projects

The first round review revealed that projects DELILAH, IN-TELE, NET-LOGO, PARLEU-NET, PEDACTICE and REPRESENTATION do share common features with respect to their contents. The TSER Themes addressed by the reviewed projects were:

- Designing and evaluating new kinds of learning environments taking into account available knowledge concerning cognitive, affective and socio-cultural factors that influence learning processes and school organizational conditions that are supportive to these learning processes; and, focusing on aspects that have not yet been adequately studied that are very relevant from a European perspective.
- The educational potential of the information society; research on the cognitive aspects of the design and application of new technologies in E&T, as well as on projects involved in evaluation and methodologies for new E&T products.
- Scenarios of applications of new approaches to enhance quality of education.

The relevant research tasks in these projects were slightly different, but all coincided on doing research on *cognitive aspects of the design, application of new technologies in E&T, and evaluation and methodologies for new E&T products.*

Research task "Scientific and technological literacy: research on social and cultural aspects of teaching and technological knowledge" is addressed by projects NETLOGO, PEDACTICE, REPRESENTATION and DELILAH, and research task "Effectiveness of policies and actions" is addressed mainly by project DELILAH.

Both of the second round projects, CL-NET and STTIS, approved in the second call of the programme TSER, share common features in respect to their contents. The themes addressed by the projects were:

- methods, tools and technologies: quality and innovation in education and training
- educational potential of the information society
- research on the cognitive aspects of the design and application of new technologies in E&T
- evaluation and methodologies for new E&T products
- design and evaluation of new kinds of learning environments (CL-NET)

The COMPETE project contributed to the socio-economic related tasks of the TSER Programme; namely the Programme's Area II (Research on education and training), which recognised, on the one hand, the demographic change in Europe and its cultural diversity, and on the other, the capabilities offered by new technologies. The perspective under which the Programme was set was:

- In the short term the aim was to provide a European base of information, knowledge and common references, covering more specifically the European

aspects and the European dimension of education and training to researchers and policy makers.
- In the medium term, the aim being on the basis of the work on these European aspects, to build a community of research on education and training in Europe, linked to the developments in educational and cognitive sciences.
- And in the long term, to strengthen the contribution of the education and training to sustainable development, employment, and innovation in Europe.

The project NATCCC-PS did address TSER tasks in the sense that it aimed at contributing to the definition of assessment tools for European cross-curricula competencies which are considered to be of high value and importance for benchmarking and improving the quality of European education.

Project IVETTE aimed at mapping out institutional, learning and cross-cultural factors that affect the implementation of virtual learning environments (VLE), and on the basis of such mapping, to propose recommendations to stakeholders on strategies for promoting the implementations of VLEs. The project's objectives were highly connected to those of the TSER Programme Area II (3rd Call). The project addressed specific problem areas outlined in the Programme's orientation, namely that of lifelong learning and educational goals, implications of societal developments for the education and training systems, educational implications of the European integration process, and education and training's contribution to fostering innovation.

3.4.2 Pedagogical, organisational and socio-economic dimensions affecting learning in ICT learning environments. Critical indicators of change.

Predominant teacher and students roles

While new pedagogical strategies and ICT-supported learning are closely linked in most of the projects analysed, it is not clear which of the two triggers innovation in the classroom. The teacher roles identified are not all innovative or a direct consequence of the utilisation of ICT, but in some way they emerge from a new understanding of teachers promoting innovations in ICT-learning settings.

It is generally recognised that the roles assumed by teachers are related to the transmission of information, to leading students' actions, to being the subject-matter expert possessing knowledge of fixed and precise contents which are capable of being attained by students. How have these roles changed? Linked to the use of the Web and other multimedia resources, in most of the ICT based learning settings, the role of the teacher as the "knowledge" authority or as the transmitter of information is in danger when using extensively sources of information different from that provided by the teacher. The teachers act more as learning guides: "*when I used Internet and multimedia, I had to change my teaching style; but colleagues who wanted to keep their traditional style, they just quit"*.

The predominant teacher roles identified were:

Teacher as learner in the classroom: Teachers are accepting that students might do better in special fields and were ready to learn with and from them: "*quite often roles were exchanged between teacher and student, especially when the latter was more experienced in using the new technology"*. Such a collaborative approach leads to the acquisition of ICT competencies by both actors.

Teacher as tutor. Among the many roles supporting the learning process, the tutoring role is one widely recognised. The tutor's role is not just the subject matter expert who facilitates learning activities, solves problems, and updates the contents.

For instance, in online discussions, the tutor facilitates communication, and it is possible to distinguish these tutor roles:

- The *tutor as modeller*, which implies someone who stimulates the learner by creating materials and situations for active learning.
- The *tutor as coach,* consultant, referee, assessor and 'helpline'**.**
- The *tutor as scaffold*, which is more of a guide and monitor, bringing parties together as manager, provider or broker.

Teacher as collaborator with students. There are many ICT-based activities in which project-based learning is the pedagogical strategy. In such activities, teachers tend to participate as peers together with the students.

Teacher as developer. The teacher develops learning materials mainly in electronic format, or provides input to professional developers.

Teacher as researcher. There is a trend in teachers' professional development that promotes the view of the teacher as a researcher of his/her own educational experiences as a way to reflect and internalise the innovations promoted in the classroom. As ICT tools and products are involved in many classroom innovations; teachers alone, or as partners of researchers in educational research, are able to use the research outcomes to help with planning and improving pupils' learning experiences with ICT, and to make them appropriate to their needs within the curriculum framework of the school.

Teacher as lifelong ICT trainee. ICT literacy is the first step in the professional development of the teachers. Teachers involved in innovations of any kind, and particularly in innovations using ICT, are more easily involved in retraining in both pedagogical and technical innovations.

Teacher as a member of a team of teachers. In distributed *e*-Classrooms, teachers are "members of a team of teachers" rather than acting only as individuals. This is due to the complexity involved in collaborative courses, such as international ones or other types of distributed learning arrangements.

Teachers' and students' roles are interdependent. If the roles of the teacher are moderator, tutor, etc., learners need to become self-reliant, active searchers for relevant information. The role of a *self-reliant student* is the corollary to a less directed role of the teacher. This raises the level of students' responsibility in learning.

The roles of students appear to depend on: a) the pedagogical approach used in classroom, b) the roles played by the teacher, and c) the classroom peers. Some of the roles identified include:

Student as teacher. Social and active learning can be encouraged by the use of ICT; new pedagogical concepts enable students to understand the role of the teacher as more actively integrated into the teaching/learning process.

Student as collaborator. Students collaborate with other students and the teacher in project-based educational activities. This is an important aspect to take into account in *e*-learning if the tutor wants to break the isolation of online students working individually.

Student as co-operator. Students cooperate in team work where they may undertake various team roles (for example leader, expert, moderator, affective supporter, record keeper, etc).

In general, students tend to adopt a more active, motivated, deep and self-regulated learning role. Collaborative rather than individual learning tends to occur. Teachers tend

to move from a traditional role toward one of a "learning facilitator". Nevertheless, these changes tend to be restricted to learning situations which employ ICT-based "open" applications, as interactive educational programs, use of the Internet as information resource, etc.

Teacher-student and student-student interactions

The significant changes in interaction among the actors of learning are linked to the changing roles of teachers and students. Team work strategies are crucial, not only for the student-student relationship, but for the teacher-student interaction.

ICT-based learning requires a modification of the conventional pedagogic triangle– learner, trainer, content. But, from constructivist pedagogical approaches embedded in the strategies adopted in ICT-based learning, it appears that interactions among teachers and pupils shift from the traditional logo-centric, teacher-oriented interactions towards informal, exploratory and meaning-making negotiation discourse.

For students, ICT tools are sometimes *tools of personal interaction* more than tools of productivity and information exchange. A rich ICT learning environment using telecommunications is seen as a catalyst for the generation of communicative learning processes and the adoption of a social mode of thinking.

The establishment of interactivity among tutors of learners is being seen as crucially important for the success of the learning experiences, whether one-to-one (individual learning) or one-to-many (learning in group). In online learning, we have identified the following indicators:

Online community of learning. Interactions based on the model of the online community of learning are strongly supported by ICT tools. Considerations about the type of communication occurring should be taken into account at the time of studying the interactions: *one-directional or bi-directional; synchronous or asynchronous; local or distributed; one-to-one, small or large groups; moderated or unmoderated*, etc. Interactions among learning actors distributed geographically in large groups create difficult organizational problems**.**

*Online free interactions***.** Free interactions and relatively *unstructured discussions* amongst learners at different sites are common in teleconferences, as well as, but less so, in videoconferences. In these environments, interactions seems to be richer than in face-to-face learning. If the pedagogical model is transmission-based, interaction might be less spontaneous than in in-class learning.

Limitations of written-based communication. Online communication is currently through writing, which poses many limitations, since many students lack proficiency in written communication; this is an issue that teachers and students (and researchers) must address. The choice of words is especially important, and this can lead to misinterpretations which trigger unforeseeable emotional reactions.

Information utilisation strategies

Role of information in learning. The selection and interpretation of information plays a key role when the sources are varied and easily accessible. There is a tension between the way information is perceived and the way it is used. Information can be viewed passively or can be interacted with in a critical manner as an object versus information as a questionable source and as a means to communicate.

Information seeking behaviours. In the learning process, there are emergent patterns of information-seeking strategies using different ICT tools (mainly the Internet); for instance, identification of needed information; selective search of information;

"exploratory surfing" (to find non-previewed information); selection of found information (by evaluating its relevance); relating selected information with other information (in a context/net); re-elaboration of new information; discussion with colleagues and teachers of selected information and the gathering process; and, application of information acquired.

Changes in the organisation of the classroom environment

In general, learning innovations challenge the teaching functions, teaching roles and school culture. The changes in the teacher and student roles as a result of using ICT affect classroom organization as a whole.

These changes are also connected to the epistemological view of the learning subject, to the learning strategy, and to organizational/institutional matters. Change of organization in the classroom appears to be caused by the combined effect of the media being used and the teaching approach being applied of placing emphasis on the learning processes rather than the outcomes, and on social learning rather than individual learning.

The most evident indicators include:

Flexible organization of learning spaces: experiences using ICT change the physical location of the classroom from regular classroom to the lab, from the located classroom to the virtual classroom with more learners spread through other centres. The effectiveness of the different classroom organizations is a matter of discussion (for some, teaching with ICT is more effective in classrooms than in labs) and there is not a conclusive solution. Computer availability in classrooms and/or labs affects, among other things, students' arrangement in the classroom and the ways ICT-based activities are performed (individual use, team work).

Flexible class timetable: the class timetable might change as a result of the use of ICT, especially if the learning experiences involve students from other classrooms or countries. Also the teachers' workplace might be independent of the course and there is some flexibility to the hours of work.

In ***online learning*****,** assuming that a virtual learning environment is "any combination of distance and face-to-face interaction, where some kind of time and space virtuality is present", the organizational arrangements vary and depend on many factors; for instance, the number of institutions involved. The ones we can distinguish are:

Virtual centralised classroom. A virtual classroom in terms of time and space where the classroom and course organisation is set by only one institution. This model is fully virtual and fully distributed in terms of participants. The tutoring system is also centralised.

Virtual distributed classroom. A virtual classroom distributed in different centres offering common courses, seminars, and distance tutoring to students scattered in a territory or from differing nationalities and cultures across Europe. A coordinating institution is necessary in order to manage the course, but combined with coordinators and tutors at the local level. The design of course materials, seminars, and if it were the case, the management of distance tutoring with students of differing nationalities and cultures across Europe, are organisational issues to be solved. Formal agreements are necessary among participating institutions.

Dual-mode classroom. Dual mode courses are usually organised by a conventional institution, combining face-to-face interactions with virtuality in terms of extending the regular classroom timetable or the classroom space (home, computer labs, etc). It introduces elements of self-directed learning, and can include collaborative virtual

experiences with teachers and learners from different institutions without formal agreements.

Pedagogical strategies

The main pedagogical strategies employed in most of the current ICT-based learning are linked to *cognitivism* and *constructivism* paradigms. According to cognitivism, learning is the process in which the learner acquires a proper understanding of the problem; instruction consists of activities designed to facilitate the acquisition of the correct representation of knowledge by the learner. For constructivists, knowledge is considered to be socially and individually constructed; the focus is on the development of a suitable environment for acquiring knowledge rather than for its transfer.

The following strategies have been observed:

Collaborative learning. It is based on the consideration of learning as a social process, stressing the importance of collaboration among the learning actors. Internet use is mostly seen in a social instead of an individualist setting, focusing on both virtual and face to face communities.

Project-based learning. It is a subset of collaborative learning, and requires certain autonomous study skills from the students.

Self-learning. A pedagogical basis quite common in online learning is the model of self-learning, also called independent work, autonomous learning, etc.

Communicative strategies to learning. Teachers and students take advantage of the possibilities of online communication and sharing, while integrating information seeking strategies for problem solving.

Cognitive aspects of learning

This parameter, central to the research themes reviewed, required special attention in MERLIN's subsequent review phases, both in terms of outcomes and methodological considerations of the projects to allow for the emergence of evidence regarding the effectiveness of ICT in the learning process. It is the view of the research team that, while the issue has been considered in the projects reviewed, it has not been investigated in depth, allowing for conclusive results.

What does become clear is that there is a strong relationship between "how ICT is used" and cognitive changes in learning. Either implicitly or explicitly stated in the results section of the project cases' documentation are other indicators of interest to this theme, including the following:

Knowledge representation. Exploitation of alternative forms of knowledge representation and less dependence on verbal expression, such as concept mapping.

Socio-cultural aspects of cognition. Socio-cultural aspects of cognition that emerge as a result of the changing roles and interaction patterns. For instance, in videoconferencing, an interesting finding is that, in discussions, distance reduces the fear of speaking one's mind.

Cognitive strategies. Cognitive strategies used in ICT are, for example, open and scaffolding access to information, and self-regulation strategies.

*Epistemological beliefs***.** These are beliefs about how knowledge is influenced by the use of ICT.

Attitudes of teachers and students towards ICT

Teachers' attitudes towards ICT are connected to socio-cultural, professional and technological barriers (national learning patrimony). It is not only a matter of individual attitude, but also social, professional attitude. Attitudes of teachers towards ICT appear to be dependent on the following indicators:

Attitudes of teachers towards the tools. There is a strong component of teacher awareness for demonstrating media competence in front of the students. Teachers could be uncomfortable if they lack strong competence when using the tools. This is a result that repeats heavily in all the environments in which the teacher plays very directive roles.

Teachers are also aware of having sufficient abilities to produce learning materials using ICT tools. Shortage of these abilities might produce insecurity with respect to their use.

Finally, teachers appreciate the aspects of materials that enhance pupils' motivation and collaboration and they realize that they can be used in a variety of ways.
It has been mentioned that attitudes towards ICT-based ODL vary and are connected with *cultural differences:* Inhabitants of Northern and Western European countries show a significantly greater preference for study with computers than students and professionals from Southern and Central/Eastern European countries. Nevertheless, the importance and weight of the facts need to be further investigated.

Positive attitudes towards the role ICT plays in teaching. There is a trend of integrating ICT tools into teaching. Teachers understand that multimedia and online materials can be used in a variety of different ways to enhance pupils' motivation.

Generally speaking, teachers and students alike develop *positive attitudes* via engagement with ICT tools and educational products. But tools which are not seen as delivering sufficient value, or that take too long to do so, tend to be rejected. Tools which offer something unique and important, and do so without taking too much time, stand a better chance of acceptance.

Negative attitudes towards the role ICT play in teaching. For many academic staff there is a negative attitude towards *online learning* as compared to face-to-face interaction; virtual learning represents a drastic departure from prevailing practice that is incongruous with their understanding of the essential nature of teaching and learning.

Other negative attitudes against ICT range from the traditional *techno-phobic* presumptions against technology based on doubts (or lack of information) of the effects of technology in the learning processes, to the fear of negative socio-economic effects of ICT on the employability of staff, such as the fear of replacing traditional teaching and teachers by ICT tools.

Attitudes towards ICT facilitating learning and engage students. Teachers' experiences of planning, implementation and evaluation of the use of ICT in the classroom have been strongly tied to the course syllabus. Teachers appreciate educational materials that enhance pupils' motivation and ability to collaborate.

Attitude of teachers towards ICT innovations according to the main focus of the institutions. There may be a difference in attitude in teachers towards ICT innovations according to the main focus of the institutions in which they work. For instance, in the case of universities that look for prestige through research in teaching, the attitude towards VLE can be positive, since many of the innovations in teaching are connected in different ways with the use of ICT.

Attitudes of students. Students' attitudes vary and are heavily dependent on the organisation of experiences and on the functioning of the tools; there are examples of how attitudes of students are dramatically affected by these factors.

Attitudes of students towards ICT depend on their conceptions of learning with ICT: It was found that students' representations of ICT range from a "quantitative conception" (ICT as a way for acquiring or applying knowledge) to a "qualitative one" (ICT as a way of comprehending knowledge). Moreover, ICT is represented as enhancing motivation, reducing information overload, speeding learning, improving computer literacy, and a way of getting good grades. With ICT, the learning process is seen mainly as an active-collaborative one which involves phases (i.e. screening; selecting; deepening).

Affective factors found in learning innovations with ICT

The documentation analysed did not provide us with evidence on the *affective level;* thus it was difficult to draw up a complete set of indicators. The ones that could be identified are the following:

Teachers' professional identity. For teachers, many of the affective factors that influence the use of ICT are very much connected to their *professional identity*. If professional identity changes as a result of the use of ICT and of the new learning approaches, there will be consequences, for teacher identity is personally and socially built, and difficult to change.

Given this view, it is easy to understand that teachers do not appear confident with respect to adopting new roles, and that they are concerned that society will not comprehend and respect their new roles. Even if teachers are motivated and willing to apply ICT-based innovations, they are confronted with the need to reconstruct their own view of themselves as teachers.

Working habits: Teachers have limited time to engage in innovations using ICT, so they need to be supported by the institutions at all levels. Furthermore, teachers have regular working habits that may need to change as a result of an innovation. A general trend observed is that teachers adjust activities to their traditional habits.

*Motivation***.** Compared to traditional learning situations, students, when learning with ICT, seem to display high levels of *motivation* and personal sense of competence. They are especially motivated by multimedia materials and the Web; freedom of choice on subjects and navigation; familiar contents; autonomous-collaborative learning; and positive competition.

Socio-cultural factors affecting learning innovations with ICT

Learning innovations challenge the teaching function and school culture, which is dependent on the level of learning patrimony and different national learning patrimonies.

Learning patrimony: It is obvious that there are variations between cultures and between content, kind and context of innovations, which are inevitably complex. National cultures, structures and practices themselves, and in general the learning patrimony, help to determine the nature of innovations. Thus innovation can not be 'held constant' whilst learning patrimonies and context vary.

Culture of collaboration. The impact of ICT is greater when a community of teachers are working together. Many schools are isolated, and there isn't spontaneous collaboration; collaboration promoted by a project in these cases ended when the project finished; A case presented by a participant shows that the pressure came from the project

managers, since there was not a culture of collaboration, of working together. In this situation it is easy to see that the innovations fail.

The use of ICT at school introduces the idea of opening the school context by *widening the potential interlocutors* for students and for teachers. An increasing communication need is foreseen between schools and families and a need to connect schools in networks so that the teaching practice is not a "private" situation but one that is disseminated in an explicit way.

Socio-cultural differences among countries. Socio-cultural differences among countries with respect to technologies has been reported.

Geographical differences. Geographical differences linked to socio-economic and educational factors (North-South) influence the use of ICT: the provision of relevant equipment and finance influence the use of computers, as well as the availability of technical support. Attitudes towards technology-based ODL varies and are connected apparently with similar geographical cultural: Inhabitants of Northern and Western European countries show a significantly greater preference for study with computers than students and professionals from Southern and Central/Eastern European countries. Nevertheless, the importance and weight of the facts need to be further contrasted and investigated.

Socio-economic status. It seems that pupils from the *upper class* categories have richer representations of ICT and that their knowledge of software and "computer processes" is much higher than in lower classes. Likewise, high achievers show richer learning profits from the use of ICT devices and communication.

Linguistic and Intercultural factors in trans-national projects. It should be obvious that these factors are issues to investigate since they affect learners. The use of ICT might be used to deal with these factors , but further research is needed. The use of educational materials in the local language looks like the best approach, at least at the pre-tertiary level. But the need of a common *language of communication* through ICT poses difficulties that influence learning outcomes. The variety of *school schedules* is an other factor that may impede a rich and meaningful networking between educational institutions in Europe.

Intercultural stereotypes are also present in international experiences. One of the assumptions for successful online learning is that teachers and students are able to explore the potential of having communication partners from other cultures and countries involved.

Institutional factors affecting Learning innovations in institutions

That the issue of institutional change is of crucial importance to the success of any innovation is well recognized. Institutional changes affect staff and managers. Discussion of on-going institutional factors on a wider scale deal with funding needed for ICT infrastructure in learning institutions, collaboration among actors, and an adequate implementation of ICT applications. In this section we outline the most prevalent indicators of change in this area.

Development of a "culture of collaboration". The introduction of ICT-based innovation requires institutional changes of a wide and unexpected range. There is evidence of a developing "culture of collaboration" among all actors (teachers, students, administrators) that is essential for successful institutionalisation of innovations.

Flexibility of Curriculum: In many countries the curricula are very tight and overloaded with information to be learned. Teachers complain about the amount of content of the

curriculum, and this reality does not allow them to use innovative forms of teaching and learning within the classroom. They state that working with computers needs much more time than with common teaching & learning tools. Teachers would appreciate a less tight and more flexible and interdisciplinary curriculum that allows them to foster new approaches to learning. Difficulties occurred when teachers were asked to understand Internet usage as a regular activity that would take place as part of regular classes instead of only during the weeks of the project.

ICT as a window of opportunities. Institutions are usually positive towards the implementation of ICT in the educational establishments. The changes should, nevertheless, be considered neither positive nor negative, but *as windows of opportunities* for institutions. For instance, in the implementation of online learning, factors that are considered positive towards full integration in higher education institutions are:

- *cost-effectiveness:* Online learning is a cost-effective way to bring people together without the cost and time-commitments of travel

- *wider access:* Online learning allows for reaching large number of people simultaneously and geographically distributed

Institutional barriers. There are many barriers to the use of ICT in schools and in other educational establishments; e.g., lack of full access to computing facilities and to the Internet; teachers suffering from a shortage of training and time to adjust; and, lack of full understanding of the implications of ICT in educational contexts. there needs to be ample planning before ICT products are introduced into the classroom.
The results regarding institutional change suggest that, while institutional change can emerge out of the usage of ICT for teaching/learning purposes, it has not as yet been felt. This is due to the *short duration of research projects* and the short amount of time ICT has been utilized in the teaching/learning process. This factor poses doubts about sustainability of the innovations with ICT. This area of study requires further investigation under a longitudinal study approach.

Teachers suffer from a *lack of personnel preparedness* and confidence. *Resistance to change* by the institution's faculty members is prominent; they need time to adjust to and absorb the implications of ICT in educational contexts.

Another barrier is *staff recognition*. Currently, the participation of teachers in research activities, as it was done in some projects, has no acknowledgement within the social organisation of school culture. In universities, research in teaching has a lower status in the research arena; this poses difficulties for educational innovations, though the situation could change in the future.

In general some strategies are necessary in order to overcome institutional constraints: incorporating right from the beginning of the project all responsible partners, such as research sites, school (and other) authorities and teacher training sites in every partnering country.

However the change of the existing system is often a much longer process than the projects can live with. One strategy used by a project was to link up with national, regional and international initiatives for making recommendations. This was successful in that sense that, after the project was finished, partners were asked to join new teams and expert groups.

Organisational factors affecting Learning innovations in institutions

The organisational conditions of ICT innovations are clearly linked to the institutional situation and changes produced by their implementation. Ideally, innovations are not

disruptive and can be fully adopted by implementing the necessary changes inside the institution. A fully *embedded innovation* within on-going institutional interventions would seem to have the best chance of success.
The innovations usually need special conditions, and these are more specific when the ICT innovations are developed in an international partnership

Many think that the organisational aspect of schools is one of the main problems confronting innovation. The school needs to be an organisation that supports the individual teacher and the teachers' teams; has flexible curriculum, classroom schedules, and classroom spaces; gives opportunities to reflect on new approaches to learning and teaching methods in teams and individually; and, fosters interaction/collaboration amongst teachers. Furthermore, there is a consensus that classrooms infrastructure and school facilities need to be changed for a more flexible use of ICT; e.g., having computers in every classroom, or students using laptops. Indicators of change here include:

Open curriculum. We already mentioned flexibility of curriculum as an important indicator. Usually the institution (talking mainly about schools) won't have any problem as long as teachers finish the formal and official curriculum. This is a concern, since the innovations need to step down from a strictly subject-oriented curriculum to allow the possibility to work with tasks not specifically related to one particular subject. In terms of flexibility, schools also need to *adapt their timetables*, especially if the projects are international.

Curriculum change and the creation of a professional culture of teachers are crucial for success of innovations: *"When you work with innovators, they do not complain, they negotiate with us on how to change or implement the curriculum: the change of curriculum leads to innovation. The organisational changes do not lead to change"*. Simply using ICT without changing the curriculum makes ICT tools little more than a toy.

Learning strategies and facilities: Other organisational conditions are connected to learning strategies and facilities: the computers must be placed either in the classroom or in labs in ways that facilitate collaborative learning. In school contexts the experiences can be facilitated if *network access* is possible from several places in the school and not only in certain restricted areas. There is a great need to develop a new generation of *school architecture* designed from the beginning for computer supporter learning environments.

Institutions are engaged in a process of change that is obvious when we look at the changes produced by Internet and the forms of online education. In higher education there have been identified four stages of organisational change as a consequence of the introduction of virtual learning:

Non-structural online experiences: this phase is characterised by the implementation of innovation at the level of pilot projects

Parallel Structures alongside 'Traditional' ones: there is a plan for going deep in the use of virtual learning inside the institution. This is characterised by the existence of a strategic plan that promotes the integration of ICT in the academic and research arena.

Mixed mode structures: this is change in the organisation of the institution, transforming the structure from single-mode to dual mode institutions.

Full online education organisations: traditional face-to-face or distance education institutions are in the process of transformation towards full online operations.

Contexts of collaboration. The organisation of contexts for school collaboration is conceived in different ways; some projects explored different models of classroom collaboration (i.e. collaboration within the class, between classes, international collaboration) and task planning (independent or interdependent tasks).

Staff training and its relation to ICT-based learning innovation

Staff training is crucial for the success of innovative approaches using ICT. Teachers should become acquainted with new methods, to get a full understanding of the educational functionality of technological tools, to become confident in managing the various components of the tasks, while regulate their expectations in order to avoid frustration.

General approaches to staff training. Training and new qualifications for teachers and trainers and other participants are absolutely necessary. General approaches pointed out in the cases include the need for:

- Staff training of awareness-raising type. Many lecturers are not happy with the traditional classroom methods.
- time allocations for training
- online sufficient support provisions for applying the concept in the classroom
- training depending on teachers' experience at novice, inter-mediate and expert levels
- usage of natural settings for training: on-the-job training learning by doing and applying the new knowledge in real learning situations
- training prior to the introduction/implementation of the innovation in the classroom to avoid frustration of both teachers and students
- training organized on the bases of teamwork so as to allow teachers to talk about their experience and reflect on the advantages and/or disadvantages of the Internet-method for school learning.

An example of a on-the-job ***training programme for school teachers developed by a project through different strategies and modalities was the following:***

- Discussing with teachers the topics of activities
- Teacher training on groupware
- Presenting the groupware to the students
- Meeting monthly in the schools with teachers to plan activities
- Visiting weekly in the classes during project-related activities (also non-telematic ones)
- Empowering the perception of teachers as main actors
- Attending International Teacher meeting

ICT-based teaching competencies: A set of basic teaching competencies are at the heart of the need for training. These are some of the required *ICT-based teaching competencies*:

- understanding the learning potential of educational multimedia and telecommunications tools, critically assessing advantages and disadvantages.
- Practicing ICT teaching and learning strategies: independent responsibility for learning, differentiation of teaching according to audience, process-oriented work, problem-oriented work.
- understanding constructivism, action learning and situated learning, use of students experiences from everyday life.
- curriculum design, looking at cross-curricular approaches and holistic learning mix classes

- management skills: information-management (becoming a facilitator), time–management and group-management (co-operative/team learning strategies).

An example of the training skills and qualifications in the field of online learning is seen in the table below:

Qualifications necessary for teachers/tutors in online learning	**Skills for teachers/tutors for online discussions**
o knowledge and understanding of the philosophy of distance education. o Mastering of different virtual teaching and learning software o Communication skills with students and with colleagues o Time management for fast and proper reaction o organization strategies of virtual classrooms o ability to work in inter-disciplinary teams	o How to manage anonymity and establishment of a learning community atmosphere o how to motivate and keep the motivation of learners high; how to avoid student frustrations o how to establish and maintain interaction among students, teacher/students and user/system, o how to moderate discussions. o How to solve communication conflicts

Another example for undertaking a teachers training module in **'Multimedia in Education',** proposed by one of the projects (PEDACTICE) and adopted by UNESCO, had the aim that the target groups construct deep knowledge and high competencies regarding:

- Why, where and how multimedia can be used in school educational settings;
- Pedagogical scenarios concerning the mainstreaming and future use of educational multimedia;
- Important learning and teaching aspects, in particular teachers' roles, students' learning strategies, social/collaborative learning, ICT literacy, students´ conceptions of learning, meta-cognition, and motivation;
- Presenting educational goals and how educational multimedia can support these goals;
- Critical and reflective selection and use of educational multimedia according to mainstream scenarios for the use of multimedia in education;
- Considering ethical and social-cultural aspects, which can influence the use of multimedia in education;
- Innovative evaluation methods related to the educational use of multimedia.

In any case the training programmes should respect and consider the "equal but different" concept in order to take into consideration the national cultures and the differences within and across the countries.

Main actors, adopters and resisters to the adoption of the innovation as identified in the projects

Actors of ICT learning innovations. The main actors and adopters of the ICT-based innovations depend on the adoption scope, but all intervene with different weight *teachers and students*, *managers and middle managers of educational institutions and (mostly in schools) parents.*

An example is that of CL-NET: Innovation at school was introduced as a shared activity between researchers and teachers. According to the action-research model, teachers acted as researchers in many of the experiments planned. The teams of teachers were intended as communities of practices. Local communities of teachers sharing a mutual

engagement, a joint enterprise, and using a shared repertoire, were organised on local basis. The main idea was that of offering a social gathering within the schools that could function as a self-supporting structure for teachers involved.

Adopters and resisters. Usually, *top senior management,* as compared to middle management and teachers, *are keen on supporting ICT-based innovations.* An example of this trend is the case of virtual learning in higher education: university authorities see opportunities for increasing the number of students, and for attracting further education learners. *Middle management* at department level seems to play not as a positive role. Connected to day-to-day academic problems, their priorities can be different.

Other groups need to be taken into account as well: *policy-makers, developers, technical staff, "content providers"*, etc.

Constraining factors and barriers for adoption of innovations. It is easy to find lack of *preparation* of the school as a whole, both in terms of training of staff, equipment and organization, and adapting ICT in the learning/training process from a holistic perspective. Again, the lack of *teachers' confidence* regarding innovative work with ICT is also a factor worth investigating further. These factors require further attention at two levels: first, regarding their detailed definition and contingencies to other factors such as *finances and governance* of education; and second, regarding the *means and methods* to overcome their constraining effects on innovation.

In the case of virtual learning in face-to-face institutions, there appear a series of intertwined *barriers* that evolve over time:

- *Uneven distribution of workloads* on teaching staff
- *Lack of necessary financial support*
- *Casualisation of intellectual labour* – in that new members of the teaching, research and support staff are engaged on temporary contracts
- *Lack of familiarity* of many staff members with anything but the basics of using ICT equipment and lack of opportunities to learn from each other in a relaxed way
- Worries about issues relating to *the intellectual property rights* of academic staff and the material they produce for teaching purposes
- Staff concerns of *being replaced* by Virtual Learning

3.4.3 Other socio-economic indicators of learning innovations

LLL paradigm and ICT learning innovations

This issue is an important concern during the life time of the project. If little evidence was found, this does not mean that the projects' participants were conscious of the lack of research and evidence that would demonstrate that the rhetoric of lifelong learning is well established.

It is difficult to summarize trends and indicators which promote the lifelong learning paradigm. ICT is seen as an important factor for achieving lifelong learning and for decreasing barriers between school education and daily life, school education and work place.

Participation in communities of practice. To get used to participating in ICT-based learning innovations, in educational research, or in collaborative projects might be a prospective measure of future success in lifelong learning of a particular learner or practitioner. The creation of and the early participation in "*communities of practice*" which take advantage of ICT to organise activities is seen a positive approach, since this

can pave the way for actors to get used to learning in these environments, and prepare them for future learning. The participation in collaborative projects at a distance offer students a first experience of a society where knowledge does not resides only in former sites but is rather distributed. The participation in collaborative projects also includes the consideration of learning as a social rather than an individual experience.

Online learning opportunities. New learning arrangements based on online learning open new opportunities for the educational system to promote lifelong learning:

- Online learning opens new ways *to reach the target groups of part-time, continuing, and postgraduate learners in the perspective of lifelong learning.*
- VLEs open new opportunities for the *internationalisation of education* (mainly of universities' learning programmes and services, and inter-university networking) allowing new perspectives for lifelong learning in international settings.
- In the case of *disadvantaged* citizens, online learning has been mentioned as an opportunity for enabling them to make the best possible use of the educational system for their initial and continuing education and training and lifelong learning.

Equity issues

While the implications of this parameter are of great importance to the orientation of the TSER Programme, this is an area that *needs further research projects* since MERLIN has found little evidence regarding this issue.

There is a general concern about the lack of a clear definition of exclusion. The dichotomy exclusion-inclusion is sometimes deceiving; it is not only the *digital divide problem*. We need a more sophisticated definition of exclusion, not only related to the physical access to a service. We should not fall on fundamentalisms in linking equity and learning technologies, and not create a new category of social exclusion: "in danger of social exclusion".

More ICT in education may be a necessary condition, but not a sufficient one. Otherwise we run the risk of transforming ICT in a "social artefact."

Inequality in access. Inequality of access to ICT products and ICT-based learning at various levels (from country to country, from sector to sector, among schools and among students) is likely to affect students' academic achievement, future job prospects, and prosperity in an information society. Nevertheless, equity differences begin to play less *critical role* if teachers and students are directly implicated in the innovation processes and dedicate much effort and enthusiasm towards improving the quality of teaching and learning.

Access of disadvantaged groups. In general disadvantaged groups suffer from a serious precariousness of arrangements in all areas of their studies. There is a need for more research.

Gender differences. Gender differences have been reported (for example, girls seem to be more receptive to collaborative components), but this issue, together with the equality of opportunities and economic support, although mentioned, need more attention in the future.

Opportunities of online learning. Virtual learning seems promising in terms of providing *open and flexible access* to a wide range of people, independent of time and place, gender, colour, status, etc.

Efficiency and effectiveness of ICT-based learning innovations

Efficiency and effectiveness is a rather special issue in ICT learning innovations needing further research, since it is underrepresented in the projects analysed. Furthermore, there is a certain consensus among projects that learning effectiveness is very difficult to measure for individual projects.

As identified, these parameters might be important aspects to be promoted in future programme Calls as topic of investigation:

Efficiency of virtual learning. Efficiency of virtual learning has been considered in some cases in terms of:

- careful spending of means
- keeping organisation, administration and technical efforts at a minimum
- use of synergies

Effectiveness of virtual learning. Effectiveness of virtual learning is indicated by these, among other characteristics:

- the best ratio between time spent on preparing the teaching materials and tutoring, and time needed for learning
- good learning results

Sustainability and scalability of innovations

Within these interconnected areas, MERLIN lacks data in most of the projects analysed. Seldom in the reports analysed are the issues of sustainability and scalability treated as key features for the success of the projects beyond their end. This area definitely needs further investigation in the EU educational establishments.

Constraints to sustainability. The school sector is resistant to sustain ICT-based innovations due to institutional, organisational, hardware availability and staff-related factors (lack of teachers' training). There is a very different situation if sustainability entails an individual or has been part of the teachers' (and students') practices or is at the level of the whole institution.

Other *organisational aspects* affect the potential of sustaining innovation : institutions often do not allow the establishment of innovative pedagogical practices; he management of time, space and social boundaries for introducing new didactical practice is often problematic. As pace for innovation within the curricula is not always apparent; schools seem to have a tendency to be inflexible organisations.

The *participation of schools* in a research project does not involve any activity once the research is completed. Schools and teachers are not supported anymore, and the innovative practice introduced by the project can hardly be continued or reproduced without being sustained within the school organisation. If we want teachers and school directors (when possible) to act as professionals, we need to include teachers in the research teams.

In general, r are serious doubts about *sustainability of individual projects*. Furthermore, since technology changes so rapidly, we can hardly measure sustainability by how the innovations become adopted by the institution, but how these innovations are able to adapt to or keep pace with technological changes.

Support strategies for sustainability. The main issue raised on this concern deals with the idea that innovation can be introduced in institutions if a supporting network of activities is planned and if the didactic activities are consistent with regular school practice planned by teachers.

There are different strategies according to sectors. The approach of one of the projects at the regional and local level was to contact the educational authorities from the very beginning.

Sustainability of Online learning. Many think that scalability and sustainability are a matter of economics. For instance online learning in order to be sustainable should be profitable. There is a long term feeling that VLEs may either provide new sources of income or reduce current costs. It seems that, at the current level of development of virtual learning, postgraduate and continuing education have the best chance of been sustainable. There is a concern about quality, a concern that institutions may just adapt and package face-to-face courses, changing only the delivery system.

As with respect to *scalability* we found too little data to suggest indicators. Scalability is definitely an area for further research.

A key reflection present in the research was the extent and scalability of innovations in general. One important concern that is always present in all kinds of innovations is that they be applicable to the whole population, if we intend them to be. ICT-based learning innovations are not an exception.

Sustainability and scalability appear to be very much related. For instance, as with respect to sustainability of projects funded by the EU, the Commission also made the very same mistake, by asking from the very beginning for exploitation plans. But, in reality only if the projects produce commercial outcomes, is there a possibility for scalability. Scalability needs time.

Implicit definitions and added value of ICT learning innovations

Innovation and its scope is an issue in any kind of project that intends to change practice. Innovation in learning with ICT is not an exception.

Definition of innovation. There are a variety of innovation definitions and characteristics depending on their focus and level of intervention. In general we prefer a holistic definition of learning innovations: A learning innovation is a complex phenomenon that emerge historically, and is culturally mediated. Learning innovations are framed by socio-cultural, technical, learning and organisational factors.

In general, the *innovativeness factor of ICT*, usually relates to the technological, organisational, cultural or pedagogical approach:

- Innovation delivery is determined by the policy and innovation cycle of each country
- Countries have different capacities for delivery innovation at a given pace
- Learning outcomes can be improved by the integration of new pedagogical concepts which can be applied if ICT is introduced into classrooms
- ICT learning platforms can enhance linkage between the educational actors

Added value of learning innovations with ICT. The added value of ICT is not questioned, and it is implicit in most of the innovations. It varies quite a lot depending on many factors:

- Enhance student-centred learning approaches

- change traditional teacher's role
- promote new competencies required for improving teaching and learning

Online learning has been reported to have the following values :

- reaching more students;
- giving more learning opportunities to those who can not come to in-class learning;
- creating learning communities both in national and international setting;
- breaking the traditional face-to-face learning classroom;
- providing for more learning resources for both independent and project work learning.

4. Conclusions and Policy Implications

4.1 Conclusions

MERLIN's deductive methodological orientation and the principle information sources used facilitated the generation of a set of "indicators of change": tangible instruments for both the planning and evaluation phase of ICT considerations in education and training. The analyses and reflections carried out in this research were based on responses to a set of transversal research questions, which reflect components of the socio-economic research in the area of ICT-based learning.

The first question is of a methodological nature in that it concerns itself with approaches to learning in ICT-based learning settings: a reflection on the results presented above suggests a clear cut approach greatly influenced by institutional, organisational and financial factors. At the school level, the effectiveness of the innovative methodology is dependent on the extent to which it is consistent with regular school practices, and in accordance with the school mission.

The research can not define a single methodological approach for the multiplicity of educational settings and learning scenarios in which technology is being used to optimise learning. As a matter of fact, it is still not clear whether it is the pedagogical practice or the ICT support that triggers innovations. One can, however, describe the progressive shift from traditional paradigms to ones integrating rich ICT-based learning environments.

In the latter case, the shift is towards more collaborative and participative forms of learning which in themselves dictate changes in the interaction process of the educational actors and educational resources. In the case of the tertiary level of education, it appears that the interaction of learning resources (human resources included) is stronger than in the case of lower levels of education, where the task assigned is mediated by the teacher and, therefore, takes precedence over content and interaction with resources. The results at hand give little evidence regarding efficiency of the learning process in innovative situations.

Instead, the results are rather indicative regarding effectiveness of motivation. Students appear to display higher levels of motivation and personal sense of competence when working with ICT.

At a first glance, the teachers' roles identified in the projects reviewed do not appear to be at all innovative as a direct consequence of ICT usage. Instead, changes emerge as teachers come to understand the roles they need to play in ICT-based learning settings. In other words, it is the interplay between the innovation and the perceived role that shapes the new support provisions required in ICT-based learning.

The role of the teachers is shifting from an agent for knowledge transmission and designer and leader of student activities to an agent for supporting learners. This requires a definitive change in the perception of the function teachers play in the process of learning, which, in turn, dictates the development of skills and attitudes that allow for flexibility in their own learning and teaching style. Teachers functioning in ICT environment need to reflect on themselves as learners, as teacher guiding takes multiple forms (modeller, coach, scaffold).

In terms of the learners, they take a more active and self-reliant role. Students can also play roles traditionally executed by the teacher. It should be noted that the adoption of such roles by students are restricted to situations where ICT-based applications are employed, and in no way should it be generalized to be applicable to all technology-based learning situations.

The second research concern embedded in MERLIN's conceptual framework has to do with the implications of the introduction of new ways of learning for institutions. More so the concern was on the way institutions are affected by the intercultural potential presupposed by the use of ICT. The analysis of research results suggests that the pace of institutional transformation is rather slow. The currently implemented learning innovations emerging from research activity, appear to have but limited support from the institutions these come to serve. This is perfectly understandable since these operate, especially at the school sector, as islands of innovation. The MERLIN results, as is the case of results from other reflexive endeavours, suggest that institutional support is a prerequisite to successful implementation (and thereafter sustainability) of learning innovations. Institutional support is often not granted on the bases of costs attached and intended changes required, both in terms of human resources and re-consideration of conceptual orientations.

With respect to institutional factors affecting learning, on the bases of the identified indicators of change, one can conclude that the undertaking of ICT-based learning affects their institutional culture in terms of:

- **the culture of collaboration**. This entails close links being built between all actors including those involved from a distance. Attached to this is the issue of language and cultural sensitivity.
- **flexibility in the curriculum**. Curricular structures are aware of the notion of "alternative teaching and learning approaches", different time schedules, interdisciplinarity, and different assessment approaches.
- **the institutional approach to achieve its mission**. This entails that institutions develop a positive view towards provisions of educational services for online learning and for the added value of ICT-based learning.

A fundamental concern in the assessment process by MERLIN was the extent to which ICT-based learning provisions promote the lifelong learning paradigm and particularly whether the introduction of ICT stimulates a dual society and thus social exclusion. The nature and scope of the projects reviewed inhibited the drawing of any meaningful conclusions regarding the issue(s) of concern. An exception to this is the results of the IVETTE project, which through its empirical evidence, concludes that "virtual learning seems promising in terms of providing open and flexible access to a wide range of people, independent of time, place, gender, status, etc". The little evidence that does exist, regarding ICT as a stimulant for a dual society, appears to suggest that the extent to which ICT can facilitate/hinder the *Lifelong Learning paradigm* is contingent on factors that have not yet been fully explored and that were outside the scope of the MERLIN project.

The review process of the cluster projects revealed that equity aspects of learning innovations were not sufficiently addressed. Exceptions to this were the projects DELILAH (TSER) and REPRESENTATION (EMMTF), and to some extent IVETTE (TSER). The first two suggest inequality in access to ICT products and ICT-based learning activities at various levels (from country to country, from sector to sector, among schools and among students). Such inequalities in ICT access and use are likely to affect students' academic achievement, future job prospects, and prosperity in an information society. This also applies to disadvantaged groups who, due to the continuous introduction of new ICT products and services, may face further exclusion from a wide range of societal activities. In this context, forming and implementing policies that would target disadvantaged groups, schools or geographical areas towards the development of more and enhanced opportunities for ICT access and use for learning is of major importance at European and country level.

The provision of more opportunities for ICT access for learning, however, cannot *per se* guarantee that students, educational or other communities, and disadvantaged groups *will* actually take advantage of it. This is because lack of ICT skills and new abilities for

managing information may also become an extremely restricting factor. For example, while in the corporate sector e-learning is becoming an important solution for in-job training, older or other employees who lack the necessary ICT skills may avoid using ICT tools and hence the training offered. This also can be true for job seekers and unemployed people in general. Overall, policies for the implementation of basic ICT training schemes targeting to such groups of people are essential.

In addition the project has noticed that the issue of *efficiency and effectiveness* is underrepresented. This is not surprising however, as the life cycle of these projects (two to three years at best) constitutes a restrictive factor on their study (e.g. in virtual learning efficiency is mostly linked to economic parameters, whereas effectiveness cares about best ratio between time spent preparing the teaching materials and tutoring and time needed for learning).

Connected to this is the fact that the projects provided insufficient evidence regarding *sustainability* of results (which in turn affected the extent to which the project could reflect on the lifelong learning paradigm). From a pedagogical point of view, sustainability of innovations depends on the supporting network of learning activities within the educational institutions.

Many think that scalability and sustainability are not only a matter of economics; for instance, online learning in order to be sustainable should be profitable. The concern should also be about quality, taking into account that scalability needs time.

Last, it is worth mentioning that MERLIN found among projects' partners an added stress factor.. Researchers have the feeling that they have to prove something in front of the funding body, and this puts pressure on the whole research process. Research funded by the Commission needs to look at qualitative differences, not only at quantitative ones.

4.2 Policy implications

Most of the projects analysed contain parts and conclusions which can be identified as recommendations for policy or at least as a contribution to the development of recommendations. Most of the aspects mentioned by the projects deal with needs for improving teaching with ICT. Some also address more general issues relating to equal opportunities, cross-European school cooperation, and institutional and organisational changes. In general, most of the projects build on the current situation in education, making this the starting point of their investigations. However political considerations should always take into account that ICT as such cannot serve as a quick fix to solve problems of traditional education relating to resourcing, motivation, and standards. It is not surprising that it is suggested to explore more information and experiences in order to enhance insights of new processes and new needs in education forced by ICT.

Implied in the results of the projects reviewed and clustered is that the human component, in terms of competence and attitudes regarding the application of innovative methods to the learning process, plays a predominant role on both the introduction and scalability of the innovation.

MERLIN recognized that an agenda for policy articulation in the field of learning innovations with ICT ought to focus in the areas of:

- equal access to educational opportunities
- cross institutional cooperation
- institutional transformation
- organization parameters regarding the educational praxis
- knowledge sharing and knowledge negotiation mechanisms
- school organization and curricula development
- provisions for learning on demand

- teacher's professional development
- provisions for support to the educational actors
- knowledge dependencies and gender issues
- lifelong learning policies

Most of the projects were focussing their recommendations on the organisation of the learning environment, but other contextual elements should be taken into account as well, reflecting the wider context of teaching and learning outside the classrooms. The learner's workplace at home and at work should be addressed, as well as the overall organisational context of teaching and learning based on different notions from the traditional ones for education.

The development of equal opportunities for ICT access and use for learning are further issues considered in several projects; only a few explicitly dealt with equity issues which are critical for providing Europe's citizens with full access and exploitation of the potentials offered by ICT for learning. Apart from the general observations of deficiencies on a local, national and European level, some projects directly address equity related issues. Research performed suggested inequality in access to ICT products and ICT-based learning activities at various levels (from country to country, from sector to sector, among schools and among students). Such inequalities in ICT access and use are likely to affect students' academic achievement, future job prospects, and prosperity in an information society. This also applies to disadvantaged groups who, due to the continuous introduction of new ICT products and services, may face further exclusion from a wide range of societal activities. In this context, forming and implementing policies that would target disadvantaged groups, schools or geographical areas towards the development of more and enhanced opportunities for ICT access and use for learning is of major importance at European and country level.

Diversity in school curricula in different European countries creates important barriers in developing cross-European school cooperation .Specifically, centrally-oriented curricula tend to be less flexible, allowing little room for schools, teachers, classes and students to develop educational activities in cooperation with schools from other countries and engage in innovative ICT activities. The need for the development of a common European culture requires the implementation of adaptive curricula that would encourage the educational world to take advantage of new opportunities offered by ICT for communication and collaboration. Language barriers need also to be taken into account. While electronic translation of documents is improving, it cannot replace synchronous communication. The development of educational software that would support alternative forms of representation for communication and knowledge objects' sharing could facilitate interaction and collaboration among schools.

It is necessary to underline the problem of an overload of content-related issues within curricula in many countries. More flexibility and interdisciplinarity are needed for curricula design and application by teachers in order to promote innovative forms of teaching and learning.

The school sector was characterized by the reviewed projects as resistant to ICT innovation. Other projects tackling higher education institutions suggest that institutional change may emerge out of the use of ICT for teaching-learning purposes. Furthermore, collaboration with the corporate sector may affect institutional change in education. This is a long-term approach to change that needs to be scaffolded and accelerated by relevant policies.

Other institutional measurements for the improvement of competencies as well as rewarding activities of teachers using ICT are also polices that could be implemented. Other policies include: creation of institution policies, making institutional regulations, integration of good practice into the curriculum along with the technology and modelling of appropriate behaviour. Team-oriented educational institutions might cope better with

the current demands related to ICT than other more individual-oriented ones where the exchange of information and collaboration is on a lower level.

Teachers need time to adjust to and absorb the implications of ICTs in educational contexts. In-job training based on learning by doing at different levels depending on ICT experiences should be further supported. Teachers' participation in 'communities of practice' where they can exchange ideas, experience and materials should also be encouraged. The integration of innovations in classroom teaching should be promoted by enabling teachers to internalise the different approaches. Therefore teacher training becomes a crucial aspect for ensuring effective results of any political measures relating to teaching and learning. Policy recommendation should explicitly address the training and provide sufficient support for facilitating the ICT integration in the classroom.

All the above, in a very crucial way contribute to the development of new ways of teaching and learning. As has been pointed out, the use of ICT for teaching and learning do affect teacher and students' roles and patterns of interaction in considerable ways. Such changes towards increasing student-centred practices, self-learning and teamwork should further be supported by corresponding educational policies. These policies should also further encourage a paradigm shift from objectivism and linear instructional design to exploratory, constructivist and socially oriented ways of learning.

On the issue of training provisions, a policy that emerged regarding training organizations is that these ought to recognize that i) managers should be trained how to choose; ii) training should be devoted to communities of teachers; iii) better links are needed between the training centres and the teachers' needs.

In this regard the dimension of teacher training, beyond the level of skill development and technological competence, requires special attention by the educational planners. Teacher training schemes that do not integrate/consider pedagogical aspects of innovation are doomed to failure. Moreover evaluation competencies are proposed as another issue which needs to be more adequately promoted in teacher training. The evidence studied in MERLIN implies that conventional forms of teacher training appear to be insufficient means for sustaining innovation. Actors such as school managers, policy/strategy designers and even parents need to participate in the building of communities of "innovation sustaining" practices. The recently announced e-learning Action Plan appears as an adequate response to this identified need. National and local schemes need to conform to such requirements if wide scale implementation of ICT based teaching/learning is desired.

In dealing with lifelong learning, the use of ICT in education and training can result in increased flexibility between working life and study by bringing learning opportunities to the work place and by bringing working life closer to school. A prerequisite of open learning systems is, however, that educational policy and stakeholders, such as educational institutions, libraries and other information sources, as well as industry and commerce, begin to perceive the whole education cycle from the viewpoint of lifelong learning. This requires collaboration and networking among the various parties.

4.2 Call for continued socio-economic research on ICT in education

MERLIN suggests specific issues that need to be further explored at the micro-level when studying learning innovations mediated by ICT, but also proposes several broad areas that might need a more strategic approach.

4.2.1 Micro-level research recommendations

- ***Attitudes towards the use of ICT***

We usually look at early adopters of innovations, but we need to know more about the attitudes of people who resist the innovation processes.

Also, there has been a mention of differences in attitudes when comparing geographic areas in the EU. We suggest looking thoroughly at this factor through comparative research in the near future. This might shed light on the EU's future research policy in this area.

- ***Intercultural differences***

It would be interesting to support studies for developing pedagogy for learning in the knowledge society with focus on the management of cross-cultural and linguistic issues in the framework of an European education space (e.g. transregional/transnational joint courses and/or learning materials development, transnational joint-student support, transnational collaborative learning, layered approaches of learning platforms, etc.).

- ***Cognitive and affective factors***

It would be interesting to support research that pays attention to the emotional aspects of learning in ICT-based learning environments, such as those of e-learning type. Interesting problems are those related to the extent to which social and learning skills, self-managing skills, and other meta-cognitive capabilities are developed.

- ***New teaching competences***

There should be studies in emerging new competencies; skills and meta-skills of teachers, tutors and other academic staff (as well as managers) for e-learning.

- ***Knowledge and information***

The analysis/reflection suggests also the need for in-depth study of people's information seeking behaviour in ICT-based learning situations and its relation to knowledge building.

4.2.2 Strategic research recommendations

- ***Institutionalisation of learning innovations***

Longitudinal projects dealing with long duration innovations in one or more institutions would provide insights with respect to sustainability and expansion of ICT innovations.

- ***Equity, exclusion and gender***

Some fundamental questions to ask are: how can we handle new forms of exclusion as a consequence of limited access to technologies of electronic transmission information?; what are the pedagogical factors that inhibit /promote social exclusion?

- ***Lifelong learning and ICT***

We need studies that make the rhetoric of European Life Long Learning more concrete by i) bridging the gap between theory and practice across the different sectors (and different 'patrimonies') of learning; ii) developing a definitive evidence base on 'what works, for whom and under what conditions', with particular regard to the use of virtual learning (e-Learning) in education and training; iii) consolidating knowledge on new ways of promoting social inclusion (e-inclusion) and integrating social inclusion policies with education and training policies more effectively.

- ***Long-term teaching and learning effects***

We need to undertake longitudinal studies of the learning effects arising from learning with ICT (such as learning in new scenarios combining face-to-face and virtual learning): changing habits of study, new assessment components, long-term teaching effects, promotion of the notion of "classroom observatory" type of activities, etc.

5. Dissemination and/or Exploitation of results

5.1 Dissemination Strategy

MERLIN has provided empirically founded knowledge on qualitative indicators of change in learning innovations with ICT. This has enabled a response to key socio-economic questions concerning the challenges and needs of the knowledge society.

Beyond the limits of the partnership and of the participants on the clustered projects, the consortium agreed to take advantage of the reports produced in order to reach larger audiences that include the Commission research programmes, policy makers, practitioners and researchers. Project partners also agreed on promoting the visibility of results by participating in international events, such as Conferences and specialised seminars. The publication of the project results and of contributions of some of the participants in the clustered project has been also part of the dissemination and exploitation strategy of MERLIN.

The results that emerged from the iterative evaluation process implied by the methodological approach followed in MERLIN were negotiated, and thus diffused to the key actors of the cluster of projects reviewed. This was done both at the formative and the summative levels.

The dissemination strategy of MERLIN intended to take advantage of the possibilities of the Internet in order to facilitate the availability and visibility of the project deliverables and results, as well as to promote online and face-to-face discussions among experts.

The target audiences identified in MERLIN include: i) European Commission research services; ii) Policy makers at local, national and international levels; iii) Researchers and practitioners in ICT-based learning.

5.2 Dissemination activities

In the course of project implementation ,MERLIN disseminated project results to a) the wider educational and education research community and b) policy and research planners. The "project" proved scalable enough so as to allow for contribution of its research orientation in other commissioned activities. The Section below outlines the structures set and actions taken in the life cycle of the project.

- *Web site of the project*

http://www.ub.es/euelearning/merlin

The site describes MERLIN'S main goals. It contains the public deliverables. It gives also information on the cluster of projects and a list of web links of interest for socio-economic research. It is also the site for contacting the coordinator and project participants. The site will be updated regularly even after the project ends, for at lest two years.

Within the site, there is also an area devoted to the MERLIN Workshop. The combination of both makes the site a place of reference for studying and receiving information on all aspects of ICT-based innovations in Europe.

- *MERLIN Workshop*

Information of the Workshop is included in the project's Web site:

http://www.ub.es/euelearning/MERLIN-workshop/index.htm

- *Participation in international Conferences and Workshops*

The Consortium has participated in several international events. It has also been invited to do presentations in workshops organized by other cluster projects.

- *Book publication*

MERLIN is about to publish a book that includes the main result of the projects as well as contributions from other researchers that were involved in the projects clustered.

- *Networking of researchers*

Organisation of a network of researchers based on socio-economic aspect of learning with ICT

5.3. Exploitation of results and Exploitation Plans

A project specific Workshop was held (Barcelona, May 30th-31st 2002) and was attended by representatives from: Tavistock Institute, NESTA Futurelab and MMU (UK), University of Rome "La Sapienza" (IT), FORTH and Ellinogermaniki Agogi (GR), SCO-Kohnstammm Institute-Universiteit van Amsterdam (NL), Friedrich-Schiller Universität and Saarland University (DE), University of Lisbon (PO), Autonomous University of Barcelona and University of Barcelona (ES), University of Innsbruck (AT).

The project's website, http://www.ub.es/euelearning/merlin/index.htm, constituted the major dissemination vehicle for project activities and emerging results. This will continue to play a central role in disseminating and/or exploiting projects outputs.

As a result of their engagement in MERLIN the project participants founded the ORIENTE Network (http://www.oriente.info). ORIENTE is a European network of researchers specialised in the study and evaluation of ongoing research tackling educational, institutional, organisational and symbolic aspects of learning environments mediated by ICT. The network is providing a European platform for the exchange of information and communication on issues related to the use of educational technology and evaluation. A Steering Committee is coordinating the network's activities, including the selection and participation of projects, which are funded on a national or European basis. These projects are either initiated by the partners of the network themselves or by international organisations requesting cooperation in the selected areas in which ORIENTE can provide expertise, such as:

- Evaluation of educational innovations and projects involving ICT
- Programme Evaluation
- Research on the impact of technology-based innovations in learning and in society

The network uses quantitative and qualitative methodologies and different approaches to research and evaluation, including cluster evaluation, case studies, progress monitoring and outcomes appraisal, either through external assessment or participatory designs.

MERLIN was also instrumental in defining an RTD proposal submitted in the frame of the EC Call for Expression of Interest (6th Framework Programme). The Expression of Interest presented by Dr. Joseph Cullen and with the participation of most of the institutions involved in the cluster projects is named **"INCH-PERFECT: Integrating the Researcher-Practitioner knowledge Base to promote Lifelong Learning for Europe"** and gathers many of the needs for research identified by MERLIN. The Expression of Interest was an outcome of MERLIN Workshop, and was agreed on by the workshop participants**.**

In terms of scientific presentations, results of the MERLIN project were presented at PROMETEUS Conference "Improving learning through technology: Opportunities for all" held in Paris, 29th –30th September 2002. The paper will appear in the Conferences Proceedings.

Results of the project were also presented in the SYPREDEM workshop held by FORTH-Crete. SYPREDEM is also an Accompanying Measures project.

In parallel, the project, as a result of its Workshop, is in the process of compiling contributions for the publication of the Book "Learning Innovations mediated by ICT: A socio-economic perspective". Contributors include: Dr. Joseph Cullen and Dr. Barbara Jones (Project DELILAH), Dr. Antonio Soeiro and Dr. Katja van den Brik (project PEDACTICE), Dr. Martin Owen (Project IVETTE), dr. Sofokis Sotiriou (European expert coordinator of several EU funded projects), Dr. Rose Pintó (STTIS project), Dr. Begoña Gros (PARLEUNET), Dr. Thomas Koehler (IN_TELE), Dr. Alessandra Talamo (CL-NET), as well as Dr. Mario Barajas, Dr Katerina Kikis, and Friedrich Scheuermann as members of the MERLIN consortium.

It should be noted that the set of indicators of change have been distributed to individuals in the SOCRATES/MINERVA Programme. Several project proposals have been presented, some of them successful: MERLIN inspires the project DELPHI (eLearning Call, 2001) a project coordinated by Dr. Mario Barajas. Also the project "Icurriculum" (MINERVA Call, 2001) coordinated by Dr. Kikis who gathers relevant data produced by MERLIN.

6. Acknowledgments

The MERLIN consortium would like to express its gratitude for the cooperation of the participating institutions and of the staff involved in the projects clustered, for their commitment for the provision of projects' documentation, feedback at different stages of the project and their participation in the MERLIN Seminar.

7. Annexes

Annex A. Scientific publications

Here we present a list of publications coming out from the different phases of development of the project.

Books

Barajas M.(ed.). "*Learning Innovations mediated by ICT: A socio-economic perspective*". In press.

The contents of the publication are:

Preface, Introduction., Mario Barajas
Chapter 1: *Learning Innovations mediated by ICT: qualitative indicators of change*. Mario Barajas, Katerina Kikis, Fritz Scheuerman
Chapter 2: *Learning and teaching with ICT*. Antonio Duarte and Katja van den Brick
Chapter 3: *Cooperation using ICT in learning settings*. Thomas Koehler
Chapter 4: *Socio-Economic aspects of life long learning in Europe: the role of learning innovations*. Joseph Cullen-Barbara Jones
Chapter 6: *"Do we really innovate by researching? The role of research projects in the development of didactic practices"*. Alexandra Talamo, Beatrice Ligorio
Chapter 7: *Institutional aspects of ICT-based innovations*. Martin Owen
Chapter 8: *Innovative application of ICT in everyday teaching - On-line, real time data processing tools on the Internet*. Sofoklis Sotiriou
Chapter 9: *Computers supported collaborative learning: Lessons learnt and questions to answer*. Begoña Gros

International Conferences and Workshops

Barajas M. Kikis K., Scheuermann F. (2002). *Critical Indicators of Innovative Practices in ICT-supported Learning.* The PROMETEUS Conference: "Improving learning through technology: Opportunities for all", CNIT-Paris, 29th –30th September 2002.

Scheuermann, F. (2002). *Learning innovations - The MERLIN project approach on the Evaluation of ICT in education*, at: CEDRA ICT Research Network meeting, Thesssaloniki, 23-24 September 2002

Barajas M. (2001) *Monitoring ands evaluation of research in learning innovations*. SYPREDEM Workshop, 14-16 December, 2001, Heraklion, Crete.

Barajas M., Scheuermann F., Kikis Katerina (2002). Critical issues in Learning innovations mediated by ICT. *MERLIN Seminar on Socio-Economic aspect of ICT-learning innovations with technology*. Barcelona, 29-30 May 2002. .

Scheuermann, F. (2001) *ORIENTE - a trans-national network on Evaluation of ICT in Teaching and Learning - The MERLIN project*, at: "e-Learning" Conference, Ellinogermaniki Agogi, Athens, 6-7 September 2001

Annex B. List of project Deliverables

Nº	DELIVERABLE TITLE	WP	TYPE	STATUS
1	Report on ICT educational issues and methodology framework	01	I	Completed
2	Report on EMMTF projects	02	I	Completed
3	Synthesis Report on innovation trends in ICT-based learning	03	**P**	Completed
4	Assessment report on 2nd round projects	04	I	Completed
5	Thematic review on research results on ICT-based learning-Innovation indicators	05	**P**	Completed
6	Joint report on research issues, new trends, and policy recommendations	06	I	Completed
7	Final synthesis report on projects' findings, on policy recommendations and on future research tasks	07	**P**	Completed
8	Project management (reports and deliverables)	08	I	Completed

Key to status: P= Public deliverable I= Internal (Partners and Commission)

ANNEX C. Description of the cluster

A) EDUCATIONAL MULTIMEDIA TASK FORCE

Title	**IN-TELE - Internet-based teaching and learning**
Keywords	Internet, schools, cost-effectiveness
Description	Use of the Internet as media for teaching . A cost-effective approach to exploiting the Internet in schools for teaching Schools. The project is directed at the media competence of teachers and students. Media competence means that the media users are able to access, comprehend, evaluate and produce mediated contents. This skill is of special concern with respect to transnational activities in unifying Europe. Internet access computer, mobile Internet set
WWW	www.uni-jena.de/svw/compsy/intele/
Coordinator	Prof. Dr. Wolfgang Frindte and Dipl.-Psych. Thomas Koehler Friedrich-Schiller Universität Jena Psychology Department Communications Psychology Unit Am Steiger 3/1 D-07743 JenaGermany +49 3641 945280 +49 3641 945283 swf@uni-jena.de

IN-TELE: Internet-based Teaching and Learning
Studying the teaching capabilities of the Internet
The IN-TELE project is developing new solutions for the use of the Internet for learning and teaching in schools and for educational collaboration between schools. Its main goal is to create, apply and test the organisational, technological, pedagogical and psychological conditions for the development of media competence of students and teachers in a modern Europe. By combining all these elements, IN-TELE seeks to provide a service which evaluates all elements of integrating new technologies into the learning environment and to come up with concrete solutions for improving pedagogy using technology as a tool.

The development of a joint European identity
IN-TELE is using 16 schools from four European countries to test its new solutions. The project is lead by three university-based research groups and two independent research organisations. The participating schools are located in Sweden, France, Germany and in the United Kingdom.
The technological, pedagogical and psychological results of the project are being scientifically evaluated and made available across Europe for exploitation. A step-wise methodology has been developed to establish sustained Internet-based linkages and multimedia communications between the European partners. The technologies used include electronic mail, World Wide Web pages, mailing lists, and other synchronous and asynchronous Internet services.
The main objectives of IN-TELE are to create a conceptually innovative technological basis for Internet-based learning and teaching between the participating schools that is tailored to the specific educational strategy, to develop an integrated working environment for the use of Internet-based information for preparation and presentation of oral and multimedia presentations to be used by the students and teachers, and to develop and implement a curriculum for training teachers, Internet-based teaching and

learning.
The project also disseminates the developed materials to help other schools with less support gain improved access Internet-based teaching and learning; provides psychological, pedagogical and media didactic support for the participating schools; supervises a joint thematic project on European identity by the participating schools.
The IN-TELE solutions are developed for average schools, dealing with the problem of low budgets, the lack of experience among teachers and authorities and the teachers' serious fears of new technologies. IN-TELE is bringing together IT-vendors with local authorities for education and telecom companies to help develop the future educational IT market and to help commercial enterprises access that market.
By adopting its own exploitation plan, IN-TELE can use the expertise of the commercial IT companies involved to market the results on a European scale. This can start when the first configuration of the IN-TELE technology platform is available and it can be part of an ongoing activity, leading to an elaborate exploitation plan for the four European regions participating in the project.

Building on proven technologies
Based on existing and well-proven technologies, the network is formed from corporate and academic intranets with internet capabilities. The ISDN links are used for videoconferencing, delivery of symposia by subject experts. The developments also offer a tool for the diagnosis or evaluation of the manufacturing process in real-life situations, thereby reinforcing the importance and consolidation of the learned material

Further development
The project outcomes will be used to enable the exploitation of such learning networks by the multinational industries, SMEs, universities and colleges involved. They will train their employees and students, thereby demonstrating the versatility, usability and efficiency of the framework and telematics network for on-the-job training, tutoring and assessment. This will be used in the drawing up of an exploitation plan for the technology developed.

Title NETLogo - The European Educational Interactive Site
Keywords Logo, open-ended environments, constructivism, WWW, teacher training
Description An interactive website for European Logo Educational Tools and Services A suite of Logo-based resources. School teachers and pupils. Logo, Internet, online courses
WWW www.netlogo.org
Coordinator Dr Demetrios Sampson
Doukas School - Palladium Lyceum
151 Mesogeion Str.
GR-15125 Maroussi Athens
Greece
+30 1 61 25 880
+30 1 61 25 882
sampson@multiland.gr

NETLogo - The European Educational Interactive Site
Learning through problem-solving with online Logo-like educational environments
The main scope of the NETLogo project is the establishment and operation of a European online reference point for the use of open-ended educational environments. The specific aim is the exploitations of the pedagogical value of these environments in the primary and secondary European schools by making available through the World Wide Web a number of innovative Logo-like tools, products and services.

NETLogo objectives
Recent developments in the field of information and communication technologies have had a significant effect on European education. The EU Member States have agreed that ICT advances can contribute considerably, mainly as cross-cultural tools in the learning process, enhancing teaching capabilities, such as creativity, problem-solving and student collaboration.
The NETLogo project is expected to contribute to this development by addressing directly the needs for communication and collaborative work, providing a website and a platform with the necessary added-value tools in which users and developers of primary and secondary educational material (teachers and students) can communicate remotely. Through project-oriented work they can exchange ideas, knowledge, courses and interact creatively in a competitive and exploratory learning scheme.
The key objectives of the NETLogo project are:
1. to provide online educational software of an exploratory nature that allows end-users (mainly teachers and students of European schools) to conduct their own experiments, communicate over the network and exchange information about open-ended educational environments, and
2. to encourage the use of open-ended environments in European education and facilitate the promotion of existing, innovative Logo and Logo-like educational software and services of European added value. This will feed existing school communities that have already built a technological infrastracture and developed the use of technology with valuable and powerful materials.
The project is seeking to develop and validate methodologies as well as viable operational models that encourage teachers' participation in collaborative working schemes in "Cyberspace". This involves developing good practice in the contribution of educators to the production of educational resources developed in a distributed environment and in incorporating the use of the WWW in the everyday learning/teaching in European schools.
NETLogo is also evaluating the new teaching and learning processes that emerge from the online use of open-ended exploratory educational software and related materials by testing it in school life, developing methods of intervention at different levels within the educational systems, infusing innovation while creating "success stories".

Exploring NETLogo markets
The project will also conduct an investigation into the potential market for NETLogo

products and services inside and outside the European Union, including Eastern Europe and USA. The project will elaborate a complete technology implementation plan, taking into consideration existing Logo tools and the current and future development of information and communication technologies. Finally, the project aims to produce a business plan for the further investments needed and the potential incomes from the full development of the NETLogo network activities.
At the end of the project the results expected include the set-up and operation of the NETLogo server which will provide a unified Web-based interface for access to the supporting tools and applications implementing the basic and the added-value services of NETLogo, with user documentation and a full report on the technical and functional specifications of the server and its online services.
The project will provide a report on market analysis covering areas such as the identification of the potential user groups, the description of suitable distribution channels and the market segmentation, and a technology implementation and business plan for the full development, deployment and operation of the NETLogo network.
Another key product is a complete course for teachers on the use of Logo covering general aspects of computing and connectivity, the basic Logo programming language and its extensions, and the methodological and pedagogical issues on using Logo during classroom activities. The final release of the course and its documentation will also be produced as a CD-ROM.

Title	**ParlEuNet - A Student's Parliament via Educational Multimedia Learning Models and Technologies**
Keywords	European Parliament, multimedia learning materials
Description	Multimedia telematics educational materials about the European Parliament for secondary school students. Multimedia content about the European Parliament, seminars and guidelines on learning, video-conferences with MEP's Students between 15-17 in all fifteen Member State countries, educational administrators, teachers and parents. Members of Parliament will videoconference with students Students and teachers learn how to use powerful technologies to access, manipulate and present information. These skills are essential for entry into the information society. Administrators, parents and MEPs will also gain competence in this area Students in pilot schools have Internet access, videoconferencing equipment, telephone, fax and in some cases high speed connectivity. The project is creating a website supported by a well-structured updateable multimedia database of educational materials
WWW	
Coordinator	Ms Christina Hazard Pegasus Foundation c/o The European Parliament Bureau REM 112 Rue Belliard 97/113 B-1047 Brussels Belgium +32 2 284 2361 +32 2 284 9009 dorit.werner@pegasus-foundation.be hazardparis@compuserve.com

ParlEuNet - A Student's Parliament via Educational Multimedia Learning Models and Technologies

Multimedia communication and knowledge resources with the European Parliament
ParlEuNet is the first European initiative which allows secondary school students to use state-of-the-art networks and multimedia resources to learn about and collaborate on projects about the European Parliament.
Internet connections, videoconferencing and a website containing a multimedia database of educational materials will be used by students to access information on the Parliament, create their own projects and exchange information and views with Members of Parliament and students in other countries. The students' work will gradually supplement the website with educational modules and resources which can be used by other students.

ParlEuNet's resources

The project aims to create, experiment with and evaluate a multimedia telematics learning environment, and in so doing, develop pedagogical models which promote learning about European politics and the Parliament. This requires the development of high quality educational multimedia content on the European Parliament based on existing conventional archives of EU information. The project is also researching transferable models of learning in telematics environments to support access to the maximum number of European schools. Thus, a unique by-product of the project is to

enhance young students' understanding of the European Parliament and its operation and thereby reinforce the sense of European citizenship

ParlEuNet: MEPs as learning guides
ParlEuNet is experimenting with pedagogic models which promote student-centred problem-based learning aiming at the design of guidelines for working in telematics learning environments with this kind of content. Members of the European Parliament will be involved from the outset of the project to propose specific educational tasks and to communicate with the students by e-mail or videoconference.
Indeed, hands-on workshops in the European Parliament will be organised for policymakers and Parliamentarians. Workshops will be organised on a national level by parents' associations as well as the distribution of a project video and major online hyperlinking with European educational projects.
Training workshops are conducted to integrate the telematics learning environment into actual classroom practice, obtaining feedback on content, the appropriateness of the media involved and the viability of the models in different EU Member State schools. The learners involved are fifteen to sixteen year olds and the multimedia materials are to be available in English, French and German.

Building new resources
A skilled curriculum developer will review all the material that is currently available in the European Parliament's archives. Students and teachers will also create new learning resources about the Parliament. The information will be available on an interactive database accessible through the Internet. As a result of student group work, young European learners will create the "Information on the European Parliament" website. In addition to educational materials, online resources and the workshops, a practical guide is being produced to disseminate the results to other European schools and to further exploit the results from the pilot experiments.

Title	**PEDACTICE - Educational Multimedia in Compulsory School : From Pedagogical Assessment to Product Assessment**
Keywords	Learning resources, online libraries, communication, education technologies development
Description	Development of a European Multimedia Resource Library (EMRL) Internet database, assessment resources Compulsory schools, teachers Improved access, assessment tools, resources for educational multimedia Internet, databases, e-mail

WWW

Coordinator Mr Gert Fosgerau
The State University College of Education
Kuskevej 1a
DK-4760 Vordingborg
Denmark
+45 53 770 304
+45 53 772 533
gf@adm.vordingbsem.dk
info@adm.vordingbsem.dk

PEDACTICE - Educational Multimedia in Compulsory School : from Pedagogical Assessment to Product Assessment

Developing European educational technologies

Pedactice accelerates the process of innovation in teaching by inviting teachers and producers to engage in continuous feedback between users and producers on assessments and other pedagogical-technological items, by offering schools free access to products for testing and assessment.
The vast body of generated knowledge is the basis of a user-friendly Internet database, the European Multimedia Resource Library (EMRL), which is being constructed during the project.

Building collaboration

The project introduces educational multimedia products into a considerable number of schools and creates teacher teams for supporting their use and experimentation in the classroom. In doing so, it takes advantage of existing collaboration between university colleges and compulsory schools, the latter representing large and small-scale users and including experimental environments for educational multimedia. One teacher from each school is affiliated part-time to the university college and represents the school's interests and expertise to the partners.
The research tasks are to study the complex relations between human learning processes, teaching strategies and the pedagogical efficiency of multimedia products. The subject areas of the educational multimedia products assessed are science, mathematics, language and culture at compulsory school level. The results are integrated into the Library, the design of which is moulded by all the potential user interests.
To the schools, the project gives support in the use of educational multimedia and familiarises teachers with assessing products and exploiting their innovative potential i.e. with respect to developing their own content sets of multimedia tools. To the universities charged with teacher training, the Library offers a dynamic pedagogical forum and a scientific platform by which to introduce, to experiment and to develop best practices, and to organise new teacher training programmes. Finally, the producers will develop a strategic instrument for adapting to the requirements of the pedagogical market and for improving their market position.

Title REPRESENTATION - Représentations des Élèves Sur les Nouvelles Technologies Appliquées à la Transmission Informatique et les Outils Informatiques Nouveaux
Keywords Primary schools, teacher training, pedagogy, concept maps, representations
Description To discern primary school pupils' representations about new technologies
A comprehensive literature review, a mapping of pupils' representations, development of guidelines and methodologies on the creation of educational software
The project users are primary school students, school teachers and in the longer term secondary school students, teachers and users of new technologies. The project architecture necessitates the direct involvement of users in all project phases and levels
The teachers participating in the project workshops will enhance their competencies and knowledge related to the pedagogical use of new ICTs. The students will benefit from the use of the tools produced to develop their representations. Both students and teachers can benefit from the use of the school network that will be set up during the course of the project
A wide spectrum of technologies (multimedia technologies, network, Internet) will be utilised within the framework of the project. The approach adopted associates the basic research related to the perceptive, cognitive and social aspects of the learning process and the applied research in the production of multimedia tools conceived for this purpose
WWW http://hermes.iacm.forth.gr/representation/default.html
Coordinator Dr. Kathy Kikis-Papadakis
Institute of Applied and Computational Mathematics - Foundation for Research and Technology
PO Box 1527
GR-71110 Heraklion
Crete, Greece
+30 81 391802
+30 81 391801
katerina@euclid.iacm.forth.gr
komis@csd.uch.gr

REPRESENTATION - Représentations des Élèves sur les Nouvelles Technologies Appliquées à la Transmission Informatique et les Outils informatiques Nouveaux

What the school children think of learning technologies
REPRESENTATION aims to develop a cartography of primary school pupils' representations about new technologies. The goal is to map pupils' representations in terms of cognitive and socio-cultural factors.
The project is based on a three-axis assumption embedded both in theory and practice. The tools and applications of recent technological development require investigation in terms of representations, as these give rise to impressions that are becoming integrated into our teaching and learning practices. Teaching for or with new technologies requires a different conceptual framework of learning processes and teaching practices, both in terms of acquisition and transfer of knowledge. Finally, learning and cost effectiveness in the process of learning material development is achieved when these are developed with methods and tools appropriate to the media, taking into account the new modes of representation and transmission.

The case study approach

The project objectives address the issue of representation through a bottom-up approach, namely through case studies. The project calls for a multi-level investigation of students' representations with feedback and quality control assurance mechanisms built into its design. Representation of new technologies and representation of new technology capabilities and the learners' perceptions being formulated will be studied with the utilisation of tools to be developed and integrated in the project. These tools include exploratory and open software and multimedia-based applications available on the WWW.
The project workplan calls for an in-depth review of the state-of-the-art, the design of the research methodology, the formation of a teacher's network and the corresponding training, tools development and installation, collection and analysis of evidence,

pedagogic audit and dissemination and exploitation actions. The project's outputs will facilitate the conception, design, development and production of educational multimedia and will be instrumental in enhancing the concept of telematics and multimedia-based learning.

A teacher-oriented observatory on educational multimedia

The specific set of tools to be utilised in conjunction with pedagogical practices, learning arrangements, classroom observation, etc., is also under investigation. The project will bring to the fore the representative structures and their evolution in pupils as they learn with the assistance of telematics and multimedia. Research is to be conducted into diverse learning and cultural environments throughout Europe. Existing school networks constitute the project's research sites and validation sites will be identified based on them. The validation of tools and methods is to take place in over 100 European schools. In parallel, the project aims at the establishment of a teacher oriented observatory on educational multimedia.

The nature of the composition of the consortium is cross-sectoral in that represented are research/academic institutions, multimedia developers and management of school networks. The partnership consists of ten institutions from eight Member States.

B) TARGETED SOCIO-ECONOMIC RESEARCH PROJECTS

Area / Task Research on Education and Training
Contract Number ERBSOE2CT962009
Title DELILAH - Designing and Evaluating Learning Innovations and Learning Applications
Cluster Education to work Innovation in Education and Training via technology
Keywords policy proposals, education, diffusion, ICTs, social exclusion, training, tools, open & distance learning, ODL, access to education & training, organizational context, transferability of innovations, action research
Description To review and synthesise 1) existing research on major cross-cultural, socio-economic and pedagogic factors in education and learning, including new learning arrangements involving learning technologies, and 2) major national policies on education and training, with a view to (a) identify theoretical and empirical gaps in current understanding and (b) establish the consonance or match between major educational and learning innovations and the different learning patrimonies or traditions as defined by the aforementioned factors. To critically assess, in a transnational and cross-sectoral fashion, the contribution of different institutional and organisational arrangements to education and learning, in relation to exploring ways of improving learning and widening access to learning opportunities, including access for less favoured and excluded groups. To develop methodologies and guidelines for the evaluation of new educational and learning arrangements and process. To contribute to the development of appropriate policies in the area of education and learning by firstly identifying ways in which policies can facilitate the contribution of new educational and learning arrangements in accordance with the different learning patrimonies, and secondly promoting transfer and the exchange of results across the study areas. Methodology DELILAH is based on a broad range of methodologies. It encompasses case studies methodology, action-oriented research and evaluation methodology, the latter involving assessment and formative evaluation. Methodology includes (1) desk research; (2) focused case studies, with intensive ethnographies involving observation and interviews; (3) assessment and evaluation; and (4) action-oriented research, with observation and focus groups methodology.
WWW not available
Coordinator Dr. Joseph CULLEN
Tavistock Institute of Human Relations Evaluation Development and Review Unit
London EC2A 4UE
Great Britain
Tel. +44- 171 417 0407
Fax. +44- 171 417 0567
EDRU@TAVINSTITUTE.ORG

Area / Task Research on Education and Training
Contract Number ERBSOE2CT972017
Title CL-NET - (Computer-Supported) Collaborative Learning Networks
Clusters Innovation in Education and Training via technology
Keywords best practice, education, ICTs, case studies, teachers, secondary schools, primary schools, action research, collaborative learning, collaborative learning networks, learning methods, communication protocols, motivation, cognitive studies
Description The central objective of this project is to investigate the cognitive and didactical aspects of computer-supported Collaborative Learning Networks (CLNs). CLNs are learning environments in which educational technology is used to help create a community of learners who build knowledge together. CLNs are the learning contexts in which equipment, information networks, but also teachers, learners and learning methods are included. The central question of the project is: How can effective knowledge building in CLNs be supported in European primary and secondary education? The project will study the educational use of different kinds of CLNs which support individual and collaborative learning from a cognitive point of view. Brief Description of the research project The research is characterized as ecologically valid action research. Action research is an approach to research in which teachers and students in their everyday context play an important role. Researchers "act as participants" in the schools while collecting data. Teachers and students become researchers and research-assistants instead of subjects of research in the traditional sense. Three kinds of methods will be used. Protocols of communications between students and between students and teachers will be analysed in terms of the number and kinds of communications taking place. Moreover, qualitative aspects will be studied (what kind of inputs are students giving; which thinking types are used; how relevant are communications; how much knowledge building is taking place). Case studies and small-scale, informal comparative experiments (action research) will help to identify best practices. By looking at the protocols longitudinally, developments in communication and learning patterns over time will be studied. An analytical approach will be used to obtain information on the advantageous long term effects of CLNs and to determine optimal balances between self-regulation and teacher-/ technology control. Tests that measure the cognitive, metacognitive, and motivational effects of CLN's will be used. Small questionnaires and interviews with teachers and students will be used to find out which tools, support structures and manuals function the best and what changes are needed in the materials developed. At some sites future challenges will be explored to allow collaborative learning with mixed topics and study areas, using different types of scenarios.
WWW http://www.xs4all.nl/~daimpex/
Coordinator Prof. Robert-Jan SIMONS
Katholieke Universiteit Nijmegen
Department of Educational Sciences - Faculty of Social Sciences
NIJMEGEN6500 HEThe Netherlands
Tel. +31-24-361-25-14
Fax. +31-24-361-59-78R.
SIMONS@PED.KUN.NL

Area / Task Research on Education and Training
Contract Number ERBSOE2CT982037
Title IVETTE - Implementation of Virtual Environments in Training and Education
Clusters Innovation in education and training via technology
Keywords education, ICTs, training, higher education, curriculum, open & distance learning, post-secondary education, training organizations, distance education, innovation in E&T organizations, international aspects, language
Description Taking advantage of the new information and communication systems, there are emerging many different experiences where traditional public institutions and training organisations are moving towards new ways of open and distance education. Participants in what is currently called "virtual campuses" are now experiencing new ways of teaching and learning. This new scenario arises tensions in the organisation and functioning of both public and private institutions. On the other hand, the new ways of telematics-based learning crosses geographical borders, challenging E&T systems all around Europe, and posing new questions to the European cultural diversity. The central objective of this proposal is to investigate the issues involved in the implementation of Virtual Learning Environments (VLE) in post-secondary public educational institutions, as well as in training institutions. The project will focus particularly on looking for a holistic view when tackling the main issues mentioned. Within this context, the key objectives of the project are : to map out the teaching and learning approaches in VLE, especially those arising from combining face-to-face and distance education methods in traditional institutions and companies. to critically assess the impact of European diversity into international VLE, in relation to common elements of curriculum, language issues, and institutional adaptation of the E&T systems to open and distance learning to contribute to innovation in public educational Institutions in relation to the restructuring of its functioning, the co-operation with similar European institutions and with the private sector when implementing VLE.
WWW http://www.ub.es/euelearning/ivette/index.htm
Coordinator Dr Mario BARAJAS Frutos
Universitat de Barcelona
Departament de Didàctica i Organització Educativa- Facultat de Pedagogia
Passeig Vall Hebrón, 171
08035 Barcelona
Spain
Tel. 34-93-4037223
Fax. 34-93-4035014
mbarajas@ariadna.d5.ub.es

Area / Task Research on Education and Training
Contract Number ERBSOE2CT972020
Title STTIS - Science Teacher Training in an Information Society
Clusters Innovation in Education and Training via technology
Keywords policy proposals, education, ICTs, training, science, teachers, teacher training, secondary schools, teaching methods, science teachers, information transformation by users, context independent, innovation in schools, symbolic languages, training materials
Description Having in mind a society where a large amount of information comes to each citizen easily and quickly, two issues are specially relevant: a) The need of mastery of technological tools and of interpreting many messages cannot be easily accomplished for many learners. Basic scientific education is a privileged context to achieve this goal and consequently the need to prepare adequately future science teachers is of high priority . b) The great amount of information received has to be well managed for each citizen. As information is selected, prioritised, interpreted and decisions based on it are taken, the act of understanding is always transformative. The process of transformation of information by users is still poorly known but thousands of decisions are taken with the interpreted information as well students learning according to their interpretation of messages. STTIS project wishes to investigate the process of transformation in a very specific field-science education- since it is possible to go deeper and better gain knowledge when reducing variables. Brief Description of the research project The methodology of STTIS to use will be qualitative. The transformations of the intentions of designers of educational innovations are a crucial point. Science teachers at secondary school will be investigated during the implementation of three processes of innovation: process of implementing the use of several technological tools process of adapting to students' interpretations of different symbolic language process of implementing new teaching strategies proposed in specific subject matters. Some rules of transformation of innovation will be inferred from results of small scale intensive studies. The rules will emerge having removed the context dependency as a variable. The main envisaged tasks are: Analysis of teachers' difficulties in: implementation of innovative teaching strategies; use of symbolic languages; use of Information Technology tools. Diagnosis and synthesis of difficulties in assuming innovation into school practice. Construction of strategies and materials for training programs for teacher trainers. Elaboration of guidelines for policy makers and teacher training agencies The main practical products will be materials for teacher training in innovative educational strategies when using common information society tools (technological tools using computers or symbolic representations). The theoretical products will be, at a conceptual level an inventory of the main problems of adaptation between innovations and teachers and, as an outcome, recommendations and guidelines for policy makers and teachers training.
WWW http://www.blues.uab.es/~idmc42/sttis.html
Coordinator Dr. Roser PINTO
Universitat Autonoma de Barcelona Departamento de Didáctica de las Ciencias Experimentales
BELLATERRA
BARCELONA 08193
Spain
Tel. +34-93-581-3206
Fax. +34-93-581-1169
R.PINTO@CC.UAB.ES

Annex D. Bibliographic Section

Alvesson, M. & Skoldberg, M. (2000). *Reflexive Methodology*, London: Sage Publications

Bakardjieva, M. (1998). *Collaborative Meaning-Making in Computer Conferences: A Sociocultural Perspective*. Proceedings of ED-MEDIA/ED-TELECOM 98, Association for the Advancement of Computing in Education.

Barajas, M. (2002) *Implementation of Virtual Environments in Training and Education, TSER Project IVETTE*. Brussels: European Commission DGXII/Science, Research & Development/G, Brussels, April 2002. Available at http://improving-ser.sti.jrc.it/default/show.gx?Object.object_id=TSER----00000000000002A5&_app.page=show-TSR.html (10/10/2002)

Barajas, M., Scheuermann, F. & Kollias, A. (2001). *Deliverable 1: Monitoring and Evaluation of Research in Learning Innovations*, Project MERLIN (SOE2-CT98-2037), TSER. Private document.

Berge, Z. L., & Collins, M. P. (1995). Overview and perspectives. In Z. L. Berge & M. P. Collins (Eds.), *Computer mediated communication and the online classroom volume one: Overview and perspectives* (pp. 1-10). Cresskill, NJ: Hampton Press, Inc.

Bransford, J., Brophy, S. & Williams, S. (2000). When Computer Technologies Meet the Learning Sciences: Issues and Opportunities. *Journal of Applied Developmental Psychology,* Vol.21, No.1, pp. 59-84.

Chelimsky, E & Shadish, W.R. (Eds), (1997). *Evaluation for the 21st Century: A Handbook*. Thousand Oaks: Sage Publications

Crawford, R. (1999). Teaching and learning IT in secondary schools: towards a new pedagogy*? Education and Information Technologies*, No.4, pp.49-63

Crook, C. (1998). Children as computer users: the case of collaborative learning. *Computers and Education*, Vol.30, No.3/4, pp.237-247.

Cullen J., (1998) *DELILAH Final Report: "Looking at Innovations in education and training: framework, results and policy implications of the Delilah project*". European Commission DGXII/Science, Research & Development/G, Brussels, November 1998. Available at http://improving-ser.sti.jrc.it/default/show.gx?Object.object_id=TSER----000000000000061A&_app.page=show-TSR.html (10/10/2002)

Cullen, J. & Jones B. (1997). *State of the art on approaches in the United States of accreditation of competences through automated cards*.. Brussels: European Commission, DGXII/Science, Research & Development/G. Private document.

Cullen, J. (2000). *Competence Evaluation and Training for Europe. COMPETE Final Report.* Brussels: European Commission, DGXII/Science, Research & Development/G.

Dale, R. (1998) *Evaluation Frameworks for Development Programmes and Projects*. Sage: New Delhi.

De Corte, E. (1993). *Psychological aspects of changes in learning supported by informatics*. Paper presented at the meeting on Informatics and Changes in Learning, Gmunden, Austria.

Dillenbourg, P. (ed.), (1999). *Computer supported collaborative learning: cognitive and computational approaches*. Oxford: Pergamon, Elsevier Science Ltd.

Duffy, T.M., Lowyck, J., & Jonassen, D. (Eds.), (1993). *Designing environments for constructivist learning*. Heidelberg: Springer-Verlag.

European Commission (1995). *Targeted Socio-economic Research. Work Programme (1994-1998).* Brussels: European Commission, DGXII.

European Commission (1996) *Building the European Information Society for Us All.* Brussels: European Commission, Directorate General V.

European Commission, (1998). *Review of Research and Development in Technologies for Education and Training: 1994-1998 - Supporting the Lifelong Learning Society through the Development of Telematics-based Tools for Learners, Educators, Trainers and Trainees*. Brussels: European Commission, Directorate General XIII.

Fitz-Gibbon, C.T. (2002). *Evaluation in an Age of Indicators*. Evaluation, Vol. 8(1): 140-148.

Forte, E. (1999). *PROMETEUS: Promoting Multimedia access to Education and Training in European Society*.
Available at http://www.hud.ac.uk/hypermail/extern/calsig/calsig.9903/msg00020.html (10/10/2002)

Fosgerau G. (2000) *PEDACTICE, Final Report*. Brussels: European Commission, public document.

Hanna, D.E. (1998). Higher education in an era of digital competition: Emerging organizational methods, *Journal of Asynchronous Learning Networks*, Vol. 2, no. 1, at http://www.aln.org/alnweb/journal/vol2_issue1/hanna.htm (10/10/2002)

Keegan, D (1990). *Foundations of distance education.* London & New York: Routledge

Kikis-Papadakis, K. & Pearson, M. (2000). *Rapport sur les méthodologies développées et les recommandations issues du projet. Project REPRESENTATION, Final Report (Deliverable A13)*. Brussels: European Commission, public document.

Koehler T. (1999. *Final Report IN-TELE.* European Commission, public document.

Kozma, R. (2001) "Innovative Pedagogical Practices Using Technology: International Comparative Case Studies". Symposium on Itineraries of Change in Education. Barcelona 15 March, 2001. Available at http://xiram.doe.d5.ub.es/canvi/ (10/08/2001)

Lawson, T. & Comber, C. (1999). Superhighways Technology: personnel factors leading to successful integration of information and communications technology in schools and colleges. *Journal of Information Technology for Teacher Education,* Vol. 8, No.1, pp. 41-53.

Majó, J. (2000). *The New Technologies and Education*. Available at http://www.uoc.es/web/eng/articles/joan_majo.html (10/10/2002)

Mavridis, L., Browne A. (2000) *Implementation of Virtual Environments in Training and Education*, TSER Project IVETTE; Deliverable 3

Miles M.B., Huberman A.M. (1994) *Qualitative data analysis: An expanded sourcebook* (2nd. Ed.). Thousand Oaks, CA: SAGE Publications.

Owen M, Kikis K., Barajas M. (2000) *Implementation of Virtual Environments in Training and Education*, *Deliverable 4*. TSER Project IVETTE; Private document.

Pintó R. (2002) *Science Teacher Training in an Information Society. Final Report.* Brussels: European Commission, public document. Available at http://www.cordis.lu/improving/ (10/10/2002)

Przeworski, A., & Teune, H. (1970). *The Logic of Comparative Social Inquiry*, New York: Wiley Interscience.

Ragin, Ch. C. (1987). *The Comparative Method. Moving beyond qualitative and quantitative strategies*. Berkley (CA): University of California Press.

Ragin, Ch. C. (1994). Introduction: Cases of "What is a case?. In Ch. C. Ragin & H. S. Becker (Eds.). *What is a Case? Exploring the Foundations of Social Inquiry*. New York: University of Cambridge Press.

Reeff J.P. (2000) *New Assessment Tools for Cross-Curricula Competencies in the Domain of Problem Solving*; *October 1998 – October 1999, Final Report*. Brussels: European Commission. Available at http://improving-ser.sti.jrc.it/default/page.gx?_app.page=entity.html&_app.action=entity&_entity.object=TSER----0000000000000328&_entity.name=Report.PDF (10/10/2002)

Salomon, G. (1993). No distribution without individuals' cognition. In G. Salomon (Ed.), *Distributed cognitions* (pp. 111-138). New York: Cambridge University Press.

Salomon, G. (1998). Novel constructivist learning environments and novel technologies: Some issues to be concerned with. *Research Dialogue in Learning and Instruction*, Vol.1, No.1, pp. 3-12.

Sampson D. (2000) *Final Report NET-LOGO.* Brussels: European Commission, public document.

Sanders J. (1997) Cluster Evaluation In Chelimsky E, Shadish W R. (Eds.) *Evaluation for the 21st. Century. A Handbook*. London: Sage publications, pp 396-404

Scheuermann F., Claeys C., Pulkkinen J. (2000) *Implementation of Virtual Environments in Training and Education*. TSER Project IVETTE; Deliverable 2, private document.

Scheuermann, F., Kikis, K. & Barajas, M. (2001). *Deliverable 3: Synthesis Report on Innovation Trends in ICT-based Learning*, Project MERLIN (SOE2-CT98-2037), TSER. Public document. Available at http://www.ub.es/euelearning/Merlin/ (10/10/2002)

Stufflebeam, D. L. (2000). The CIPP model for evaluation. In D. L. Stufflebeam, G. F. Madaus, & T, Kellaghan (Eds.). *Evaluation models: Viewpoints on educational and human services evaluation*. Boston: Kluwer Academic Publishers.

Van den Akker, J., 1998, The science curriculum: between ideals and outcomes. In Fraser, B. J., Tobin, K. J. (eds), *International Handbook of Science Education*. Kluwer. London, p 421-447.

Van der Meijden, H., Simons, R.J. & de Jong, F. (2000). *Final Report of the CL-Net Project, (Deliverable 18).* Brussels: European Commission, public document. Available at http://improving-ser.sti.jrc.it/default/show.gx?Object.object_id=TSER----00000000000009E6&_app.page=show-TSR.html

Voog J. , Odenthal L. (2000) *A Portrait of Emergent Practices: Summary of a Study on Innovative Use of Information and Communication Technology in Education*. Available at http://waldorf.eds.udel.edu/oecd/quality/papers/H12VoogtOdenthal.DOC (10/10/2002)

Vosniadou, S. (1996). Towards a revised cognitive psychology for new advances in learning and instruction. *Learning and Instruction*, Vo.6, No.2, pp. 95-109.

Windschitl, M. (1998). The WWW and classroom research: What path should we take? *Educational Researcher*, Vol. 27, No.1, pp. 28-33.