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ABSTRACT: This report, project Deliverable 3, aims at synthesise research results from selected TSER projects relating to teaching and learning methodologies, organisational and cross-cultural issues and related policy recommendations. The outcomes contribute to the definition of an Analytical Thematic Structure of indicators for subsequent analyses. The work described here constitutes input considerations for the subsequent project activity

KEYWORDS: Innovation, learning, efficiency of learning innovation, organizational changes, socio-cultural effects of innovation, indicators, parameters, policy recommendations

REFERENCES: See bibliography

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Introduction

This public document intends to inform the reader of MERLIN's principle operational objectives in relation to the prevailing trends in the field of learning innovation. This is addressed via consideration of a set of three interrelated research questions which relate to issues of efficiency of learning innovation, organizational changes and socio-cultural effects of innovation.

As a result of the investigation of 8 selected RTD projects with strong TSER components (6 projects were analysed and documented in the first round within WP 2) the prevailing trends are reported in this deliverable. The analytical research work is completed by the finalization of a list of parameters and qualitative indicators which are defined and presented here. This list will be the framework for research in future research activities of the remaining work packages.

Again, based on the work within WP 2 a revision of the research framework design has been carried out and adapted to the methodology for the in-depth review of 2 RTD projects under the scope of "innovation in learning". Deliverable 3, as presented here, is containing the complete and updated set of relevant material developed in WP 1, 2 and 3 so far, including the results of the assessment of the projects as well as given comments by the project's coordinators.

1. Overview of the MERLIN project (from Del. 2)

The principle operational objectives in MERLIN is the monitoring of progress and the review of RTD results of a cluster of TSER and EMMTF projects in the area of learning innovation. The project through an iterative process, is to develop a conceptual framework which, on the one hand is to inform us on the progress made –via the implementation of the cluster projects, towards the achievement of principle IV Framework Programme objectives- as these are reflected in the TSER Programme Orientation, and in doing so identify the effects of these projects on learning innovation under the scope of: *innovation in learning*, *instructional/organizational* and *socio-cultural change*, and on the other to articulate policy recommendations.

Specifically, MERLIN intends to cluster a selected group of projects, looking for approaches to capitalise on the results of these projects in their different contexts, defining innovation settings where ICTs play a key role in teaching and learning processes. In order to help in the analysis, a series transversal research questions are posed for all projects:

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 effectiveness is 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 focus of analysis is 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 project activity calls for the assessment of a cluster of already finished research projects mainly from the Second and Third Calls of the former TSER programme as well as projects from the Joint Multimedia Call with a TSER component that have recently finished or are in the last phase of development. The research questions to be responded by the project have been formulated on the bases of research issues/tasks outlined in the Programme's Calls (see Section 2.2 below). By reviewing the intermediate and final reports of these clustered projects MERLIN will be able to identify the methodological trends, and prevailing learning scenarios with the use of ICT, as well as policy recommendations these projects produced/suggest. The first phase work calls for the review of such a sub-set of projects.

This first round review of projects facilitated the creation of an analytical thematic structure for the subsequent work, including the analysis of some of TSER projects from the 3rd Call currently in progress, and whose objectives were related to the research concerns embedded in the project objectives. This set of projects ("second round projects") are either finished or about to finish.

The first round projects considered for review in the frame of WP2 were: PEDACTICE, REPRESENTATION, PARLEUNET, IN-TELE, NETLOGO (EMMTF supported) and DELILAH (TSER supported).

The second round projects analysed in WP 3 were belonging to the 1st and 2nd TSER Call of the IV Framework Programme were CL-NET (Computer-Supported Collaborative Learning Networks) and STTIS (Science Teacher Training in an Information Society).

The project activity is being implemented under the orientation of Cluster Evaluation and under the scope of the Context Input Process Product Evaluation Model (details are given in Deliverable 1).

The project's third work package (WP), entitled "Review of intermediate and Final Reports 1st round projects" is an activity of 2.2 [?] months duration and intended to:

- critically review of projects and final reports under the scope of Innovation in Teaching in order to provide a framework of indicators and categories outlining their main outcomes, primarily in the thematic areas of: *new learning methods using ICT, new learning skills and roles for teacher/trainer* and *organizational issues*

- synthesize recommendations out of the projects, according to their goals, in order to provide inputs to the subsequent WPs.

The process by which the project addressed the above-described tasks, methodological problems encountered and outputs achieved are reported in the Sections that follow.

2. Background of the project

Project deliverable 1 aimed at outlining the key components of the MERLIN project under the scope of its "Context". The context in MERLIN is no other than the theoretical/political orientation implied in the European Commission's literature as that is operationalised via RTD work programme objectives and tasks.

2.1 State of affairs

What are the major topics related to innovation and the implementation of ICT in education the international community of research and education is discussing?

In the following section the issues embedded in this statement/question will be addresses from a review of literature perspective. Since it was assumed that the discussion of these issues differ in research and practise, both perspectives are of relevance for exploring relevant research questions within the scope of the MERLIN project objectives.

Reviewing the literature it can be remarked that the term of "Innovation" is used on a very broad scale based on different definitions, ideas and perspectives presented in the discussion of introducing ICT to education. As more it is used, as more it is discussed what it really means and how to adapt the term adequately in the on-going debate of ICT innovations. An example of the "innovation" debate can be found at http://www.innovation.cc/articles/definition.htm ("An Exchange on Definitions of Innovation from the Innovative Management Network"). Innovation can be classified into domain (e.g. industry, medicine, education) and scope. It can be remarked that most of existing definitions are related to the industrial domain, where mostly technology (product) is seen to be the core of the definitions. But if applied to teaching and learning innovation can be process-oriented as well, describing progressive changes and goals in relation to the process of organisational change as well as the process and flow of knowledge. Tony Bates defines 4 different categories for innovation: organisation, administration, curriculum design and instruction (http://cade.athabascau.ca/vol2.1/shale.html). Focussing on the field of educational technology these perspectives are added to more technology-oriented approaches and even mixed, leading to a more general and abstract picture about the meaning of the term.

With respect to the Merlin objectives all different perspectives have to be taken into account, but more sophisticated instruments are needed for operationalising research and defining an adequate methodology. As earlier stated the research issues to be taken into account in MERLIN are dealing with pedagogical, organisational/institutional and sociological/cross-cultural issues.

Since European projects differ from their goals, contents and methodology, it is difficult to generalise their outcomes in regard to certain relevant aspects connected with technology, education and learning. Even when the objectives and outcomes are similar from a point of view that it would allow more general conclusions, there is a lack of initiatives and structures combining relevant outcomes in order to generate new information concerning the research connected with applying ICT in education.
The definition of innovation the project adopts is given in section 2 above.

Recent running projects financed by the IV Framework Programme demonstrated a large variety of approaches concerning

- the use of media
- didactical concepts
- user groups addressed
- research methodology
- generating and presenting the outcomes.

Based on the agreement of 400 signatories of the Memorandum of Understanding (MoU) (http://www.prometeus.org.uk/) an initiative is currently in place, with the goal to create a "Partnership for a Common Approach to the Production and Delivery of Learning Technologies, Content and Services" (PROMETEUS). The goals of this initiative are to bring together key players in Europe in order to promote an European approach concerning:

- optimal strategies for multicultural, multilingual learning solutions,
- new instructional and training approaches and new learning environments,
- affordable solutions & platforms based on open standards and best practices, and
- publicly accessible and interoperable knowledge repositories.

Besides these efforts, which are supported by various "CEN/ISS" activities organised by the "Information Society Standardization System of the European Committee for Standardization" there is currently no adapted approach for collecting and analysing data from European projects in order to come to more general conclusions, independent from their contents.

In times of financial restrictions, the demand for more efficiency and effectiveness is often connected to the potential of tele-supported university teaching. New media require different styles of conveying knowledge and it raises questions about which didactic methods are applicable to Web-based teaching. New methods also demand intensified preparation. Whereas it is becoming more popular to use VLEs as the technical platform for the distribution of online study, many descriptions, and reports, promote the thesis that almost unlimited possibilities exist in education that just have to be implemented. The current state is backed by the dilemma of research in the area of ICT-assisted education on an international level. There is a lack of common approaches concerning the assessment of relevant aspects. In addition, Windschitl (1998) states a lack of scholarly articles. He claims that, by observing that, a vast majority of published work is just description of technology implementation in classrooms. In the same time design guidelines for the implementation of virtual teaching and learning are being published (e.g. Porter 1997, Hall 1999), but there availability of empirical proven research is still not-sufficient. Increasing need for intensified research is seen in regards to pedagogy and computer-mediated communication. Furthermore more investigation is needed on how to combine adequately self-regulated and (teacher) guided learning and how to enhance a reflective learning process since this is considered to be a key-factor for successful learning (Kashihara, Uji´i & Toyoda, 1999). To know more about human cognitive strategies would be an important step in this direction.

Since the Internet enables educational institutions to reach a diverse population and to provide telematics-based education, widespread activities take place in order to develop and provide distance education on a university level throughout Europe[1]. The increasing impact of ICT on organisational structures and political decision making can be stated on several parameter like the increasing trend of university co-operations in education. The US Oklahoma Universities are a recent example of collaborative delivery of courses, based on an e-learning approach for joint education (http://www.rose.cc.ok.us/,

[1] See for example the European Association of Distance Teaching Universities (EADTU, http://www.eadtu.nl/, or http://www-icdl.open.ac.uk/icdl/export/europe/netherla/european/inst/), and International Centre for Distance Learning (ICDL, http://www-icdl.open.ac.uk/icdl/index.htm)

http://www.ucok.edu/) The constitution of the (virtual) Phoenix university is another prominent case of joint activities in education based on the integration of ICT. But still concepts are needed directing towards organisational improvements on effective open flexible learning.

Since there are more dimensions to care about than the technological potentials there, virtual education forms "a critical pressure point for challenging the dominant assumptions and characteristics of existing traditionally organized universities in the 21st century" (Hanna, 1998).

In its review of research and development concerning ICT between 1994 and 1998 the European Commission stated the large need of further activities in research and development based on long term studies, experimental studies and practical motivated implementation studies (1998, 70). Telematics and multimedia-based training are widely considered as key issues to be discussed in the context of future education. "These aspects are at the core of important European Union research programmes and are being addressed by a number of EU projects on research, technological development and demonstration (RTD)" (Forte, 1999). The results of these projects are usually presented in the inter-mediate, annual or final report addressed by the project coordinator to the Commission. These reports are usually reviewed by project officer of the EC and external reviewers in order to verify the progress of projects by different aspects (e.g. organisational, financial, technological, methodology). So far it was never achieved that outcomes of projects are critically analysed and compared towards relevant key indicators of virtual teaching and learning.

An approach for integrating activities in Europe into a common approach already had been intended by the TSER IVETTE Thematic Network. The aim of this project was to map out teaching and learning approaches in virtual learning environments (VLE), to critically assess the impact of European diversity on international VLE and to contribute to innovation in public educational institutions. Based on case studies by different European institutions of Higher Education various perspectives had been chosen for discussing important issues of education in virtual learning environments: an institutional, pedagogical and cross-cultural point of view. The results of several work packages of the project can be seen as one important step which should be added by another one with a new shift from case studies towards the outcomes of relevant European projects.

The Sections that follow recall the objectives of the first and second TSER programme (IV Framework Programme), and those set by the Educational Multimedia Task Force, as these constitute the contextual environment and focus areas for the project's subsequent review tasks.

2.2 TSER Objectives and Orientation

The TSER objectives play a central role in MERLIN in that these constitute the framework of objectives that the project has to respond to. The work undertaken in MERLIN comes to inform the public whether or not recently funded research activity in the area of Education and Training has made a contribution towards the achievement of

the TSER objectives and in parallel to identify the added value behind the conduct and result outputs of such activity.

As reported in Deliverable 1 "Monitoring and Evaluation of Research in Learning Innovations", the TSER objectives were integrated in the research concerns not only of the TSER Calls but, due to their transversal nature, in those of other Community Programmes, namely the Telematics Application Programme, SOCRATES and the Joint Multimedia Call. A discussion on the distinct objectives of the EMMTF initiative is provided on Section 2.2 of this report.

The Programme's Area II (Research on education and training) recognized on the one hand the demographic changes in Europe and its cultural diversity and on the other, the capabilities offered by new technologies, set its goals on a three-level perspective where,

1. 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.
2. 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.
3. And in the long term, to strengthen the contribution of the education and training to sustainable development, employment, and innovation in Europe.

The Programme's Area II, strongly related to MERLIN's research interest, called for research to be undertaken by the European research community and that had to facilitate our knowledge base regarding the problem areas outlined here:

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. Key themes will be: identification of future educational needs and their implementation in policies; the relationship between E&T sector and working life including strengthening apprenticeship training elements in schools and higher education systems; the role of general theoretical elements in vocational education and training; and new models for combining work and training over the life cycle.

Implications of societal developments for the E&T system: E&T is facing a number of societal phenomena directly influencing the conditions of teaching and learning. It is widely acknowledged and often stated by educational experts and practitioners that developments in the society such as the changing family structures, the ageing of the population, social exclusion as well as the entertainment industry and deviant behaviour are also challenging the E&T systems. Empirical research assessing trends and interventions are needed on key issues: the influence of mass-media and the entertainment industry on the education process; violence and drug abuse in schools; new educational roles of schools in the context of changing family structures, including perceptions of teaching tasks, social integration models and relationships between

educational and social policies at appropriate levels; new demands for education and training in the context of a growing elderly population; integration of disabled students, and consequences of multicultural societies for learning and teaching.

Educational implications of the European integration process: Given the diversity of national systems, new efforts should be made in order to study the educational implications of the integration process. More specifically, attention should be given to comparative, empirical analysis of the strategies followed by national E&T systems to address the European dimension. Key thematic aspects of this should be: the impact of the European diversity on the practice of learning and teaching in Europe; the potential for common elements in curricula in the context of mobility and free movement of labour; and institutional and organizational adaptation in the E&T system in the context of European integration.

E&T, the labour market and economic growth: In modern economies it is recognized that investment in human capital is a precondition for economic growth. From the individual's perspective, the relationship between E&T, especially vocational education and training, and the potential for labour market participation, is of outmost importance. Attention should be paid to how flexible arrangements in working life could be used as institutionalised mechanisms for improved investments in E&T, as well as to developing a better understanding of training, competence and skill gaps and economic actors' capability to identify them. Other key themes will be: the effectiveness and flexibility of the E&T system vis-à-vis labour market demands with a critical view on the role of public policy aimed at enhancing human capital as a tool to avoid unemployment; vocational training needs in societies 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.

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. A further theme, where research is required, is on the identification and assessment of elements in the education process which are conductive to fostering an innovation culture. 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 needs 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.

Under such an orientation the Programme Work plan suggested that research was to be undertaken in the themes of:

- Education and training policies, European dimension and diversity
- Quality and innovation in education and training
- Education, training and economic development

While all three themes are of interest to MERLIN, of special interest is the theme of "Quality and innovation in education and training".

In the First Programme 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.

2. *Quality and innovation in education and training*

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

- Research on international transferability explanatory models of multi-level educational effectiveness.
- 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 organisational conditions that are supportive to these learning processes. Focus on aspects that have not yet been frequently studied and 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 E&T, or on the cognitive aspects of the design and application of new technologies in education and training and project involved on evaluation and methodologies for new E&T products.

3. *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.

The Second Call (1997-1998) concerning Area II aimed at the development of targeted research focusing on macro, long-term issues and methodological approaches under the scope of labour market and unemployment, the information society, and, minorities and disadvantaged groups, in the sub-areas of:

- Effectiveness of policies and actions, European dimension and diversity
- Methods, tools and technologies: quality and innovation in education and training
- Education, training and economic development

In this second call the important themes related to the innovative approach to the use of ICT in learning were, like the second one in Area II: Research on educational and training (E&T):

1. *Effectiveness of policies and actions, European dimension and diversity*

   - The capacity for change and adaptation of educational systems.

2. *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...

3. *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, disadvantage and social exclusion. The interdependence of these challenges were to also receive the required attention in research endeavours.

In this context, MERLIN's evaluation, on the bases of its interest, is concerned mainly on the issue of "Methods, tools and technologies: quality and innovation in education and training".

MERLIN is to investigate whether or not the research conducted has, on the one hand addressed these interrelated problem areas in a manner that allowed for new knowledge to be generated, and on the other, whether the results of the set of clustered projects, comprising MERLIN's case studies facilitate the articulation of policy on E&T. The global question to be considered by MERLIN is whether the TSER funded research activity has informed us on how, while maintaining effectiveness, we can make educational and training resources more readily available to the diverse population of Europe (and that both in terms of cultural and age-divergence).

The specific research questions that MERLIN is to seek answers to via the review of Community supported projects and their outcomes are based on the orientation and scope of the TSER Programme. MERLIN's research questions are recalled in Section [2.1.3] below.

2.3 EMMTF Orientation

The Joint Multimedia Call launched in 1996 was a joint effort of different EC Programmes regarding the building of learning environments of the future and improving the quality of the learning processes. The Task Force built on the achievements of the Education and Training Sector's projects while combining the strengths of the six EU Programmes which came together to fund research and development work. The objectives of the Call not only relate directly to those of the TSER but emerge from and build on concerns embedded in the TSER objectives orientation.

One can make the claim that the EMMTF orientation is a testing/demonstration scheme of developments in learning technologies to formulate solutions for the existing socio-economic concerns and divergence in our society. Such an orientation can help us enhance understanding regarding the process by which the new technological solutions can facilitate the accessibility of quality educational and training provisions for all European citizens. MERLIN, in the frame of WP2 is undertaking the review of a set of six research and development projects which, at the level of their objectives, manifested strong links to the orientation of the TSER Programme's objectives.

The principal concerns of the Joint Multimedia Call, reflecting on the orientation and objectives of the specific programmes participating in the Educational Multimedia Task Force, concentrate on the axes of: Technological and pedagogic innovation, School involvement and teachers training, and, Cooperation and networking. These, as stated above, aim primarily on the building of learning environments of the future and at improving the quality of the learning.

The specific aims and concerns of each of the three axes as revealed in the scope of the 46 projects selected to receive Community support is outlined here:

- Technological and pedagogic innovation
- School involvement and teacher training
- Cooperation and networking

Literature on the Task Force's framework and activity regards that the integrative cross-programme nature of this new research enables technical research and development to be combined with cognitive and social research. This combination helps to guarantee strong learner involvement in the projects selected while giving firm support to the overall dissemination of the activities, results and findings of these research and development efforts.

As documented in the Call's literature "the subjects covered by the projects include the full range of primary and secondary curricula, from language learning and the social sciences to physics and mathematics. Vocational training is addressed too, including banking, microelectronics, metallurgy, medicine, tourism, electronic publishing; as well as more generic topics such as the environment, European cultural diversity, managerial

skills and the evaluation and accreditation of multimedia-based earning." (European Communities, 1998, p. 51)

The TSER concerns in this frame of activity is both of causal and effect nature. MERLIN's review frame concentrates more so on the effect side. In this regard the MERLIN project is interested in identifying the activities undertaken in the EMMTF projects that are of socio-economic nature and the impact of their results in addressing/achieving the TSER objectives.

As stated above the five EMMTF projects reviewed in the frame of the project's second work package were selected from the total of 46 EMMTF for the strong socio-economic aspects suggested in their initial documentation.

A concise description of the EMMTF projects is available at: Review of research and development in technologies foe education and training: 1994-1998, European Communities, 1998. A description of the five EMMTF projects being reviewed in the frame of MERLIN and the TSER project DELILAH is provided in Annex I.

2.4 Suggested criteria on Innovation

MERLIN'S perspective to Innovation in ICT-based learning is reflected in the definition it adopted and discussed in deliverable 1, namely that,

> 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 and reform educational services, educational theory and the educational praxis.

While this is a rather generic definition it is within the scope of the current discourse on innovation in learning.

The study on the "School of Tomorrow" initiated by the OECD (OECD, 2000) suggests that at the time of selecting the innovation sites, the following criteria are considered:

- By "innovation/improvement" is intended a deliberate plan for school improvement that has a clear starting point and an identifiable set of changes that moved the school forward as a learning organization. The changes may be innovative or not and may have been applied gradually over time or concentrated in a shorter time period. The Site Nomination Form should identify what the main participants feel is the change that has occurred, whether it be defined as a reform, an innovation, or just an improvement.
- Innovations must be school wide, but may related to curriculum, teaching, staff development, home and community involvement, resources, continuity of learning, or the spatial land temporal components of teaching and learning.
- Innovations should lead, or have the potential to lead to significant improvements in the quality of education, its costs, or in equity of access.
- Virtual schools could be selected as sites but will require adaptation of the instruments. For most such schools, the "innovation" is the expansion of the (traditional) school to reach students at a distance. That is, virtual schools are usually initiated to reach a specific audience that is not being well served by

> traditional schools. Evidence of success, therefore, should center on demonstrating that the desired audience is being reached and the quality of education delivered meets or exceeds reasonable expectations.

The article that emerged from the same study (Voog, Odenthal, 2000), "A Portrait of Emergent Practices: Summary of a Study on Innovative Use of Information and Communication Technology in Education" takes the stand that 'emergent practices' contribute to the innovation of education, not only by introducing ICT in education (substitution approach) but at least by changing existing teaching practices (transition approach) and ultimately by changing the underlying rationale for education (transformation approach)

The approaches proposed constitute parameters for the classification of the innovations suggested by the six projects reviewed.

In looking at current innovative pedagogical around the world, a more analytical approach is outlined by Kozma(2001). He poses fundamental questions like to take into account in any study of innovative practices:

> "How do these practices change the classroom? What new teacher and student roles are associated with "Innovative pedagogical practices that use technologies"? How do they affect patterns of teacher-student and student-student interactions? In what ways does the use of ICT change the organization of the classroom, extend the school day, break down the walls of the classroom, and involve other actors in the learning process (such as parents, scientists, businesspeople, etc.)?
> How do these practices change curriculum content and goals? What impact do these practices have on student competencies, attitudes, and other outcomes? Have they changed what students are learning and what teachers need to learn? Have they changed the ways student outcomes are assessed?
> What capabilities of the applied technology support innovative pedagogical practices? How do these capabilities shape the practices they support? What are the barriers to using ICT in these innovative ways? How do teachers are overcoming these barriers? How do they cope with limited resources?
> What are the national and local contextual factors associated with the use of "Innovative pedagogical practices that use technologies"? Which factors seem to be present across different innovative pedagogical practices?
> Which ones are associated with different practices? What are the implications of contextual factors for the sustainability and transferability of "Innovative pedagogical practices that use technologies"?

For this author successful implementation of innovative practices depends on characteristics of the innovation, on factors such as classroom organization and personal characteristics of the teachers and students (micro level); on school organization and personal characteristics of administrators and community leaders (meso level); and on national and state policies and international trends (macro level). He with other authors (De Corte, 1993; Salomon, 1993; Kozma, 1994) assume an integral, transactional relationship between successful technology-based innovations and this extended set of personal, pedagogical, curricular, and organizational factors that constitute the context of their use .

Furthermore, Kozma points that "To qualify as an innovative pedagogical practices that use technologies, a practice must be one:

1. That shows evidence of significant changes in roles of teachers and students, the goals of the curriculum, assessment practices, and/or the educational materials or infrastructure.
2. In which technology plays a substantial role. Technology should not merely replace previous practices but make a significant contribution to change.
3. That shows evidence of measurable positive student outcomes. There should be some kind of documentation that shows that the intended goals and objectives were attained or that shows a desirable impact on an important indicator, such as student learning, enrollment or completion rate, etc.
4. That is sustainable and transferability may not yet be proven. Consequently, there should be evidence or reasons to believe that they are able to be sustained and transferred. And as a final criterion, "Innovative pedagogical practices that use technologies" are those practices:
    - That are innovative, as locally defined. Innovation is often dependent on the cultural, historical, or developmental context within which it is observed-what is innovative in one country may not be in another.

- These parameters are to also be considered in the frame of the work described here, and have been also considered in the definition of "categories/trends" that the review of the six research projects is to result to

Lastly, MERLIN is not ignoring the principle issues identified by the President of the Information Society Forum, Joan Majó, namely that "…how do schools teach the use of new technologies – content doesn't vary, but the method does, as it incorporates these new technologies…" and that "…these new technologies, apart from bringing about some change at the level of the school, will also produce changes in the environment, and seeing as what the school wants it to prepare its students for this environment, when the latter changes, the activity proper the school will also have to change. Consequently, the school has to go beyond the teaching of the new technologies and the teaching through the new technologies" (http://www.uoc.es/web/eng/articles/joan_majo.html).

2.5 MERLIN's Research Orientation

On the bases of the parameters implied in the different Programme Calls and as a result of the reflections about the first round analyses of cases the specific questions that MERLIN comes to respond to were refined.

The Section that follows outlines the indicators under which the sub-cluster of the 2 TSER projects (Science Teacher and CL-Net) will be assessed. This assessment will facilitate the refinement of the indicators which again will form the framework for the in depth review of yet another sub-cluster of projects in the frame of WP4. The list of indicators provided below (complete list and template see Appendix) is neither conclusive nor exhaustive. It responds to the objectives of WP 2 and 3 and, constitutes again to the refinement and the Analytical Thematic Structure of indicators for subsequent analysis and related policy recommendations.

RESEARCH QUESTION 1: ***What are the new methodological approaches to learning in technology-based learning scenarios ?***

- **Parameter 1.1**: Results of the project with respect to the ICT-mediated innovations
- **Parameter 1.2**: Roles:
    - New teacher roles identified as a result of ICT based innovative pedagogical practices
    - New student roles identified as a result of ICT based innovative pedagogical practices
- **Parameter 1.3**: Patterns of teacher-student, teacher-teacher and student-student interactions as a result of ICT mediated innovation
- **Parameter 1.4**: Classroom organizational changes emerging as a result of ICT usage
- **Parameter 1.5**: Cognitive aspects (collaborative learning, problem-based learning, learning to learn, etc)
- **Parameter 1.6**: Attitudes:
    - Teachers/trainers attitudes towards ICT and ICT mediated instruction/learning
    - Student attitudes towards ICT and ICT mediated learning
- **Parameter 1.7**: Critical Factors:
    - Factors that have a influence in learning mediated by ICT, including the affective dimension
    - Socio-cultural factors that influence learning via ICT (both from a positive and negative perspective)

RESEARCH QUESTION 2: ***What are/were the main institutional changes as a result of ICT implementation ?***

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.

- **Parameter 2.1**: Main institutional changes described as a result of the introduction of ICT into the existing structures.
- **Parameter 2.2**: Staff Training:
    - Staff training approaches tested/applied
    - The role of staff training in the project
- **Parameter 2.3**: Main actors, adopters and resisters to the adoption of the innovation as identified in the projects
- **Parameter 2.4**: Organisational conditions that are supportive of the innovation (short, medium and long term)

RESEARCH QUESTION 3: ***What are the Socio-Economic aspects of the analysed Learning Innovations ?***
Socio-economic aspects involved in the ICT-based learning innovations: How do the outcomes of the project shed light to the following socio-economic aspects:

- **Parameter 3.1**: LLL paradigm
    - Evidence regarding the promotion of the LLL paradigm
    - The role of ICT in the promotion of the LLL paradigm
    - Implied requirements for the promotion of the LLL paradigm
- **Parameter 3.2**: Equity issues: Evidence regarding socio-economic changes promoted by ICT in terms of
    - Gender
    - Citizenship
    - socio-economic strata
    - age
    - other socio-economic parameters (i.e. disadvantaged groups)
- **Parameter 3.3**: Socio-Cultural aspects
    - Socio-Cultural aspects regarding promotion of ICT mediated innovation
    - Socio-cultural aspects regarding the use of ICT in learning environments

2.6 Methodological approach

As stated before the overall objective in MERLIN is to monitor progress and review the results of a cluster of TSER projects from the Second and Third TSER Calls in the IV Framework Programme that encompass in their objectives innovative approaches to the use of ICT in learning. In doing so, the aim is to depict effects and implications of socio-economic nature.

The objective of the project's third work package is to review a set of projects supported by the TSER programme. Its aim is, on the one hand, to depict key indicators and trends of socio-economic nature and, on the other, to contextualise these in the frame of the MERLIN project objectives.

The review of the selected projects, through the identification of similarities, differences and major trends in the orientation, implementation and socio-economic natured results, is to facilitate the formulation of indicators for the assessment and evaluation of the on-going TSER projects.

The work in this WP complements the definition of the project's specification for the Analytical Thematic Structure of Indicators for the cluster analyses that are to follow in the frame of WP4.

The work package 2 and 3 activity called for comparative review of cases under the scope of the Programme's objectives – those being the set of projects indicated in Section 2.2 and 2.3 above, and on the other individual cases reviews. The nature of the activity of this WP presupposes a case study orientation as the individual projects become the object of study. On the other hand, the activity and the nature of the expected result, suggest a reflexive methodological approach grounded on hermeneutics for the building of meaning of data (project's reports/documentation) as the aim is on understanding the trends that come from the conceptual framework's objectives, embedded in the EMMTF and TSER Programme orientation.

Since the 60s a strong debate over methodology has deeply influenced social and educational research. In this debate, which is not only related to the validity of quantitative and qualitative research methods, but more deeply rooted in the ideological assumptions behind these methods, the use, the utility and validity of case studies has appeared as a permanent issue. Still today, social and educational research based on individual cases faces strong criticisms. This is partly due to the fact that the term "case" is one of the many basic methodological constructs that have become distorted or corrupted over time, gaining multiple and sometimes contradictory meanings. On the other hand, the view that quantitative researchers look at many cases, while qualitative researchers look at only one or small number of cases, can be maintained only by allowing considerable slippage in the conceptualisation of a case. To apply the same term to vastly different methodological constructs serves only to increase the perception that the different kinds of social science research are irreconcilable and that their practitioners speak mutually unintelligible languages (Ragin, 1994, p.5).

However, and even assuming that some of the criticisms against the use of case studies have sound arguments, no other approach seems to bring more light into the relative darkness of social and educational research aimed at illustrating and even enriching theoretical perspectives.

The main point is whether we can learn something of theoretical or practical value from the comparative work based on a given set of individual case studies. The answer assumed by the MERLIN Consortium is clearly affirmative, although it deserves some explanation. As many social researchers have pointed out[2], conventional variable–oriented comparative work –such as quantitative cross–national research–, as compared with case–oriented comparative work, disembodies and obscures cases. In most variable–oriented work, researchers begin by defining the problem in a way that allows examination of many cases, be they empirical units or observations; then they specify the relevant variables, matched to theoretical concepts; and finally they collect information on these variables. From that point onwards, the language of variables and the relations among them dominate the process. The resulting understanding of these relations is shaped by examining patterns of co–variation on the data set, observed and averaged across many cases, not by studying how different features or causes fit together in individual cases.

Alternatively, a case–oriented approach –as the one it is going to be undertaken here– places cases, not variables, at center stage. And, in this sense, the traditional definition of what is a case in comparative social science can also be applied here (Ragin, 1987, p.5): a

[2] See, for example, Ragin, 1987.

case is defined by boundaries around places and time periods. Accordingly, a country in a given time period may be a case, a whole continent may be also a case, but also an individual institution or a pupil may be a case. And it is by comparing different cases that it becomes possible not only to illustrate a theory (or trend in this case) but to better define that theory (Pzreworski and Teune, 1970).

The approach tends to place more emphasis on deviation and variety than on common trends. The reflection on variety of meaningful patterns of causes and effects of educational innovations is aimed at enriching our knowledge not in terms of a set of evident case descriptions, which conform a silent picture but in terms of actual analysis and theory formation.

This implies that cases should be addressed as wholes, not as collections of variables. In this context, the need for interpreting specific cases and pinpointing the combinations of conditions –the causal complexes– that produce specific outcomes encourages this holistic view. The different parts or conditions that make up a case are understood in relation to each other and, together, are considered as composing a single situation.

Lastly, the case–oriented method, is expected to stimulate a rich dialogue between ideas embedded in the project's framework and their socio-economic and educational implications. Because of the flexibility they allow in approaching social reality, case–oriented methods do not restrict or constrain the examination of evidence. They do not force researchers to view casual conditions as opponents in the struggle to explain variation. Rather, they provide a basis for examining how conditions combine in different ways and in different contexts to produce different outcomes.

As stated above the work undertaken in this work package is of reflective "hermeneutics" nature in that the meaning of a part can only be understood if it is related to the whole (Alvesson, p.53). In the literature one reads of different uses of the reflexivity or reflection which typically draw attention to the "complex relationship between processes of knowledge products and the various contexts of such processes as well as the involvement of the knowledge producer" (id p.5).

3 Cases

In the frame of its third work package MERLIN is to review a set of 2 RTD projects belonging to the 1st and 2nd TSER Call of the IV Framework Programme. One further TSER project (DELILAH) already had been reviewed during WP 2. The TSER projects were selected amongst the TSER Area II projects, Programme Cluster: Innovation in Education and Training via Technology, for its relevance to the research concerns of MERLIN, in that the project intended to investigate the potential of new forms of learning arrangements for improving access to E&T for different sectors and different groups of citizens.

The scope of the review includes:

- Identification of Innovation Scenarios
- Identification of Methodological Trends
- Identification of Issues emerging from the Learning Scenarios
- Identification of socio-cultural, institutional and organisational perspectives to ICT based learning
- Identification and Selection of socio-economic variables affecting ICT based learning

On the bases of Programme Objectives and in the frame of MERLIN's scope for the first level review one could anticipate that the results of the set of the projects reveal both similarities and differences in the issues investigated by MERLIN.

3.1 Steps taken and Problem Encountered

As already stated before in Del. 2, relating to the previous case studies, the process by which MERLIN is reviewing the 2 TSER projects is by the conduct of desk research of these projects Final Reports, deliverables and other supporting material.
Steps taken:

1. The project requested to the coordinators of each project to provide such kind of information and material needed. This proved a rather time consuming task, but in any case proved to be a "linking mechanism" between MERLIN and the projects and acted as a first step to the organization of the projects Workshop that is to follow.
2. Additional information (articles, descriptions etc.) was collected from Internet resources (web-Sites etc.), where available.
3. Assessment of cases by applying a common frame of research questions and aspects (See Annex 2). The template was designed, applied and subsequently re-fined during each WP by the project Consortium. The information provided in the Final Reports and other material etc. was organized in the frame of this instrument the project developed and served as the "data" via which the case-study reports were produced
4. Production of a report on each case
5. Synopsis / syntheses of cases studied
6. Conclusions and finalisation of list of indicators.

However, it must be stated that some points in this investigation process proved to be rather problematic relating to different.

- amount of documentation material provided by the project consortiums (Final reports, Deliverables etc.) or available on the Internet
- focuses of the documentation given
- approaches and
- depths of analyses during the research work of the projects studied here.

Furthermore it was a challenging task to agree to a common approach on the assessment of cases and the applications of the instruments developed in terms of the common understandings of research questions and information needed. The content of these case study reports constitutes the material via which the project depicted the categorization parameters. The method used for this level and the time allocation devoted to this level of work did not call nor allowed for verification of the assessment. In this regard, the level of subjectivity in the assessment of the issues sought here might be high. Furthermore, the materials that became available to the partners were not all of the same quality, scope and depth. Likewise, the level of responsiveness varies generally from project to project. These issues become apparent in the case study reports.

As a consequence of problems encountered further steps therefore had been foreseen:

- Double-assessment of cases by the MERLIN Consortium
- Communication of all reports to the projects and collection of feedback from co-ordinators of the projects analysed (Feedback from NETLOGO, DELILAH, REPRESENTATIONS, IN-TELE)
- Revision of project reports

In order to ensure the quality of the research performed, additional measures have been envisaged. In addition to the given methodology, the case study reports of WP 2 and WP 3 were communicated for verification to the coordinators of the analysed projects. So far feedback given was not satisfying in some cases. Where applicable comments given were included here in the reports of case studies (see section 4).

The work undertaken in work package 2 and 3 also contributed to the refinement of the methodological parameters for the subsequent analytical work. These problems already encountered during the work with WP 2 was taken into account in the process of collecting documentation in the frame of WPs 4 and 5.

3.2 CL-NET

CL-NET was funded by the TSER Programme, 2nd Call. The main research tasks within TSER's 2nd Call that the project CL-Net responded to are:

- Methods, tools and technologies: Quality of innovation in E&T
    - 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.

- Effectiveness of policies and actions
    - The capacity for change and adoption of education systems.

The themes that the project addressed were:

- Scenarios of applications of new approaches to enhance the quality of education,
- Educational Potential of the information society […] evaluation and methodologies for new E&T products,
- Design and evaluation of new kinds if learning environments.

Envisaged outcomes

- To make visible how CLNs enhance knowledge acquisition and especially collaborative knowledge building, focussing on the learning and communication processes.
- To investigate what kinds of tools and support-structures facilitate collaborative knowledge building.
- To investigate whether students will be enabled to become competent and active actors in their own environments as self-regulated knowledge builders.
- The major expectation is that communication in CLNs will become richer in content, more varied and can be characterized as knowledge-building instead of knowledge acquisition tools.

Socio-economic aspects

European society is increasingly dependent on information and knowledge and needs to keep up with and anticipate to global developments. Preparing learners for participation in a networked, information society in which knowledge will be the most critical resource for personal, social and economical development, is one of the basic objectives for education today. Furthermore, the developments in society and in organisations ask for new kinds of skills that should at least partly be prepared in schools. New learning outcomes as described by political actors, parents, teachers and company representatives refer to outcomes that are *durable, flexible, functional, meaningful, generalizable* and *application-oriented.* Computer-supported collaborative learning (CSCL) is considered as one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology. By following cognitive principles of learning, technology-enriched learning environments can provide advanced means for the production of knowledge and constructive communication. The passive ways of learning can be transformed into interactive and collaborative learning in (and between) classrooms and between teachers and learners.

3.2.1 Input Related Objectives

Target population

Twenty schools from Greece, Finland, Belgium, Italy and The Netherlands involved in the project. Almost 600 students from primary, (age 10-12), secondary (age 13-16) and vocational education (age 18-24), and 25 teachers participated in this project, experimenting with different kinds of software.

Statement of the problem

Developments in the learning and information society as well as in learning organisations, ask for new learning outcomes which can be reached according to recent learning theories through both a shift towards action learning and towards experiential learning. In other words, a new balance between guided learning, action learning and experiential learning is needed.

The main hypotheses were:

1. CLNs can be introduced in regular schools effectively.
2. CLNs promote collaborative knowledge building.
3. The number and quality of communications between students improve over time.
4. CLNs effect conceptual change, motivation, cooperation and meta-cognition of students.
5. Cross-national communication using CLNs is possible and valuable.

Specific goal of the project

The specific goals of the CL net project were: evaluation of cognitive, meta-cognitive and motivational effects of the learning environment, in which educational technology is used to help create a community of learners who build knowledge together.

Objectives of the project

1. To synthesize existing research on computer supported collaborative learning that aims to stimulate knowledge building.
2. To find effective ways to introduce collaborative learning networks in schools.
3. To develop didactical models, design principles and learning scenario's for the use of CLNs in primary and secondary education.
4. To experiment with different kinds of CLN-tools which support the learning process and the acquisition of knowledge building skills.
5. To evaluate the (meta)cognitive, motivational and social effects of collaborative learning, supported by computer networks.
6. To experiment with cross-national communication between schools.

Research questions posed

The central question of the project was: How can effective knowledge building in CLNs be supported in European primary and secondary education?

Specific research questions were the following:

1. What are the cognitive effects of the use of computer-supported collaborative learning environments?
2. Do CSCL environments like the ones designed and implemented in the different CL-Net sites result in change in pupils' meta-cognitive and epistemic beliefs from external or internal into interactive?
3. What is the evolution of pupils' self-reported motivational dispositions in the course of each project?
4. What are possible motivational trends and patterns of differences (or similarities) among the participating countries?

Methodology used

The research was 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 were used:

1. Protocols of communications between students and between students and teachers have been analysed. Moreover, qualitative aspects were studied. *Case studies* and small-scale, informal comparative experiments were conducted.
2. Tests that measure the cognitive, meta-cognitive, and motivational effects of CLN's have been used and further developed.
3. Small questionnaires and interviews with teachers and students were used.

3.2.2 Outputs Related Objectives

RESEARCH QUESTION 1*: New Methodological approaches to Learning*

Parameter 1.1: *Results of the project with respect to the innovations*

Referring to the main goals of the project it can be stated that most of its objectives have been achieved with variation in the level of achievement:

1. Existing research on computer supported collaborative learning that aims to stimulate knowledge building was synthesised.
2. Ways were found to introduce CSCL in schools. Didactical models, design principles and learning scenarios for the use of CLNs in primary and secondary education were developed.
3. All countries experimented with different kinds of CLN-tools which support the learning process and the acquisition of knowledge building skills.
4. Cognitive, meta-cognitive, motivational and social effects of collaborative learning supported by computers were evaluated.
5. One cross-national experiment between schools in Belgium and The Netherlands was conducted.

Parameter 1.2: *New teacher and student roles identified as a result of ICT based innovative pedagogical practices*

The CL-Net first put a great emphasis on collaboration between teachers and between teachers and researchers. Meetings between teachers (international, national, local and school meetings) gave an opportunity to discuss problems and feelings, to meet partners and find commonalties, to involve more teachers into the project and to foster the perception of the role as researcher. In at least two of the case studies, one of the aims of the research was to create a community between teachers and researchers (i.e. *Our world* and *Discover your town* case studies). In the majority of the other case studies collaboration between teachers was also an important point of the research. The tasks of a teacher were complemented with new competencies, like information-management, time-management and group-management. The teacher must design the curriculum and monitor and manage its progress. Moreover he has to monitor the database and assess the depth of investigation that goes on. CSCL requires teachers' ability in helping learners to follow their own learning route, to offer just-in-time feedback on their knowledge construction, and to scaffold them when they encounter difficulties as novices in many

fields, like searching, selecting, processing and reporting information, working adequately in groups, and (co)-constructing meaningful knowledge.

Parameter 1.3: *Patterns of teacher-student, teacher-teacher and student-student interactions as a result of ICT mediated innovation*

In the great majority of the case studies, collaboration between students was enhanced not only through communication at a distance, but also in dyads, small groups, and class-groups interactions. Children worked in pairs at the computer, not for a lack of technological resources, but for a precise educational choice: stimulating children to discuss and interacting to each other, making explicit their thinking that sometimes generated productive cognitive conflicts.

In the Greek case study a very interesting analysis of audio and video recordings makes possible to observe the type of collaboration that the students were experiencing, as well as the cognitive, meta-cognitive, and motivational effects of their collaboration. Dyads styles of collaboration were classified in three categories: *Reciprocity, Forced collaboration* and *No collaboration.* When the interaction is categorized as Reciprocity style there is a great deal of planning, opinions' exchanging and task division among the students. In the No collaboration category the mutuality among students is completely missing. The Reciprocity style was the most frequent in the dyads interaction, with the 60% of occurrence. Transcriptions of audio and video data were further analysed and the text was divided into four different categories of exchanges: co*gnitive, meta-cognitive, motivational*, and *collaborative.* About 50% of exchanges belongs to the collaboration category: students were mostly talking about issues related to aspects of their collaboration. A very interesting result has been observed when combining different styles of collaboration with numbers of cognitive and meta-cognitive exchanges. Exchanges are related to the collaboration style: there are no cognitive or meta-cognitive exchanges in the No collaboration style, while the number of exchanges increase in the Forced collaboration and even more in the Reciprocity style.

The communication has been stressed also in both the Italian case-studies and the meta-cognitive questionnaire has shown that communication is influenced by the project in both samples. For this reason a further qualitative analysis of the communication has been done looking in particular to how communication is articulated and what are the specific features of the different type of communication.

Different phases of communication have been distinguished:

- **Communication in the classroom**
  During this phase, although students are aware about the interlocutors at a distance, the communication in mainly based on ideas generated by the class itself and it is very much influenced by the relationships between classmates. With a specific reference to the communication generated by computer based activities, the "Discover your town" case-study shows that kids are able to co-construct knowledge, and to activate argumentative skills and critical inquiring.

- **Communication explicitly aimed to an external audience**
  When well scaffold, this phase can be very productive: previous ideas are developed and improved, new ideas are produced, and critical thinking appears.

- **Communication at a distance supported by computers**
  Analysis of this phase is focused on trying to define the interlocutor perception. Considerable changes are observed over time:
  - Initial messages are referred to a vague interlocutor, very often the interlocutor is not even mentioned. The messages are simply self-referred and suitable to any reader,
  - later the content is more specific and it is observed a decentralization of the point of view. In this phase children's' discourse is more based on interventions classified as "elaborated positive replies" and "problematisation".

- **Communication based on the external interlocutors contributions**
  Consistent part of the communication posted on the Internet or exchanged through e-mail goes back in the class and new type of communication phase takes place. This time the communication is based on the elaboration of the information coming from the partners outside the class. Pupils in this phase show to be critical reviewers and to be able to distinguish between formal aspects and the content of the messages (see "Our world" case-study). In this latter phase new knowledge and information is generated. While the communication progresses to the next round of phases, the interlocutor at a distance gains a more clear identity and becomes more and more relevant.

Parameter 1.4: *Classroom organizational changes emerging as a result of ICT usage*

The studies indicated that the introduction of computers itself affects the nature of the whole learning environment. These effects, referred to in the project as "first-order" effects of educational technology, refer to learning of skills of using information technology, developing skills of basic knowledge acquisition, generally increased motivation, and accessing extended sources of information. First order effects also involve changes in structures of classroom activities and changed division of cognitive labour between the teacher and the students.

Comentario: ????

The project further identified that bringing computers into the classroom did not automatically lead to what is called "second-order" effects of educational technology. The second-order effects involve engaging students in a sustained question- and explanation-driven inquiry, true knowledge building, and progressive discourse analogous to scientific practice. The second-order effects may lead to a profound change in the students' conceptions of what learning and knowledge are all about, and they need strong pedagogical support from the teacher. These appear further to require deep change in teachers' conceptions of knowledge and in the *pedagogical practices* of school generally, rather difficult to be achieved. Perhaps the theoretical and practical principles of CSCL are still too recently articulated to be widely recognized and applied in practical educational reforms.

Parameter 1.5: *Cognitive aspects (collaborative learning, problem-based learning, learning to learn, etc)*

The project reports that in the great majority of the case studies, collaboration between students was enhanced not only through communication at a distance, but also in dyads, small groups, and class-groups interactions. The findings seem to confirm the results of the evaluation studies comparing CSILE and non-CSILE classrooms showing significant advantages for CSILE classrooms on standardised test scores for curricular domains like language and mathematics, but also on process-oriented measures like quality of question-raising and depth of explanation. The important additional finding provided by the CL-Net project is that these positive cognitive effects can also be obtained in non-laboratory settings or at least in settings that are representative for the 'habitat' of most European teachers and pupils in the late nineties.

The project did acknowledge that the cognitive effects obtained in it are rather small. Moreover, the positive conclusions with respect to the cognitive effects drawn at the end of some case studies are sometimes jeopardised by a number of methodological problems. Nevertheless it was considered that additional evidence that it is possible and feasible to significantly contribute to upper elementary and lower secondary school pupils' conceptual and cognitive development by means of CSCL systems, even in settings where the technology-based support is still rather small and where teachers and pupils are relatively unfamiliar with systems for CSCL like KF and with the constructivist learning pedagogy underlying them.

Parameter 1.6: *Teachers/trainers and student attitudes towards ICT and ICT mediated learning*

Reported is that all the teachers were very positive about their participation in the project. While at the start they were rather sceptical and anxious, once they became familiar with the new approach and once it became clear what kinds of support they would get from the researchers, they became enthusiastic. All teachers declared that they had learned a lot, that they wanted to continue to work with CSILE, also in other domains, and that they wanted to intensify the collaboration with the other classes and with other schools. In their notes or interviews, teachers evaluated positively the collaborative learning experience for their classes. The enthusiasm had been seriously put to test by the high amount of workload, the classroom management problems they had experienced realising a radical educational innovation in their rather traditional classroom practice and the numerous technical problems they had encountered during the project.

The motivational and meta-cognitive questionnaires administered as part of the work plan gave some information about the attitudes towards cooperation. Results differ in the participating countries. In both of the Italian case studies there was a significant increment in students' positive perception of peer help and preference for collaboration. In Belgium, the meta-cognitive and the motivational questionnaires gave disappointing results. According to the results of the motivational questionnaire, the CL–Net environment seems to have a significant positive impacts on pupil’s beliefs and attitudes toward cooperative learning, but these findings were not supported by that from the open “communication” questions of the meta-cognitive questionnaire: there was no evidence of any effect of the experimental setting.

Parameter 1.7: *Factors that have an influence in learning mediated by ICT, including the affective dimension Socio-cultural factors that influence learning via ICT*

- **School culture**
  The culture of most of the schools and its classrooms does not offer ample possibilities for collaboration for knowledge building. Schools are still very much based on the traditional didactic triangle: matters of tuition are largely predefined in curriculum and the teachers' main job is to achieve correspondence between the more or less 'hard' knowledge and skills prescribed and the heads and hands of the individual pupil.

- **Timetable**
  It is not so easy to integrate new didactical practices in existing curricula. The schools' timetables often leave little time for experiments that diverge from the mainstream instruction.

- **Teachers**
  Teachers have no time and are not able to design the assignments and questions without extensive support for students that are optimal for CSCL. Although the scientific community has considered the principles of CSCL highly promising for the development of future learning environments, this is not yet the case among practicing teachers. Teachers need to be trained in being a guide and tutor, and not merely the transmitter of information. Teachers should be supported in the creation of electronic communities. In that way they will develop new learning methods and form their own learning community. Furthermore, teachers need more technical know-how and expertise.

- **Materials**
  There are not enough didactical materials nor are there enough good examples available to help teachers' fulfil their new roles.

- **Planning**
  There is a need for theoretically well grounded development of CSCL practices and tools which are adequately embedded in practical educational context. The results of previous research also highlight the importance of carefully analysing the presuppositions of application of technology-based instructional innovations in practical classroom situations. This is also because it is not self evident if new technologies have also pedagogical value without carefully planned instructional strategies and adequately educated teachers.

- **Technical support**
  More attention needs to be paid to technical support and ICT training in order to build efficient computer supported collaborative learning environments in the schools.

- **International collaborative projects**
  The international collaborative projects are a more specific elaboration of out-class computer-supported collaborative work and learning. The motivation for active participation is likely to be higher, but the contextual conditions are more difficult to be satisfied. Language-and culture-related issues can pose insurmountable problems. One of the ways to overcome them is to define these problems as challenges for

learning: differences in language can constitute learning goals as well in addition to task-oriented collaboration.

RESEARCH QUESTION 2*: Institutional Innovation*

Parameter 2.1: *Main institutional changes described as a result of the introduction of ICT into the existing structures*

Some of the case studies described in this report were "embedded" within on-going institutional interventions on a wider scale. These plans range from merely funding the schools for computer equipment to develop and implement school practices supported by technologies. However, very little was done to facilitate the re-structuring of the school practice, even in situations that could be considered as opportunities for testing changes under protected conditions. The project was experienced as an extra-curricular activity: teachers and researchers were more or less given a "carte blanche" to implement the learning environment. The sole condition was that teachers had to finish the formal and official curriculum.

Parameter 2.2: *Staff Training: Staff training approaches tested/applied; The role of staff training in the project*

Researchers of the CL-Net project have provided both pedagogical and technical support. Good preparation among the teachers involved, respecting and creating 'golden rules' for communication and collaboration, monitoring and participating actively in the computer-supported interactions, enhancing the teachers' competences both regarding their pedagogic-didactic repertoire in general, their ability to offer scaffolds for learning, and an orientation for innovation, belong to the conditions to be satisfied if computer-supported collaborative learning is to conquer a place in temporary European classrooms. Technical support is also indispensable. Manuals on how to use the different software, training, technical support in case of a computer breakdown, guidelines for using the database for analysing the interaction (like Analytic Toolkit for Knowledge Forum), all kinds of support are necessary.

Parameter 2.3: *Main actors, adopters and resisters to the adoption of the innovation as identified in the projects*

To a certain extent, schools perceive experimental projects like CL-NET as external, as originating from motivation of agencies that pursue objectives related with scientific investigation, as accepted by the head of the institute for the school prestige, but not as a really productive tool for the benefit of their own school community. Furthermore, the educational system does not consider these kind of innovations as a reality of the teachers' profession and provide time to reflect on the practice, discuss and re-elaborate these innovations, still is considered as optional and a luxury.

Parameter 2.4: *Organisational conditions that are supportive of the innovation*

- **Short/Medium Term**
  It is becoming increasingly clear that in order for computers to be widely used in a school as a tool for facilitating learning in other subject-matter areas, they need to be distributed in the classrooms and several other computer activity areas. In addition, the computers must be placed in the classroom in ways that facilitate collaborative learning rather than traditional frontal teaching. Similarly, network access must be possible from several places in the school and not only in certain restricted areas.

- **Long Term**
  In order to facilitate CSCL in elementary and secondary level education, a substantial change in pedagogical practices and in the wider culture of schooling is needed. Nevertheless, the culture of school learning cannot be expected to change immediately but presupposes a long process of exploring and testing different cognitive and pedagogical practices. Furthermore, there is great need to develop a new generation of school architecture designed from the beginning for computer-supported learning environments. School libraries should become more and more the centre of the school and should become (multi)mediatheques.

RESEARCH QUESTION 3*: Socio-Economic aspect of Learning Innovations*

Parameter 3.1: *LLL paradigm*

No major factors were found.

Parameter 3.2: *Equity issues*

In Greece, there were gender differences in one of the components of the motivational questionnaire: the so-called “feeling that the other students help”. The girls seem to have been particularly sensitive to the collaborative component of the experimental intervention, while no similar change has been detected for the boys.
Although a great deal of money have been spent to equip schools with computers, many schools, particularly elementary schools, do not yet have enough computers available for computer supported collaborative learning, or do not have the right kind of computers and the necessary network infrastructure.

Parameter 3.3: *Socio-cultural aspects*

No major factors were found.

3.2.3 Other aspects related to the innovative dimension of the project

What appears to be innovative in the project outcomes (external perspective) as compared to what the project participants claimed ?

In introducing the software in schools the researchers were conscious that they were introducing three innovations at the same time: the didactics of collaborative and co-operative learning; learning with computers and inquiry learning/knowledge building. Moreover, there were two curricula at the same time: the regular one and the one introduced by the program.

Comentario: ? Is that a citation?

3.3 STTIS

Information below come from the Final Report. Most of the content are excerpts of this report selected according to MERLIN research interests.

The project **Science Teacher Training in an Information Society (STTIS)** was approved in the second Call of the programme TSER. The main components within TSER tasks in area II (Research and educational and training) were:

Theme*:* Methods, tools and technologies: quality and innovation in education and training.

Task: The educational potential of the information society, research on the cognitive aspects of the design and application of new technologies in E&T, or on the cognitive aspects of the design and application of new technologies in education and training and project involved on evaluation and methodologies for new E&T products.

The main ***Goals*** of the project was at knowing the conditions for science teachers to successfully implement in their classes some curricular innovations, to document the obstacles that they need to remove and to develop appropriate materials for reducing the effect of unfavourable factors. Its has been adopted the view that innovations are not designed by the teachers themselves being only the transmitters. This is often the situation for teachers in many of the countries, even the level of curriculum' specificity takes large differences among European educational authorities.

The ***Envisaged Outcomes*** as a whole looked at:

1. Reporting the state of the art on the use and value of informatics tools in five partner countries (France, Italy, Norway, Spain and the UK) were examined. The study was concerned with the provision of and kinds of use of computers and informatics tools in secondary schools and more particularly in science and technology classes.
2. A study on how teachers transform expected uses of such tools and from this study to conjecture about difficulties and opportunities for the use of the tools in the classroom. It focused on the use of selected informatics tools in the science classroom. The informatics tools selected to be of interest to STTIS are basically of two kinds: computational modelling and simulation; and real time experiments and display systems.

3. According to the data provided above, report on teacher transformations as a) teacher adaptation in order to use Computer Tools in their science classes; c) transformation of the use of IT tools expected by teachers in their science classes.
4. Report on the use of images in sciences: students' difficulties in reading images; teachers' awareness and interpretation of students' difficulties; teachers' transformations when using images.
5. Report on he nature of difficulties arising when teachers are expected to adopt an innovative teaching sequence: how teachers' non-neutral interpretation of a proposed teaching sequence may result in transformations with important conceptual consequences.
6. Report on general trends, if any, in the transformation undergone by teachers when facing different curricular innovations.
7. Elaboration of improved teacher training materials based on the research done, addressing the most conflictive points or the most probable transformative mechanisms operating when teachers have to incorporate a particular innovation.
8. Guidelines for policy-makers to communicate the research results with suggestions for improving the design and implementation of teacher education programs and of didactic innovations.

The project started on December 1997 with a duration of 3 years. It was coordinated by Dr. Roser Pintó (Universitat Autònoma de Barcelona, ES) and the other partners were: Laurence Viennot (Laboratoire de Didactique de la Physique dans l'Enseignement Supérieur. Université Denis Diderot. Paris VII, FR); Jon Ogborn, Institute of Education, University of Sussex, GB); Elena Sassi, (Physics Education Group, Universita "Federico II" of Naples, IT); Andreas Quale (Dept. of teacher Education and School Development, University of Oslo, NO).

3.3.1 Input-related Objectives

Target population
Teachers of Science and Technology classes in secondary schools.

Statement of the problem
The STTIS studies on the take-up of innovations focused on the nature of their use in class practice. The project studied the key aspects which may influence the take-up of an innovation with respect to a) Informatics tools used; b) Symbolic representations; c) Innovative teaching sequences for specific content

Specific goal of the project
The STTIS research studied three types of educational innovations in science education, focusing on the nature of their use in class practice, paying special attention to how they are interpreted and transformed by teachers. The innovations studied were:
- the introduction of informatics tools, in particular those of computational modelling and simulation and of real-time experiments and display systems;
- the construction and/or use of images;
- the implementation of innovative teaching sequences for science courses at secondary school level

Objectives of the project

1. Improving Scientific Formation for a European information society*:*
The project addresses the contribution of scientific and technological education to the mastery of technical devices and to the learning of different symbolic languages to use for communication. This hints at new approaches to some scientific and technological content and puts an emphasis on some old and new skills.

2. Making more room for innovation in the training of Science teachers
Whilst the hardware and software for information processing and exchange can be readily purchased and are quickly becoming more and more widely distributed, the use of tools for analysing and representing information requires a rather advanced intellectual level together with high order critical skills. In the Information Society, the science teachers training processes need to be focused also on the use and experience with information technology tools having in mind that those change the focus and the content of the science and technology curriculum.

3. Improving the adaptation of teachers to innovations
A central issue is to analyse teachers' role and possible obstacles when confronted by innovations, and to investigate the factors that influence the quality of take up. A better mutual adaptation between teachers and innovation has to be fostered.

4. Contributing to a changing society
The proposal aims at improving the adaptation of individuals to a changing society, through better knowledge of the circumstances for successful implementation of innovations and, more specifically, to infer some patterns of transformation in the process of implementing innovations.

Research questions posed

- What are some of the problems and opportunities for the use of informatics tools in science classrooms?
- How do teachers transform the expected uses of such tools? What transforming trends can we conjecture to be involved?
- What are some of the problems and opportunities of the use of images and graphic representations in science courses?
- How do teachers deal with such problems, in the context of innovative teaching? What transforming trends can be inferred?
- What specific requirements are expected of teachers in certain selected and well-defined curriculum innovations in science?
- How do teachers understand these expectations? How do they act in the classroom? What transforming trends can we thereby conjecture?

Methodology used

The research methodology adopted was qualitative in nature, because they believe this to be the right way to address the essential problems in this project; quantitative methods

might become appropriate at a later stage, after the qualitative diagnosis and description of the problems has been done.

The principle of triangulation indicated collecting a variety of data for each case. Data collected by each country consisted of a practicable and appropriate selection from:

- observation records (researcher notebook) in the classroom
- video recording of student activities (if permitted or suited to the situation)
- recording (audio or video) of teachers' explanations
- copies of tasks given to students (worksheets, tests)
- copies of written work done by students
- interviews with teachers
- discussions/interviews with students

Learning Technologies Applied

- tools for simulation and modelling
- tools for acquiring and representing data

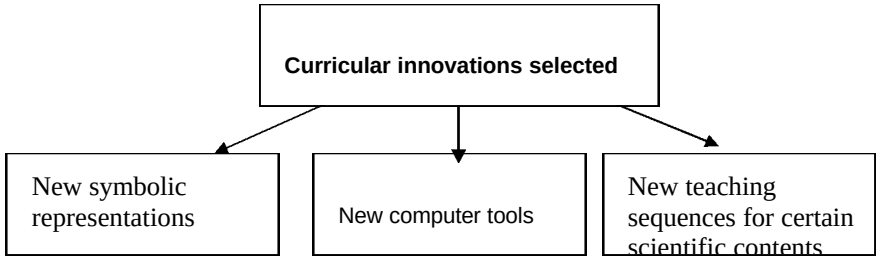
As for instance: simulation tools in teaching optics; and MBL (Micro-computer Based Laboratory) in mechanics, MBL in teaching kinematics and forces, MBL in teaching energy and kinematics, spreadsheets and other simulation tools in teaching motion in force fields; CBL and MBL in teaching thermodynamics, mechanics and electromagnetism, spreadsheets and other modelling tools in teaching science

ICT arrangements

The experiences took place in typical classrooms and lab work scenarios for science class equipped differently depending on the partners. The learning activities were part of the students curriculum, and were evaluated accordingly. Nevertheless, the research was concentrated on what teacher do in the classroom.

Learning issues studied

The STTIS project has intended to achieve results for improving teacher formation plans addressed to Science teachers that have to incorporate in their courses curricular innovations. The aim was to increase awareness of factors which may foster better adaptation to innovations. The curricular innovations to incorporate come from the results of empirical education research, from new theoretical hypothesis about learning and processing information or, from the use of new ways to provide information and to communicate. STTIS selected the curricular innovations expressed in the scheme:



All the project has been informed by the view that the transmission of information is transformative in its nature. The preliminary information is encoded by the first transmitters, which drive their transformation; then it is decoded by the first receiver, namely, the teacher. When teachers use new information in the classroom (a new tool, an innovative approach, an innovative image, etc) it is decoded and thus transformed. Every single act of encoding and decoding leads to a transformation process. Significant changes can take place from the didactical intentions assigned by the designers.

Its has been adopted the view that innovations are not designed by the teachers themselves being only the transmitters. The project aims at knowing the conditions for science teachers to successfully implement in their classes some curricular innovations, to document the obstacles that they need to remove and to develop appropriate materials for reducing the effect of unfavourable factors. Its has been adopted the view that innovations are not designed by the teachers themselves being only the transmitters

3.3.2 Output-related objectives: Research Questions

RESEARCH QUESTION 1*: New Methodological approaches to Learning*

Parameter 1.1: *Results of the project with respect to the ICT-mediated innovations*

About the *use of selected informatics tools in the science classroom*, the issues which teachers face in constructing viable classroom events ('lessons') have much in common. This appears even though the schools range from difficult and disadvantaged schools to select and advantaged schools; even though teachers' circumstances vary from considerable expertise to relative lack of expertise; despite variations in the supply and availability of informatics tools, despite differences in teaching traditions and practices, and even though national school structures vary considerably. (Final Report, p.7).

Informatics tools are not fully 'naturalised': The newness or novelty of the use of informatics tools is widely given a value of its own. In particular, teachers expect it to motivate students, to provide variety, to simply attract attention, to be "what the students want nowadays". We can say rather little about how the use of such tools might appear when (and if) they become habitual, that is, fully naturalised within the system (p.8)

Teacher transformations of the expected use of Computer Tools in science courses: According to the results, the implementation of IT entails a number of transformations or changes in expected use as an educational tool. The observed changes undertaken by teachers are as follows:

- Changes in the goals of proposed activities. Rather than using a given computer tool in a way allowing to achieve certain goals, teachers modify the crucial aspects of the activities that lead to such goals.
- Changes in the approach of some of the tasks carried out during teaching. When the chosen IT tool has been designed according to specific ways for practising certain tasks, it would appear that the approach to some of these tasks has been changed,

- Changes in cognitive demands made to the students. Several observations could be interpreted as a tendency to change cognitive demands originally planned in the curricular innovation
- Changes in the degree of student involvement. The role of teachers and students during class sessions depends often on their skills in the use of computers.
- Changes in the expected use of Computer Tools in order to comply more adequately with teachers' conditions. The use of the tool is not regarded in terms of manageability, but according to teacher's usual practice (Final Report p9.)

Parameter 1.2: *New teacher/student roles identified as a result of ICT based innovative pedagogical practices*

Teacher identity, personally and socially built, has largely remained steady up to the present time. Roles assigned by society and personally assumed by teachers are the following, information transmission; leading students' actions; knowledge of fixed and precise contents which are capable of being attained by students and contained in the textbook; responsibility for always providing the right answer to students' questions. Taking into account curricular innovations designed in the light of educational research, teachers are provided with new roles (that of facilitating students with the independent acquisition of new information; that of suggesting new activities through which students can independently build a knowledge domain; that of providing students with a multiple and varied range of materials, and particularly that of using facilities from IT technology). Given this view, it is easy to understand that teachers do not appear confident with respect to mastering knowledge and its classroom application, and that they are concerned that society will not comprehend their new role, for which they wish to be respected.

Essentially every case study shows a teacher trying to achieve a balance between the use of the computer, and habitual classroom practices with which that teacher and class are familiar. It is common to select only those aspects of the proposed teaching sequence that fit customary practice. However, a shift towards learner-centred computer use is favoured by openness to changes in the role of teacher and learner.

When analysing "transformation trends" when teachers implement innovations (WP4) an unexpected trend found by different research teams has been that of the change in teachers' roles when faced with innovative proposals in different fields (Final Report, p.75):

- Changes have been observed in the role of answering questions. In some cases, if teachers are uncertain about a given answer, questions are passed on to students. Teachers turn down questions posed by their students either by means of returning the question or by reformulating it. The leading role is inverted.
- When there is new computer equipment or a new computer application, teachers do not explain how it works; this task is passed on to the most skilful students who manage to display it to their peers.
- As far as RT graphs are concerned, some teachers allow students at the keyboard to decide how to optimise a given image for themselves, providing no correction whatsoever when students are not doing the optimisation task successfully. This is an unexpected change in teachers' role, since it effectively means that responsibility, with regard to visual language, is neglected.

- Some teachers have shown themselves to be more interested in scientific concepts themselves than in their students' learning process. Student errors are seen merely as the incorrect outcome, without any analysis being attempted of the underlying reasons explaining why the student has written or drawn something incorrectly.
- A further trend, perhaps related to the previous point, is that of only an over-preoccupation with students' state of mind. When students work in class, teachers are mainly concerned with maintaining a quiet and calm course group and encouraging their students to do well, but they do not attempt to understand the causes underlying the failure in their students' scientific reasoning.
- Teachers' roles also change when they are not those who decide class activities. When students are interested in a given activity, the original plan is altered. Teachers are flexible, and tend to accept students' proposals, thereby putting aside the expected goals of the originally planned proposal.

Overall, it can be concluded that the traditional teachers' role (i.e. that of being the only authority in class who decides what to do at each step, and whose most relevant role is to assess the answers, proposals and questions made) has been altered to a certain extent. However, it seems that these changes could be related to a lack of self-confidence more than to the acknowledgement of the new innovative roles being assigned to the teacher.

New student roles identified as a result of ICT based innovative pedagogical practices

The roles are in consonance with those assigned to teachers. In fact the project related the new roles with those changes in the role of the teacher and can be deduced from these changes, but in fact STTIS did not studied these changes.

Parameter 1.3: *Patterns of interaction*

We found little information about that matter.

Parameter 1.4: *Classroom organizational changes emerging as a result of ICT usage*

In dealing with the teacher transformations related to the use of computer Tools in science classes, and specifically with the teacher adaptation in order to use the Computer Tools in their science courses (p.39), the authors express that the use of IT tools in science courses presents teachers, and sometimes the school, with a new situation. If teachers assume the use of these new tools, among other advises they then should try to:

- Integrate the Computer Tools in the teaching process. Teachers may even, perhaps, plan a sequence of lessons containing the use of different Computer Tools in several steps.
- Plan the teaching sequence in order to get access to the computer-room when required (or use portable computers instead). A certain lack of adequate planning may have negative effects on the rhythm and timing of the teaching sequence.
- Invest the time allowed for Computer Tool use in a reasonable way, bearing in mind the pressure of time with regard to meeting syllabus requirements.

In short, the teachers' adaptation of Computer Tool use in the science courses would benefit from increased flexibility in the use of different educational resources, and in their management of space and time.

On the other hand, the teachers should adapt to contextual circumstances (p.76). The use of different innovations in science courses leads teachers (and sometimes the school itself) to adapt to a new situation. Some teachers analysed by the different research teams have altered the proposed activities in several ways:

- Compliance with constrictions concerning the use of space also affects teachers' performance of new proposals. In order to have access to the computer room or to have computer equipment in the lab, some teachers have to undertake a wide variety of 'manoeuvres'. The computer room has to be booked in advance in order to ensure full access throughout the pre-established time slot. Additionally, activities to be done in the computer room have to be planned in advance, since it is not always possible to discuss results, given that other groups sometimes share the computer room. This has led to splitting course groups and to establishing turns for running the desired software.
- Access to the central computer is not guaranteed to all students, so there is some sort of space constriction to be taken into account. Some students are only able to watch the activity of other classmates (or even the teacher) that is running on the central screen, and then load the data collected in class onto a portable computer or, simply load the complete software, so these objective circumstances have influenced the efficacy of the activities being carried out.

Parameter 1.5: *Cognitive aspects of learning mediated by ICT*

In analysing the changes in cognitive demands made to the students (p.44) in the science classroom, several instances could be interpreted as a tendency to change cognitive demands originally planned in the curricular innovation:

- Rather than being concerned with students' construction of a mental model of a computer set, teachers give instructions on what should be done step by step, without providing a general idea of tool constituents and how they work.
- Instead of enabling students to comprehend a concept or related group of concepts, teachers introduce concepts without relating them to each other.
- In preference to taking advantage of unexpected graphs (on screen) as a means of provoking cognitive conflict, teachers repeat graphs or sometimes even provide the "right" choice
- Rather than promoting the internalisation of the goals as a way of favouring self-regulation, the intended teaching activities turn out to be simply 'motivation tasks'
- As opposed to trying to elicit previous concepts, the corresponding teaching episodes consist of answering simple questions.
- Instead of promoting concept structure, problems are seen as challenges from which pupils and teacher can learn.

As a conclusion, even if the experiments were carefully designed, and the teachers had support to do the innovation, they mediate learning in a very traditional way.

In looking at the "Crossing national results from different teaching sequences", (WP3), when discussing the *planning of learners' activity, especially during practices*, the authors show that the cognitive structure of the students activity is not planned in the same detail as the practical aspects. Quasi unanimously, only global descriptions of activity are stated by teachers, no fine grained specifications of chaining, links, types of questioning, orientations of debate are specified (p.58).

In looking at general trends identified by the project with respect to general trends in innovation transformations done by teachers, STTIS states that in general there is a reduction on the cognitive demand on students (p.69). With respect to teachers' interest in affecting students' *cognitive* domains, several trends have been detected. Here we summarise some:

It has been observed that some teachers, though very few, turn every activity or problem into a cognitive challenge to be tackled by students. This is achieved by increasing cognitive demands in the proposed activities, seeking abstract similarities, implementing a PEC cycle (Predictions /Experiment/Comparison), etc. However, it has been observed, and in most of the cases studied, that teachers turn a proposed activity directed at cognitive development into a particular action to be carried out. Thus, for instance, students are asked to describe and classify objects rather than to provide coherent explanations. Or instead of explanation-based examinations, 'rote-learning' type examinations are proposed. Or that demands on reasoning are sometimes absent in experimental work, being reduced to the simple verification of previously taught laws. Tasks to be carried out are limited to copying data, not as a way of building certain concepts. Finally, although some teachers actually acknowledge that students' previous ideas and spontaneous statements about scientific concepts are relevant, they do not take advantage of this in order to build knowledge.

To sum up, it can be said that, when faced with innovative tasks, there is a widespread tendency to place poor cognitive demands on students.

Parameter 1.6: *Teachers/trainers and students attitudes towards ICT and ICT mediated learning*

The attitudes of teachers towards the use of ICT are subsumed in the documentation of the whole project but not specifically mentioned. Attitudes are nevertheless connected to teachers convictions. In the following we summarise STTIS position:

In analysing the factors that may influence teacher transformations, teachers convictions and beliefs about what they ought to be doing is relevant with respect to attitudes (p. 45).

Most teachers have strong convictions and beliefs about the value of computer tools, about the role they should play in teaching, and about the way they can facilitate learning and engage students. Any proposal concerning the use of computer tools is likely to be met with objections on the grounds of some conviction or other; these objections must be overcome if the proposal is to succeed. Some characteristic beliefs are:

- Convictions about the need to master use of computers:
  These range from believing that teaching students how to use an computer tool is central to studying science, to believing that such activity is a necessary task for

which the school must plan in advance. No teacher doubted the teaching investment that needed to be made, but they differed in their view of who should be making such investment.

- Convictions about goals for students
  Differences in teachers' beliefs about their own roles, and about what is important for learning, led them to emphasise differing qualities to computer tools: on the one hand, involvement and activity; and on the other hand, efficiency and the demands placed on students' reasoning.

- Convictions about efficiency
  Teachers claim that computer tools can, or should, save time, do things more efficiently, or do things faster or in greater quantity. However, the idea that the use of computer tools in teaching subtracts from total teaching time does not appear to survive experience of using them. Teachers are often struck by how much time is needed to discuss results, trace errors in a model and manage equipment. There is also the phenomenon that, by adding to what can be done, the computer is liable to add to what apparently needs to be done.

  Generally, tools which are not seen as delivering sufficient value, or that take too long to do so, will be rejected. Tools which offer something unique but important, and do so without taking too much time, stand a better chance of acceptance.

- Convictions about precision and correctness
  The consequences of the fact that computers generally produce definite, clear-cut and often well-presented results are not seen in the same way by all teachers. Some value the way computer use may circumvent student errors: giving the 'right' graph or the 'correct' ray diagram, for example. Others are concerned that students will too easily believe the computer, and take opportunities (such as the failure of certain integration algorithms) to stress that clear-cut result can be wrong.

Student attitudes towards ICT and ICT-mediated learning are not mentioned independently than that what is already been said about teacher attitudes.

Parameter 1.7: *Critical factors*

- *Factors that have an influence in learning mediated by ICT, including the affective dimension*

The main factors that influence the use of computers in schools are identified, where having data, by the teachers themselves to be the provision of relevant equipment and finance. These claims seem to be supported by the calculations and data of the previous part of the report. When prompted, teachers also identified training as an issue (p.35).

In dealing with the issues related to teachers' beliefs about their own identity and appraisal, STTIS poses some interesting issues that might influence teaching and learning, although the comments are more devoted to teaching (p.74). Teacher identity, personally and socially built, has largely remained steady up to the present time. Roles

assigned by society and personally assumed by teachers are the following, according to Van den Akker (1998): information transmission; leading students' actions; knowledge of fixed and precise contents which are capable of being attained by students and contained in the textbook; responsibility for always providing the right answer to students' questions. Taking into account curricular innovations designed in the light of educational research, teachers are provided with new roles (that of facilitating students with the independent acquisition of new information; that of suggesting new activities through which students can independently build a knowledge domain; that of providing students with a multiple and varied range of materials, and particularly that of using facilities from IT technology). Given this view, it is easy to understand that teachers do not appear confident with respect to mastering knowledge and its classroom application, and that they are concerned that society will not comprehend their new role, for which they wish to be respected.

Even if teachers that participated in the STTIS project are motivated and willing to apply innovations in their science courses, it is by no means clear that they have reached the stage "of reconstructing their own view for themselves as what it means to be a teacher of science" [according to the new assigned role].

In the use of computer tools, teachers' development can be traced back (from skeptisism to absolute enthusiasm, ending with moderate confidence) and it is interesting to observe that each one of these gives way to different student activities in classroom (p.82)

- *Socio-cultural factors that influence learning via ICT*

A general trend has been observed, which probably could not have been otherwise, for teachers to adjust activities to their traditional working habits. This may lead to difficulties when implementing innovations as it can give way to a certain reluctance or to conceptual and procedural alterations when adding new information to previous teaching content.

Teachers have been found who describes the traditional strategy of teaching concepts in a declarative way as "the" most efficient way for students to learn.

Teachers maintain their old routine without paying attention to the "critical details" specified in the new proposal (p.82)

RESEACH QUESTION 2: ***Institutional Innovation***

Parameter 2.1: *Main institutional changes*

In reading the reports we found little evidences of institutional changes studied or observed by STTIS

Parameter 2.2: *Staff training*

- *Staff training approaches tested/applied*

Chief element in STTIS. Talking about innovation in the training of Science teachers(p.24)**,** the training that many teachers have received has been mainly focused on the learning of classical scientific contents, and of some psychological and educational contents. Only some skills very close to the specific content are usually stressed. So, even interested in up-dating their work, starting 1997 STTIS found that:

- teachers without adequate experience in activities based on information technology tools
- some of the teachers with resistances to the changes that informatics support represents.
- teachers not well enough prepared to teach how to interpret symbolic representations, because of the difficulty of understanding the device when representations are displayed by computers or because of the difficulty of understanding the underlying concepts.

In the Information Society, the science teachers training processes need to be focused also on the use and experience with information technology tools having in mind that those change the focus and the content of the science and technology curriculum. (p.22)

Teacher training need to account for improving the adaptation of teachers to innovations. It is not enough to propose new materials or new tools in order to implement an educational innovation. The most critical phase in curricular innovation is its implementation in school praxis. Teachers play a decisive role as innovation transformers. When teachers are confronted with innovations, they do not act as passive transmitters of the intentions that inspired the originators of a given innovation. A crucial point for successful take up is how they receive the corresponding information.

- *The role of staff training in the project*

It was crucial. The proposal tried to contribute, from the starting point of science teacher training, to knowledge of the obstacles to reading graphically coded information and to propose ways to cope well with symbolic languages relevant in an Information society.

As an implication for teacher education STTIS show that trends in this study might be a good starting point for those teacher trainers interested in preparing teachers to take up curricular innovation. STTIS work, in this sense, provides descriptions of certain behavioural trends whose undesired effects could be then anticipated and/or avoided.(pag.73)

Parameter 2.3: *Main actors, adopters and resisters to the adoption of the innovation as identified in the projects*

The project concentrates basically on teachers. A central issue in the proposal is to analyse teachers' role and possible obstacles when confronted by innovations, and to investigate the factors that influence the quality of take up. A better mutual adaptation between teachers and innovation has to be fostered.

Many common learning-teaching difficulties can be addressed and overcome by activities based on real-time experiments on phenomena well known in terms of every-day knowledge. But such changes inevitably meet resistance from teachers who have not been trained in the use of such tools and whose concepts of the curriculum are formed by the existing curriculum, which indeed is shaped in part by the very lack of such tools in the past.

Parameter 2.4: *Organisational conditions*

This parameter was not present enough according to the documentation managed to make any significant input.

RESEARCH QUESTION 3: ***Socio-Economic aspect of Learning Innovations***

Parameter 3.1: *LLL paradigm*

We found very little evidences about dealing with LLL issues

Parameter 3.2: *Equity issues*

The project has not studied these variables, even when the schools range from difficult and disadvantaged schools to select and advantaged schools; even though teachers' circumstances vary from considerable expertise to relative lack of expertise; despite variations in the supply and availability of informatics tools, despite differences in teaching traditions and practices and obvious national differences. Actually STTIS generalise its findings based in this premises.

Parameter 3.3: *Socio-Cultural aspects regarding promotion of ICT mediated innovation and the use of ICT in learning environments.*

Not all the innovations exist in every country. Arising for this is that variations between national cultures and between content, kind and context of innovations, are inevitably mixed. This is a feature of reality in trans-European action of every kind. National cultures, structures and practices themselves help to determine the nature of innovations which are practicable or are thought desirable. Thus innovation can not be 'held constant' whilst national culture and context vary. It follows that analysis must treat this as a real phenomenon rather than as a methodological flaw. Results purporting to be about a kind of innovation need to be set in their national context, hypotheses about the effects of that context being made explicit. (p.33)

In looking at common conclusions across countries about the use of informatics tools on Science classes, the set of case studies from five European countries, together provide a resource one can draw upon to suggest hypotheses and conclusions which may be common to, or relevant to, experience across more than one country. Reading the case studies as a whole, "we are struck by the way, despite certain obvious national

differences, it would be in general rather easy to imagine any one case study as having arisen in a different country" (p.37).

In cross comparing the materials created by the partners, there is an indication that the effort done in this work has been to design research-based examples of teacher training, aimed at fostering the complex process of taking up a didactic innovation through materials which can be used in many ways. STTIS think that the prepared materials can make a contribute to this aim at a European level. (p.80)

In conclusion STTIS poses that even the curricula and the local conditions are different in the European countries, innovations of that type can be applied beyond the national borders.

3.3.3 Other aspects related to the innovative dimension of the project

Implicit definition of learning innovation as result of the project implementation?

Innovation seems to be twofold: on the one hand there is the innovation in itself, usually designed and "given" to teachers; but for STTIS the transformations (adaptations) teachers make of the designs become part of the innovation in itself.

The project aims at knowing the conditions for science teachers to successfully implement in their classes some curricular innovations, to document the obstacles that they need to remove and to develop appropriate materials for reducing the effect of unfavourable factors. "*Its has been adopted the view that innovations are not designed by the teachers themselves, being only the transmitters" (p.5)*. This is often the situation for teachers in many of the countries, even the level of curriculum' specificity takes large differences among European educational authorities.

The curricular innovations to incorporate come from the results of empirical education research, from new theoretical hypothesis about learning and processing information or, from the use of new ways to provide information and to communicate.

Teachers, being intermediaries between designers and students, play a major role in selecting, highlighting, interpreting and acting upon any proposed innovation. Therefore, it is worthwhile comparing the expressed aim with the actual use of the activities that should lead to this aim. The STTIS research teams are interested in knowing how teachers transform the innovations encountered and in seeking certain trends in the nature of these transformations. This knowledge could avoid a number of drawbacks with regard to an appropriate implementation (p.1)

The results as a whole, including a set of inferred teachers' transformation trends, enable STTIS to state that the introduction and naturalisation of didactic innovations is a complex and lengthy process. During the naturalisation process, many changes of the innovations may occur, since teachers adapt them to specific goals and objective circumstances. Internalising innovative approaches entails broad acceptance of their rationale, and also means becoming capable of implementing such approaches in different contexts and situations. These aspects should be taken into account in order to prevent or minimise reductive interpretations, and to favour the adoption of innovations

that is in resonance with the designers' didactic intentions, when explicit, or, if this is not the case, with the potentialities contained within such innovation.

Teachers need positive assistance in coping with the transfer of innovations into actual class-work, since this often implies not minor changes in their role. In order to acquire the know-how needed for a successful adoption of innovations, teachers need to be supported in becoming well aware of why innovations are being proposed and of the problems encountered in traditional teaching approaches.

To favour innovation uptake, appropriate teacher training is a crucial element, even if this alone cannot guarantee teachers' successful adoption of innovation. We need to bear in mind that the uptake of an innovative rationale is transversal with respect to content, even though implementation in class-work calls for specific content to be addressed.

Parameters considered in defining the "efficiency" of the innovation?

For STTIS, efficiency concepts are linked to the use of the computer tools. Teachers hold different convictions about the efficiency of the tools (p. 52) Teachers claim that computer tools can, or should, save time, do things more efficiently, or do things faster or in greater quantity. However, the idea that the use of computer tools in teaching subtracts from total teaching time does not appear to survive experience of using them. Teachers are often struck by how much time is needed to discuss results, trace errors in a model and manage equipment. There is also the phenomenon that, by adding to what can be done, the computer is liable to add to what apparently needs to be done.

On the other hand, the use of a ICT often shifts the focus of work rather than adding to it. For example, MBL (microcomputer-based laboratory) makes collecting and processing large amounts of information very efficient, thereby shifting the focus of work onto the arguably more important and valuable tasks of analysing, interpreting and discussing the data collected. The teacher does, of course, have to share this conviction about priorities.

Generally, tools which are not seen as delivering sufficient value, or that take too long to do so, will be rejected. Tools which offer something unique but important, and do so without taking too much time, stand a better chance of acceptance.

Parameters considered in defining the "effectiveness" of the innovation?

Closely relating the previous section the socio-educational value of the project is stressed at the level of teacher training. The approach of STTIS was to deal with situations that are close to what happens in the classrooms when introducing innovations in the schools. They emphasise how teachers transform the innovations previously given or designed by "experts". The need for a specific teacher training contents in innovating practices is stressed, so effectiveness is linked to this training

This teacher training should be based on an effective integration of the "new" approaches with the "old" (p.85). The training should address explicitly and extensively how the "old" approaches need to be avoided, modified, integrated with the "new". STTIS recommends strongly to use the case study strategy. Emphasis on problems deriving from

traditional teaching is also recommended, for instance through commented examples of both students' learning difficulties and inefficient teaching strategies.

Focus only on the "new" should be avoided; STTIS recommend to associate what is being and what was previously dealt with, and to explain and clarify the risk of conflating the "new" with the "old", which easily results in hypertrophy and/or incoherence of the teaching process.

Added value of ICT in the innovation(s) studied?

In this project the added value of ICT was obvious: many of the experiments in school labs can not be done without the use of ICT. ICT was a tool necessary for undertaking the experiments and observe how teachers transformed the learning sequences.

Evidences of sustainability of the experience

In our opinion this was not studied. But, as long as the teachers are trained, and the schools equipped, this type of innovation could be sustainable.

Are there evidences that would allow the innovations to be scalable?

In our opinion this was not studied. But, as long as the teachers are trained at national level, and the schools equipped, this type of innovation could be scalable.

Policy recommendations

Here we present the guidelines for policy recommendations suggested by STTIS (p. 88) in the final report:. The aim is to present suggestions for improving the design and implementation of teacher education programs and of didactic innovations

General recommendations

- *Internalising innovative approaches*

The introduction and naturalisation of didactic innovations is a complex process. Innovations in science education are increasingly needed to foster greater scientific literacy of the citizen. They are inevitably transformed by teachers who not passively implement the innovations' didactic intentions; thus innovations need to be flexible and robust. All didactic innovations to be fully naturalised, i.e. to be thought and used as natural and appropriate strategies/tools for teaching/learning, go through a "metabolic process" that may be long. Internalising innovative approaches entails broad acceptance of their rationale and also means becoming capable of implementing them in different contexts and situations and interpreting them in resonance with their didactic intentions and potentialities. The take-up of the innovative rationale is transversal with respect to contents, even though implementation in class-work calls for a specific content to be addressed.

- Appropriate teacher training programs

During the naturalisation process many changes of the innovations may occur since teachers adapt them to specific goals and objective circumstances. Teachers need positive assistance in coping with the transfer of innovations into actual class-work, since often this implies not minor changes in their role. In order to acquire the know-how needed for a successful adoption of innovations, teachers need to be supported in becoming well aware of why the innovations are proposed and of the problems encountered in traditional teaching approaches. Learning/teaching difficulties in science education are widespread and many have been thoroughly studied. In the current status of science education, still many problems are present and innovations may greatly help.

To favour the take-up of innovations, appropriate teacher training is a crucial element, even if this alone cannot guarantee successful innovation adoption by teachers. Thus policy-makers should trigger the implementations of appropriate teacher training programs, which greatly benefit from research-based recommendations.

Here some guidelines are presented, they are aimed at improving teacher training programs and at favouring the take-up of innovations. They refer to both the rationale of the training and to specific features of the training materials.

- *Innovations' take-up*

The training design and materials should be prepared taking into account that innovations are easier to accept if: - they address curriculum areas not presently taught but which teachers would value. In many systems this would involve the development of new curricula so that work on these new areas would not be seen as distracting from the syllabus content; - they address those curriculum areas taught but where teachers believe that present methods are ineffective. Experimentation is more likely to be viewed as reasonable if what exists is felt not to be good; - they address also disciplinary contents teachers are well familiar with.

- *Transparency of reasons for innovations*

The training should give grounded reasons for the proposed innovations, taking advantage of the science education (and related fields) research results, in order to improve acceptance of new approaches by teachers.

- *Effective integration of the "new" approaches with the "old"*

The training should address explicitly and extensively how the "old" approaches need to be avoided, modified, integrated with the "new". The use of case studies is strongly recommended. Emphasis on problems deriving from traditional teaching is recommended, for instance through commented examples of both students' learning difficulties and inefficient teaching strategies. Focus only on the "new" should be avoided; it is recommended to associate what is being and what was previously dealt with, and to explain and clarify the risk of conflating the "new" with the "old", which easily results in hypertrophy and/or incoherence of the teaching process.

- Focus on holistic view

The training should focus on helping the teachers become aware of and grasp an holistic view of innovation: topics, concepts, approaches, etc... The aim is to avoid or minimise the tendency to fragment a whole into small unrelated pieces. Emphasis on establishing links between activities, questions, specific episodes, different levels of language, etc, is highly recommended, for instance through analysis of examples and tasks about them.

- *Linking innovation rationale and critical details*

The critical details of an innovative approach, that may deeply affect its impact, are also the most difficult to communicate to teachers.
The training should explicitly explain, show and illustrate, through real cases, that without appropriate detailed actions the innovative effects are easily reduced or nullified. Special focus is needed on increasing teachers' awareness about careful planning of the cognitive dimensions of class activities as well as of their practical aspects.

- *Attention to language (oral, written, visual)*

The training should extensively explain and show the need to be extremely careful with all types of used language. For instance, this implies: - help to word in scientific terms what is expressed in everyday language, eliciting and overcoming possible conflicts; - attentive care in drawing, reading and interpreting graphs, schemas, diagrams, etc.; - analysis of the understanding of new scientific concepts proposed, to verify their correct adoption. It is also recommended the analysis of teaching materials (texts, images, activities, worksheets, etc.) which may reinforce students' previous erroneous conceptions and learning difficulties. Special attention should be paid to encourage students to interact verbally about the proposed tasks.

- *Reflections about possible transforming trends in taking up innovations*

The training should call attention upon the most common transformations and limited interpretations of innovations done by teachers in implementing innovations in current class-work, as, for instance, the transformations trends listed above. Analysis of examples and case studies is recommended, together with focus on practice, discussing, clarifying, considering alternatives, etc.

Attention needs to be called upon possible sources of conflicts deriving from current curricula/syllabi constraints and contextual circumstances.

4. Synthesis of the MERLIN case studies

4.1 Synopsis of cases analysed in WP 3

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

- 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 main goals of these projects are indicated here below:

- Knowing the conditions for science teachers to successfully implement in their classes some curricular innovations, to document the obstacles that they need to remove and to develop appropriate materials for reducing the effect of unfavourable factors.(STTIS)
- To investigate the cognitive and didactical aspects of effects of computer –supported collaborative Learning Networks (CLNs). CLNs are learning contexts in which equipment, information networks, but also teacher, learners and learning methods are included.(CL-NET)

The envisaged outcomes of the projects reveal that while all projects aim on improving methods, tools and technologies in education, the scope and focus are different. For example CL-NET ‘s envisaged outcomes are to make visible how CLNs enhance knowledge acquisition and building , with a major expectation that CLNs communication will become richer in content and varied. Others are investigate what kind of tools and support structures facilitate collaborative knowledge building and whether students will be enabled to be competent and active as self-regulated knowledge builders.

STTIS is focussing on reporting the state of the art on the use and value of informatics tools in five partner countries, a study of selected informatics tools in science classroom: computational modelling and simulation, and real time experiments and display systems. Other reports as teacher transformations in the use of computer tools, the use of images in sciences, difficulties arising when teachers are expected to adopt an innovative teaching sequence, general trends by teachers when facing different curricular innovations, elaboration of improved teaching trained materials, guidelines for policy makers to communicate the research results with suggestions for improving the design and implementation of teacher education programs and of didactic innovations.

The target population includes students from primary, secondary, vocational education and teachers experimenting with all kinds of software in CL-NET while in project STTIS the target population is teachers of science and technology classes in secondary schools.

As anticipated the learning scenarios are considerably different. The STTIS project studies the take up of innovations with respect to informatics tools used, symbolic representations and innovative teaching sequences for specific content. The project aims to improve scientific training for a European information society, making more room for innovation in the training of science teachers, improving their adaptation to innovation and contributing to a changing society.

In CL-NET, the main hypotheses were that CLNs can be introduced in regular schools effectively, it promotes collaborative knowledge building, improving the number and quality of communication between students, and it effects conceptual change, motivation, cooperation and metacognition of students. Cross-national communication using CLNs is possible and valuable.

Output related objectives

RESEARCH QUESTION 1: *New methodological approaches to learn*

Parameter 1.1: *Results of the project with respect to the innovations*

It was stated that in CL-Net all the major objectives have been achieved:
- Research on computer supported collaborative learning that aims to stimulate knowledge building was synthesised.
- Ways were found to introduce CSCL in schools: didactical models, design principles and use of CLNs in primary and secondary were developed.
- All countries experimented with different kinds of CLN-tools, and collaborative learning supported by computers were evaluated.
- One cross-national experiment had been carried out.

Relating to the use of selected informatics tools in the science classroom in the project STTIS, the issues which teachers face in constructing viable classroom events have much in common, even though the schools range from difficult and disadvantaged schools to select and advantaged, despite teachers expertise, availability of informatics tools, traditions and even though national school structures.

Informatics tools are not fully “naturalised”. The newness or novelty of the use of informatics tools is widely given a value of its own. Teachers expect it to motivate students and to provide variety.

Teacher transformations of the expected use of computer tools in science courses:
The implementation of IT entails a number of transformations or changes in the use as an educational tool. The observed changes undertaken by teachers are: Changes in the goals of proposed activities, in the approach of some of the tasks carried out during the teaching, in the cognitive demands made to the students, in the degree of student involvement, and in the expected use of computer tools in order to comply more adequately with teachers conditions.

Parameter 1.2: *New teacher and student roles identified as a result of ICT based innovative pedagogical practices*

There are indications of changes of teachers and student roles. The CL-NET first puts a great emphasis between teachers and between teachers and researchers. Meetings between teachers gave an opportunity to discuss problems and feelings, to involve more teachers into the project and to foster the perception of the role as researcher. The tasks of a teacher were complemented with new competencies, like information-management, time–management and group-management. The teacher must design
The curriculum and monitor and manage its progress. CSCL requires teachers ability in helping learners to follow their own learning route, to offer just-in-time feedback on their knowledge construction, and to scaffold them when they encounter difficulties as novices in many fields.

In the great majority of the case studies, collaboration between students was enhanced not only through communication at a distance , but also in dyads, small groups, and class-groups interactions, stimulating children to discuss and interacting to each other, making explicit their thinking that sometimes generated productive cognitive conflict.

Different phases of communication have been distinguished:
- communication in the classroom: The communication is mainly based on ideas generated by the class itself and it is very much influenced by the relationships between classmates. The communication generated by computer based activities show that kids are able to co-construct knowledge, and to activate argumentative skills and critical inquiring.
- communication explicitly aimed to an eternal audience: when well scaffold, this phase can be very productive, previous ideas are developed, new ideas are produced, and critical thinking appears
- communication at a distance supported by computers, analysis focused on define the interlocutor perception. Initial messages are referred to a vague interlocutor, later the content is more specific and it is observed a decentralization of the point of view.
- communication based on the external interlocutors contributions. It is based on the elaboration of the information coming from the partners outside the class. Pupils show to be critical reviewers and to be able to distinguish between formal aspects and the content f the messages.

The outputs of STTIS suggest that the teacher identity has largely remained steady up to the present time. Roles assigned by the society and assumed by teachers are information transmission, leading students actions, knowledge of fixed and precise contents which are capable of being attained by students. In the light of educational research, teachers are provided with new roles, facilitating students with the independent acquisition of new information, suggesting new activities through which students can independently build a knowledge domain, providing students with a multiple and varied range of materials, and particularly using facilities from IT technology. Every case study shows a teacher trying to achieve the balance between the use of the computer and habitual classroom practices. It is common to select only those aspect of the proposed teaching sequence that fit customary practice. A shift towards learned –centred computer use is favoured by openness to changes in the role of teacher and learner.

Changes have been observed in the role of answering questions, in some cases the questions are passed are passed on to students. When there is a new computer or computer application, teachers do not explain how it works and students have to manage to display it to their peers. Some teachers allow students at the keyboard to decide how to optimise a given image for themselves providing no correction. For some teachers student errors are seen merely as the incorrect outcome, without any analysis being attempted. Teachers are mainly concerned with maintaining a quiet and calm course group and encouraging their students to do well, but they do not attempt to understand the causes underlying the failure in their students scientific reasoning. Teachers roles also change when they are not those who decide class activities, and tend to accept students proposals. Traditional teachers role has been altered, however it seems that these changes could be related to a lack of self-confidence more than to the acknowledgement of the new innovative roles being assigned to the teacher.

Parameter 1.3: *Patterns of interactions*

We found little evidences on that matter.

Parameter 1.4: Classroom organizational changes emerging as a result of ICT usage

According to STTIS, the use of IT tools in science courses present teachers and sometimes school, with a new situation, where they should try to:
- integrate the computer tools in the teaching process
- Plan the teaching sequence in order to get access to the computer room when required
- invest the time allowed for computer tool use in a reasonable way.

In short, the teachers adaptation of computer tool use in the science courses would benefit from increased flexibility in the use of different educational resources, and in their management of space and time. On the other hand, the teachers should adapt to contextual circumstances.

CL-NET studies indicate that the introduction of computers itself affects the nature of the whole learning environment. They refer to learning of skills of using information technology, developing skills of basic knowledge acquisition, generally increased motivation, and accessing extended sources of information. It also involve changes in structures of classroom activities and changed division of cognitive labour between the teacher and the students.

Parameter 1.5: *Cognitive aspects of learning mediated by ICT*

In CL-NET , in the great majority of the cases studied, collaboration between students was enhanced not only through communication at a distance, but also in dyads, small groups and class-groups interactions. The findings show significant advantages for CSCL classrooms on standardised test scores for curricular domains like language and mathematics, but also on process-oriented measures, and these positive cognitive aspects can also be obtained in non-laboratory settings or at least in representative settings. It is

possible and feasible to significantly contribute to conceptual and cognitive development by means of CSCL systems.

In analysing the changes in cognitive demands made to the students by STTIS in the science classroom, several instances could be interpreted as a tendency to change cognitive demands originally planned in the curricular innovation. Teachers do not provide a general idea of tool constituents and how they work, they introduce concepts without relating them to each other, they repeat graphs or even provide the right choice in preference to provoke cognitive conflict, they do not promote the internalisation of the goals as a way of favouring self- regulation, teaching episodes consist of answering simple questions, and problems are seen as challenges from which pupils and teacher can learn. As a conclusion, even if the experiments were carefully designed, and the teachers had to support to do the innovation, they mediate learning in a very traditional way . STTIS states that in general there is a reduction on the cognitive demand on students. Demands on reasoning are sometimes absent in experimental work, being reduced to a simple verification. Although some teachers actually acknowledge that students previous ideas and spontaneous statements about scientific concepts are relevant, they do not advantage of this in order to build knowledge. When faced with innovative tasks, there is a widespread tendency to place poor cognitive demands on students.

Parameter 1.6: *Teachers and trainers attitudes towards ICT and ICT mediated learning*

CL-NET reports that teachers were very positive about the participation in the project. They declared they learned a lot, and they wanted to continue to work with CSILE, also in other domains. They had experienced realising a radical educational innovation in their rather traditional classroom practice and the numerous technical problems they had encountered during the project.

The motivational and meta-cognitive questionnaires gave some information about the attitudes towards cooperation. The CL-NET environment seems to have a significant positive impacts on pupil's beliefs and attitudes towards cooperative learning, but these findings were not supported by that from the open communication questions of the meta-cognitive questionnaire.

In the results of STTIS, the factors that may influence teacher transformations, convictions and beliefs about what they ought to be doing is relevant with respect to attitudes. Most teachers have strong convictions and beliefs about the value of computer tools. No teacher doubt the teaching investment that needed to be made, but they differed in their view of who should be making such investment.

Differences in teachers' beliefs about their own roles, and about what is important for learning, led them to emphasise differing qualities to computer tools: on the one hand, involvement and activity; and on the other hand, efficiency and the demands placed on students' reasoning.

Generally, tools which are not seen as delivering sufficient value, or that take too long to do so, will be rejected. Tools which offer something unique but important, and do so without taking too much time, stand a better chance of acceptance.

Some value the way the computer use may circumvent student errors. Students will too easily believe the computer , and take opportunities to stress that clear –cut result can be wrong

Parameter 1.7: *Affective and socio-cultural factors***.**

According to CL-NET, the main factors that have an influence in learning mediated by ICT are: school culture: Schools are still very much based on the traditional didactic triangle.

- timetable: schools timetables often leave little time for experiments, that diverge from the mainstream instruction.
- teachers: they need to be trained in being a guide and tutor , and not merely a transmitter of information. They need more technical know-how and expertise. In that way they will develop new learning methods and from their own learning community.
- materials: there are not enough didactical materials nor are there enough good examples to help teachers fulfil their new roles.
- planning: There is a need for theoretically well grounded development of CSCL practices and tools which are adequately embedded in practical educational context.
- technical support: more attention needs to be paid to technical support and ICT training in order to build efficient computer supported collaborative learning environments in the schools.
- international collaborative projects: They are a more specific elaboration of out-class computer-supported collaborative work and learning.

In STTIS, the main factors that influence the use of computers in schools are identified by the teachers themselves to be the provision of relevant equipment and finance, and it is interesting to observe that each one of these gives way to different student activities in classroom.

A general trend has been observed, which probably could not have been otherwise, teachers to adjust activities to their traditional working habits. This may lead to difficulties when implementing innovations as it can give way to a certain reluctance or to conceptual and procedural alterations when adding new information to previous teaching content.

Teachers have been found who describes the traditional strategy of teaching concepts in a declarative way as "the" most efficient way for students to learn.

RESEARCH QUESTION 2: ***Institutional innovation***

Parameter 2.1 *Main institutional changes*

CL-NET found that some of the case studies described in this report were "embedded" within on-going institutional interventions on a wider scale. These plans range from merely funding the schools for computer equipment to develop and implement school practices supported by technologies. However, very little was done to facilitate the re-structuring of the school practice, even in situations that could be considered as opportunities for testing changes under protected conditions. The project was experienced

as an extra-curricular activity: teachers and researchers were more or less given a "carte blanche" to implement the learning environment. The sole condition was that teachers had to finish the formal and official curriculum.

Parameter 2.2: *Staff training*

Researchers of the CL-Net project have provided both pedagogical and technical support. Good preparation among the teachers involved, respecting and creating 'golden rules' for communication and collaboration, monitoring and participating actively in the computer-supported interactions, enhancing the teachers' competences both regarding their pedagogic-didactic repertoire in general, their ability to offer scaffolds for learning, and an orientation for innovation, belong to the conditions to be satisfied if computer-supported collaborative learning is to conquer a place in temporary European classrooms. Technical support is also indispensable.

Staff training is a chief element in STTIS. The training that many teachers have received has been mainly focussed on the learning of classical scientific contents, and of some psychological and educational contents. Only some skills very close to the specific content are usually stressed. STTIS finds teachers without adequate experience in activities based on information technology tools, some of them with resistances to the changes that informatics support represents, and teachers not well prepared to teach how to interpret symbolic representations. In the information society, the science teachers training processes need to be focused also on the use and experience with information technology tools. Teacher training need to account for improving the adaptation of teachers to innovations.

Parameter 2.3: *Main actors, adopters, and resisters to the adoption of the innovation as identified in the projects*

To a certain extent, schools perceive experimental projects like CL-NET as external, as originating from motivation of agencies that pursue objectives related with scientific investigation, as accepted by the head of the institute for the school prestige, but not as a really productive tool for the benefit of their own school community. Furthermore, the educational system does not consider these kind of innovations as a reality of the teachers' profession and provide time to reflect on the practice, discuss and re-elaborate these innovations, still is considered as optional and a luxury.

According to STTIS, many common learning-teaching difficulties can be addressed and overcome by activities based on real-time experiments on phenomena well known in terms of every-day knowledge. But such changes inevitably meet resistance from teachers who have not been trained in the use of such tools and whose concepts of the curriculum are formed by the existing curriculum, which indeed is shaped in part by the very lack of such tools in the past.

Parameter 2.4: *Organizational conditions that are supportive to new learning processes (CL-NET)*

In short-medium term, the computers must be placed in the classroom in ways that facilitate collaborative learning rather than traditional frontal teaching. Similarly, network access must be possible from several places in the school and not only in certain restricted areas. In long term , in order to facilitate CSCL, a substantial change in pedagogical practices and in the wider culture of schooling is needed. There is a great need to develop a new generation of school architecture designed from the beginning for computer supporter learning environments.

RESEARCH QUESTION 3: ***Socio economic aspects of learning innovations***

Relating to this question little information and indications are given from the CL-NET project. However, some interesting aspects are given in STTIS.

Parameter 3.1: *LLL paradigm*

We found little evidences on that matter.

Parameter 3.2: *Equity issues*

Regarding equity issues CL-NET concluded there were gender differences in one of the components of the motivational questionnaire. The girls seem to have been particularly sensitive to the collaborative component of the experimental intervention, while no similar change has been detected for the boys.

Although a great deal of money have been spent to equip schools with computers, many schools, particularly elementary schools, do not yet have enough computers available for computer supported collaborative learning, or do not have the right kind of computers and the necessary network infrastructure.

Parameter 3.3: *Socio-cultural aspects regarding the use of ICT*

In STTIS difficulties were stated due to the variations between national cultures and between content, kind and context of innovations, which are inevitably confounded (mixed). National cultures, structures and practices themselves help to determine the nature of innovations. Thus innovation can not be 'held constant' whilst national culture and context vary. It follows that analysis must treat this as a real phenomenon rather than as a methodological flaw. Results purporting to be about a kind of innovation need to be set in their national context, hypotheses about the effects of that context being made explicit.

STTIS states the difference of curricula and the local conditions in the European countries. So far it is difficult to generalise innovative measures to be applied in Europe, beyond the national borders. It has been adopted the view that innovations are not designed by the teachers themselves being only the transmitters.

4.1.2 Other aspects

CL-Net mentions the introduction of 3 different innovations, relating to the didactics of collaborative and co-operative learning; learning with computers and inquiry learning / knowledge building. Furthermore it is stated that 2 different curricula where applied in the same time, given by the computer program and the classroom teaching concept. This might be considered as one of the weaknesses of the pedagogical concept applied.

In STTIS innovation is seen from 2 different perspectives: the innovation as such provided to the teachers and the transformation process (adaptations) by teachers for integration in the classroom. Furthermore the conditions for science teachers to successfully implement in their classes some curricular innovations were analysed, and the obstacles relating to removing and developing appropriate materials for reducing the effect of unfavourable factors were documented. The need for adequate teacher training is therefore pointed out in the project.

In STTIS efficiency is seen for the view of teachers who claim that computer tools can, or should, save time, do things more efficiently, or do things faster or in greater quantity and the aspects relating to the experiences with the integration into classroom which contradict the expectations.

Effectiveness in this project is very much related with the needs concerning teacher training of "new" approaches adding or replacing old ones.

4.2 Synthesis of case studies analysed in WP 2

As indicated in earlier Sections, projects DELILAH, IN-TELE, NET-Logo, PARLEUNET, PEDACTICE and REPRESENTATION do share common features in respect to their contents. The TSER Themes addressed by the reviewed projects are:

- 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. Focus on aspects that have not yet been frequently studied and 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, or on the cognitive aspects of the design and application of new technologies in education and training and project involved on evaluation and methodologies for new E&T products.
- Scenarios of applications of new approaches to enhance quality of education.

The relevant research tasks are slightly different, but all coincide 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.

The goals of these projects are outlined here below:

- to investigate the potential of new forms of learning arrangements for improving access to education and training for different groups, in particular excluded ones (DELILAH)
- 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 (IN-TELE)
- to establish and operate a European online reference point for the use of open-ended educational environments (NETLOGO)
- to allow secondary school students to use state-of-the-art networks and multimedia resources to learn about and collaborate on projects about the European Parliament (PARLEUNET)
- to explore the potentials and the context of ICT in teaching and learning (PEDACTICE)
- to develop a cartography of primary school pupils' representations about new technologies (REPRESENTATION)

The review of envisaged outcomes reveals that while all projects aim at improving media competence and critical approaches to learning using ICT, there is variation in the scope, focus, and depth. For example, IN-TELE, considered a holistic approach looking at creating, applying and testing the organizational, technological, pedagogical and psychological conditions (concerned more with teacher training) depending on experts to create learning materials and training courses, PARLEUNET focused on student and teachers creating learning materials by themselves for an area that isn’t quite defined in the school curriculum. Likewise, REPRESENTATION examined students perceptions of ICT across Europe using concept mapping tools and methods, whereas, NETLOGO’s orientation was on the establishment and operation of an online reference point for the use of open-ended educational environments, where “...NETLOGO web-server with 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” Educational software: a complete course for teachers n the use of Logo; Internet-platform for education, development of methodologies and operational models to encourage teachers participation in collaborative working schemes, evaluation of teaching and learning; Investigation into the potential market of NETLOGO products and services inside and outside the European Union, including Eastern Europe and USA; Elaboration of a technology implementation plan; production of a business plan for further investments needed and the potential incomes.

DELILAH’s envisaged outcome is the enhancement of our knowledge base on learning innovation at the levels of both theory and policy and practice, with emphasis on the issue of exclusion. PEDACTICE’s envisaged outcome is of a different nature in that this project aimed at the development of an ERML: European Resource Library, the evaluation of multimedia products. The two projects share an “intersection” in that both looked into the issue of organizational change –as did other projects. Again both their aims and results -great influence from the methodological approach, are different in that

the latter oriented the teaching-learning practices whereas DELILAH evaluated practices applied.

The target population in all five EMMTF projects is both students and teachers while projects NETLOGO, PEDACTICE and REPRESENTATION also include multimedia designers and developers, and policy makers as target groups. DELILAH varies considerably in that included in its target groups are the sectors of higher education, compulsory school, corporate and the socially excluded.

As anticipated the learning scenarios are considerably different; these range from virtual campus, schools network, open learning, training in the corporate sector and telematics training for voluntary community groups (DELILAH), to Internet based individualized skill development (IN-TELE); changing of roles between learners and trainers (as in NETLOGO) and to concept mapping at both the individual and classroom levels, on various topics such as environmental issues, history and every day issues (REPRESENTATION). In PEDACTICE, learning approaches related to different pedagogical concepts were implemented. "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". Networking and the Internet appear to be central.

The socio-economic elements projects aimed to respond to vary as well. Specifically, REPRESENTATION and DELILAH provide the educational decision makers with useful information regarding measures related to the implementation of ICT in schools. Further, REPRESENTATION via its action research approach and concept mapping methods aimed at unfolding aspects regarding ICT usage not easily revealed through more conventional research methods. IN-TELE, more focused on technological dimensions discussed the importance of "media competence" (the Internet based communication means here that media users are able to access, comprehend, evaluate and produce mediated contents), as one of the most significant media for social and economic life in a unifying Europe. A secondary focus in IN-TELE was on the development of a joint European identity –that not being perceived as a key factor, but rather as an instrumental one. NETLOGO intended to contribute significantly to the EU policies related to the application of "cross-cultural" tools in the learning process, enhancing teaching capabilities such as creativity, problem solving and student collaboration. This project addresses directly the needs for communication and collaborative work by providing a web site and a platform for remote communication of developers and other educational actors. PARLEUNET in turn looked at creating awareness about a European Institution (European Parliament), generally speaking about European citizenship being an area of study.

As indicated above, with respect to the socio-economic dimensions of TSER the projects fall, mainly, under the tasks of Areas II, 2nd Call: Methods, tools and technologies: quality and innovation in education and training.

Outputs of the projects

RESEARCH QUESTION 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 effectiveness is considered in the different innovations analysed?*

Parameter 1.2: ***New teacher and student roles***

There are indications of changes of teachers and students roles. A new understanding of the role of the teacher in Internet settings is mentioned in IN-TELE: Teachers express that they do not insist in being ahead anyway; They might see themselves already in a changed role, they accept that students know better in special fields and were ready to learn with and from them. This is also confirmed in the research of REPRESENTATION. The fact that teachers were not essentially more experienced than their students concerning their competence in using computer and new media, and that there was common development of tasks in the project (in which either side will take lead) resulted in new ways of teacher-student-interaction and teacher's and student's role-concept. Likewise, the outputs of NETLOGO suggest that social and active learning is encouraged by the use of ICT and that new pedagogical concepts enable students taking the role of the teacher to be more actively integrated in the teaching/learning process. This social dimension of collaborative learning requires attention in WP4. In the same line of thought PEDACTICE proposes that based on a general positive attitude of teachers towards multimedia, the teacher needs to acquire sufficient competence (information about, experiences) for applying it adequately in classroom; teachers regard their new roles as becoming facilitators (or guides) and student roles as more co-operatively interacting beings when using multimedia; teachers should become developers of software or be able to interact with developers; new pedagogical approaches include concepts for problem-based learning and project work. New required competencies include: understanding of the potential of the media, understanding the potential of educational multimedia, understanding constructivism, ICT-teaching strategies (independent responsibility for learning, differentiation of teaching, the use of students experiences from everyday life, problem-oriented work related to real-world objects, process-oriented work, cross-curricular work and holistic learning mix classes, forms and subjects, related with action leaning and situated learning, reflection and co-operative/team learning strategies; becoming a facilitator. "Multimedia literate teachers in the didactical sense of this concept are capable of guiding students who are accessing the educational content of multimedia products and on-line services. Furthermore, they are familiar with digital encyclopaedias. The Internet as an electronic extension of the classroom as well as multimedia products that comes along with textbooks. In particular, they know how to encourage their students to access and gather knowledge, analyse and sort it out, apply it, and create personal media messages, and to evaluate and judge them. In addition, by virtue of acquiring and practising multimedia didactical competencies, the teachers can teach students to become authors of multimedia products".

In REPRESENTATION, the action research approach demanded teacher's active participation in all aspects of the projects' activities. Teachers have worked as *partners* with the researchers and were able to use the research outcomes to help with planning and improving pupils' learning experiences with ICT, to make them appropriate to their needs within the curriculum framework of the school and country concerned. For

example, the analysis of the concept maps was available to the teachers to give them insights into pupils' representations of ICT. As a result of this new information teachers were able, if they wished, to change aspects of classroom management and pupil-machine-teacher interactions. Concept mapping development required a considerable shift from traditional teacher and pupil roles. Pupils assumed a more active role in the teaching/learning process engaging in individual or collaborative, project-based concept map construction and sharing. Teachers acted more as facilitators and coordinators of pupils' activities.
A consequence of the suggested change(s) described via the research outputs of the reviewed projects is the reappraisal of teachers' competence, roles and responsibilities.

A bit different from the changing paradigm suggested above is what was seen in PARLEUNET: Roles of participants were mainly associated to the problem solving approach and the collaborative learning strategy, and not necessarily to the use of ICT. The commonest roles adopted by students in the groups were: leader, expert, moderator, affective support, and secretary. In any case, it should be kept in mind that the actual role of the student will depend on the context, and more specifically on the assurance of the role by the teacher and by the rest of the group. The role played by the teachers in supporting and guiding the students' work, the role of the Member of the European Parliament in reducing ambiguity and fostering motivation towards the task, etc. are examples of the many variables that affected students' collaboration in the project. All these observations should make us consider the relative importance of the ICT tools in the context of similar settings such as PARLEUNET.

Parameter 1.3: ***Changes in patterns of teacher-student and student-student interactions as a result of the use of ICT***

The research results of DELILAH indicate the need for alteration of the traditional pedagogic triangle –learner, trainer, content and that this being sought in the educational sectors particularly with moves towards tutorial support systems which are not merely technical problem-solving aids but afford more personal support and mentoring. Suggested is that students and teachers alike have to develop autonomous learning strategies. This is confirmed in REPRESENTATION's results where in the constructivist pedagogical approach persued it was seen that interactions among teachers and pupils departed from traditional logo-centric, teacher-oriented interactions towards informal, exploratory and meaning making negotiation discourse. The changing patterns of interaction between the educational partners is also evident in the results of NETLOGO. Stated is that "With respect to communication, there was a rise in tension in the way information was perceived and used, i.e. information as an object versus information as a questionable source and as a means to communicate. The learning environment was a catalyst for the generation of communicative learning processes and the adoption of a social mode of thinking. Finally, with respect to communicating about constructions there was educational potential for in-depth interaction about actions and processes, about specificity in articulating constructional experience and in taking into account the experience of others. There was rich opportunity for reflection and for de-contextualization, two aspects of learning process which have been identified as critical to pupils understandings and at the same time very difficult to achieve in traditional settings." PEDACTICE further supports the notion that "Teachers see that the pupils have fun and enjoy their learning with the packages as much as they use the self-regulation potential of the products for motivation".

The significant changes in interaction among the actors of learning are linked to the parameter "changing roles". In PARLEUNET for example, the fact of working in teams was crucial not only for the student-student relationship but for the teacher-student interaction. The fact that these interactions were mediated by ICT tools suggest that ICT tools for students are tools of personal interaction more so than tools for productivity and exchange of information. This is supported by PARLEUNET when connected is that one of the important changes in patterns of teacher-student and student-student interactions as a result of it was the construction of group community, in virtual communities, is almost the opposite of what happens in classical pedagogy, where telephone calls or mail between colleagues, or students and teachers happens in between meetings.

Parameter 1.4: ***Ways the use of ICT change the organization of the classroom***

According to the DELILAH findings learning innovations challenge the teaching function and school culture which is dependent on the level of learning patrimony and different national learning patrimonies. It is proposed that new evaluation and accountability models which make the school more responsive to the wider society need to be developed for the guidance of policy makers and educators.

PEDACTICE provided us with an example manifested on which are constraining factors for the use of ICT in learning "… organizational exigencies force teachers using multimedia to teach in a less than optimal manner; in traditional structures students are usually not able to use ICT at their desk … one needs to have enough computers to teach effectively but computers are costly and have to be used intensively to justify the investment. Computers in classrooms are more adequate to teaching than using computer labs. Local experts are needed or staff with knowledge on ICT outwith the school, operating in a peripatetic role" (taken from content provided at the Case's template). Indicators of the changing arrangements are also seen in the outputs of PEDACTICE, where students were working half of the time during the class timetable.

The information gathered regarding this parameter is rather weak and inconclusive. Worth discussing however is what is reported in project NETLOGO where the change of organization in the classroom appears to be caused by the combined effect of the media and the approach applied to the teaching of the subject matter, in this case mathematics. The project reports that "We identified alternative epistemologies such as an ontological view that mathematics is an existing entity to be discovered and constructionist views. We observed different degrees in pedagogical emphasis on learning process versus outcome and on a paradigm of individual versus social learner. Finally there was tension between CIT versus mathematical perspectives to the BOE activity and different levels of importance given to tight planning versus open ended activity. In all cases, however, the important issue was the influence of the communicational medium on constructive mathematical activity. There was turbulence in the classroom activity which gave rise to focus and reflection on mathematical learning process. There was also rich opportunity for a more social rather than individual mode of mathematical learning and an orientation towards forming a new framework for planning classroom activity."

Parameter 1.5: ***Cognitive aspects of learning mediated by ICT***

The fact that there is real relationship between how to use ICT and cognitive changes in learning comes across rather strongly. However, many times this happens not due to ICT in itself, but on suffering the problem of using ICT. There are some interesting findings in the projects that are either implicitly or explicitly stated.

In PEDACTICE, for example, the issue of cognitive aspects is discussed in terms of the innovative learning products which "are exploiting the potential of the non-linear learning processes where the primary cognitive rationale is that of giving the scholars access to the media conceived as open and flexible: technological knowledge carrier". Stressed in NETLOGO, REPRESENTATION and PEDACTICE is the collaborative dimension of ICT in learning, in relation always to the epistemonological beliefs implied by the pedagogical model of the case. PARLEUNET reports that the fact that students were working half of the time during the class timetable suggest that changes could have occurred.

A central to the REPRESENTATION assumption was that concept mapping could facilitate pupils to represent what they knew and what they may come to know by constructing and reflecting upon their concept maps. Computer based concept mapping gives pupils access to graphical environment for knowledge representation and break away from the hegemony of written language in learning. Project findings indicate that many of the less-able pupils produce impressive concept maps and pupils who often achieve little using written expression could find a power voice using concept maps. These were produced with a relative ease and did not undermine the validity of content.

This parameter, central to the research themes reviewed, requires special attention in MERLIN's subsequent review phases both in terms of outcomes and methodological considerations made by 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, so as to give conclusive results. The team realizes the complexity involved in investigating cognitive aspects of media as it can not be isolated from the content and other socio-pedagogical factors.

Parameter 1.6: ***Attitudes of teachers, students and trainers***

Attitudes have been studied in different ways in the projects. The general trend is that teachers, and students alike, via engagement with ICT tools and products develop a positive attitude.

REPRESENTATION reports that teachers expressed a high degree of positive attitudes and dedication towards exploring new ways of using ICT in the teaching/learning processes and in applying Computer Based Concept Mapping to a wide spectrum of curriculum areas. In IN-TELE where the concern was on media competence and interpersonal communication it was found that teachers' recognition of shortage of skills and knowledge was considered as a serious deficit that was tried to be avoided. PEDACTICE, in its attempt to assess multimedia products found out that teachers today are less afraid of multimedia than they were ten years ago. The project reports that

teachers experience concerning planning, implementation and evaluation of the use of educational multimedia in class are strongly referred to the syllabus and teachers appreciate the aspect that of products enhance pupils' motivation and partly collaboration and that these products can be used in a variety of different ways. The suggestion for improvement of the educational multimedia products were mainly in the way that these should be designed (more open). Teachers wish for faster programmes, easier navigations, more diversity in presentation, task organization and levels of difficulty and better opportunities for self-regulation of learning.

The impression formulated from the results of the PARLEUNET project suggests a different impact in attitudes. In terms of students attitudes toward communication PARLEUNET investigated into the issues of:

- Do the attitudes of students towards communication in an intercultural environment change due to working in a rich technological environment?
- Do the attitudes of students towards communication in an intercultural environment change due to different forms of pedagogical support?

The project reports that there seems not to be an effect of participating in the PARLEUNET project on the attitudes towards intercultural communication. There is also no differential effect of pedagogical models, but the results are seen by the coordinators of the project as not definitive, given the technical problems they had.

Still it is noted that attitudes of teachers towards technology did not change that much in what respect to other subjects as "be media competent"; uncertainty or doubts about their own knowledge in front of students was considered negative by teachers.

PARLEUNET concludes that students attitudes towards communication are very much related to the well functioning of the ICT tools. This is implicitly implied in other projects i.e. PEDACTICE and REPRESENTATION

This parameter, as in the case of the parameter on cognitive aspects of ICT usage, the results are rather inconclusive suggesting that special attention needs to be paid on the results from projects reviewed in WPs 3, 4 and 7, under the scope of "innovations' effects on attitudes".

Parameter 1.7: ***Affective and socio-cultural factors***

This parameter is at the heart of the experiences of all projects but constitutes the focus point in project DELILAH. The various projects, dependant on their orientation, considered investigation in different socio-cultural aspects. Project DELILAH found within the *school sector* the greater resistance to "innovation". Organisational structures and curricular organisation were entrenched and time and resources in all cases were limited to begin the re-evaluation of what parts of curriculum were appropriate for ICT innovation. Evidence suggested that the most promising innovations derived from a careful examination of the curriculum and focusing innovation on those parts most appropriate for ICT delivery. Learning innovations challenge the teaching function and school culture which is dependent on the level of learning patrimony and different national learning patrimonies. Finally new evaluation and accountability models which

make the school more responsive to the wider society need to be developed for the guidance of policy makers and educators.

The results in project REPRESENTATION suggest that pupils from the upper class categories appear to have richer representations of ICT and that their knowledge on software and "computer processes" is much higher than in lower classes. Likewise, high achievers revealed richer representations of ICT devices and communication. In terms of the graphical representations regarding ICT the project further reveals that pupils in the Northern countries denote concepts on ICT with mode nodes and longer descriptions than those in the South, whereas the reverse is noted regarding the richness on ICT users. Significant differences were found at the country comparison level i.e. Spain and Greece contrasts on the representation of networks and on the richness in users. The project does state that although the findings outlined above may provide invaluable insight into the factors that influence pupils ICT representations further research is needed to confirm the results.

The transnational nature of the projects reviewed presupposes investigation and orientation towards linguistic and intercultural issues.
In the case of IN-TELE, The important socio-cultural factors that influence learning processes in this project were two:

- *Intercultural Stereotypes.*
  One of their assumptions for successful Internet-Based teaching and learning is that the teachers and students were able to explore the potential communication partners from other cultures and countries which were involved in IN-TELE (intercultural relationships).
- *The linguistic problem*:
  One potential barrier to the success of this project is the fact that they were involving schools using 4 different languages. All students were encouraged to use the material produced in the language of the other countries and this was integrated, where possible, into the language teaching in the schools. It is a distinct advantage of the UK schools that the Internet in general is English language based. They intend not to abuse this position and to try to make the central web site available to all. All schools were encouraged to hold key information pages about their schools in all the languages of the schools involved.

These issues emerged in REPRESENTATION as well, and in conjunction with the diverse school schedules constituted constraining factors to a rich and meaningful networking between schools in Europe.

Project PEDACTICE reports that adequate competencies of teachers lead to adequate access to multimedia and ICT based learning. The project holds the view that applying adequate pedagogical concepts results to better learning outcomes which in turn have positive consequences for lifelong learning, but in parallel stresses the fact that cultural diversity has to be taken into account.

RESEARCH QUESTION 2: ***Institutional innovations****: What were the specific effects of ICT in the innovation from the point of view of institutional/organisational factors on the following aspects*

Institutional level

- *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, specially in what respect to ODL*
- *Institutional/organisational change: main actors, adopters and resisters to the adoption of the innovation as identified in the projects*

Parameter 2.1: *Institutional changes*

DELILAH found that learning innovations across all the sectors under study require institutional changes of a wide and unexpected range. There seems evidence of a developing "culture of collaboration" in all sectors, a process in which industry is becoming heavily involved. The project anticipates that this process will effect the process of institutional change.

The issue of institutional change is rather poorly addressed in the research of the EMMTF projects. Project REPRESENTATION reports that no institutional changes resulted from the introduction of Computer Based Concept Mapping activities in the participating schools. This was intended as the project's methodological approach –action research based, did not allow for demands to be placed on schools that would lead to major alternations on the official institutional practices. Evidence regarding institutional changes is not provided in either NETLOGO nor IN-TELE. Of interest are the findings in PARLEUNET that clearly reveal that the organization of the school or the curriculum hampered the potential impact of the ICT innovation. This is also implied, yet not exclusively stated, in REPRESENTATION. Project PEDACTICE suggests that ICT can be catalytic to institutional change under a set of conditions. The project results in agreement with those in PARLEUNET, reveal that **there are still incredible barriers to the use of ICT in schools** –there is not full access to computing facilities and to the Internet; teachers still suffer from a lack of personnel preparedness and teachers need time to adjust to and absorb the implications of ICT in educational contexts; ICT products need planning before entering 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 of yet been felt. This is justifiable by the short duration of research projects and the short amount of time ICT is being utilized in the teaching/learning process. This area of study requires further investigation under a longitudinal study approach.

Parameter 2.2: *Role of staff training*

The importance in the role of staff training is as evident in the reviewed projects as is the changing roles of the actors. In DELILAH the training was found to be a prominent requirement in all four sectors studied. Likewise, the training of teachers in all countries under study indicated a recognition of the growing use of ICT in schools together with a

recognition of the new teaching roles expected within open systems. The sub parameters pointed out in the cases include the need for

- time allocations for training
- on line sufficient support provisions for applying the concept in the classroom
- training to be offered depending on teachers' experience novice, inter-mediate and expert levels
- on the job training in the sense of learning by doing
- usage of natural settings for training
- 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 teacher groups so as to allow teachers to talk about their experience and reflect the advantages and/or disadvantages of the Internet-method for school learning.

Parameter 2.3: *Main actors, adopters and resisters to the adoption of the innovation as identified in the projects*

In all projects the actors involved in the adoption of the innovation were teachers and students including teacher training schemes. In DELILAH it is the sector of schools, higher education, corporate and disadvantaged groups that are recipients of the fruits of the research activity.

Constraining factors identified include the lack of preparation of the school sector –both in terms of training of staff, equipment and organization, to adapt ICT in the learning/training process from a holistic perspective. The issue of teachers confidence levels regarding innovative work with ICT is rather predominant in all projects. 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.

Parameter 2.4: *Organizational conditions that are supportive to new learning processes*

This parameter is strongly linked to the one above and the content below might appear as contradictory to the statement on need for further research on constraining factors to innovation made above. The findings in DELILAH that support that "the lesser formalization and great flexibility of response to change of an education and training sector the better the results in terms of some IT based innovation" is supported by the result from the EMMTF projects.

PARLEUNET mention that on the organisational level, the school must be flexible enough to deal with the particularities of the educational innovation. Participating in an innovation that implies international collaboration, has the consequence that time slots will have to be found between different schools during which students can actually communicate with peers in other countries. However, this might mean that schools need to adapt their time tables. A similar issue concerns the willingness to step down from a strictly subject-oriented curriculum to allow the possibility to work with tasks not specifically related to one particular subject.

For PARLEUNET there is also a clear requirement for a better preparation of practical and organisational matter. Some rather 'basic' practical requirements will have to be met on school level in order to be able to successfully implement an innovation. For example there is a need for a good infrastructure that enables students to work collaboratively in their class as well as internationally. All the technological tools should function properly and in case of a technical problem, there should be an easy access to technical support.

The results in PEDACTICE are rich in this domain and prescribe "good practices" regarding organizational conditions that can be supporting of innovation in terms of educational multimedia. These are tightly linked to policy intensions. A similar analysis is found in project REPRESENTATION under the scope of "space for innovation in the curricular structures". Amongst the recommendation is that ICT facilities should be included within the classroom context instead of computer labs; there should be availability of local experts to which teachers can turn to for help; there should be interaction between the teachers and the content developer –REPRESENTATION further supports that there should be interaction between teachers and educational material tool designers. Furthermore, it is suggested that there should be supportive activities for improving use of ICT in classroom by availability of online teaching materials and distribution of all administrative documents via intranets and e-mails. The issue of investment focusing on the study of implementation of multimedia material, content and tool evaluation and teacher training are also considered (the set of recommendation that emerged from the PEDACTICE project regarding educational multimedia products appears in the case's notes in Annex II).

NETLOGO focus on the pedagogy and learning of materials via a site also makes a case regarding the integration of innovative processes and products into the school culture. Likewise, this project points out that accessibility of innovative processes and products is dependant on the schools ICT infrastructure and know-how but also on the local communication infrastructure. The results here point to the direction that given the "right" design –context dependent, an Internet service such as NETLOGO could be of use to a large variety of schools and systems.

RESEARCH QUESTION 3: *Socio-economic aspects involved in the ICT-based learning innovations: How do the outcomes of the project shed light to the following socio-economic aspects:*

- Life long learning: how ICT promoted LLL paradigm?
- Social exclusion: did ICT promote social exclusion or rather did new social opportunities? Equity issues, as for instance, if in the projects is described any change in the gaps in academic performance among subpopulations defined by gender, citizenship, entry level ability, socio-economic strata. If so, describe what has occurred and what evidences are done in the projects for attributing change to the use of ICT and how.
- Socio-Cultural aspects of using ICT

Parameter 3.1: *Ways of promoting the Lifelong Learning (LLL) paradigm by ICT experiences*

The indications from DELILAH are that the more intense the use of ICT the more relevant becomes the provision of opportunities for social support, including peer support. In such an environment learning becomes identity construction and facilitates the building of "communities of practice", which in turn enhance and realize the notion of lifelong learning. Similarly, in REPRESENTATION it is noticed that teachers' participation in the research process proved to be extremely motivating for their professional development and increased their interest and experience for lifelong learning practices. An important implication of the REPRESENTATION project is that the promotion of LLL can best be supported by encouraging teachers to create "communities of practice" which will take advantage of ICT opportunities and organize their activities, communicate and share materials and ideas. PEDACTICE refers to its activities implications for LLL in terms of students. No reference is made on this parameter by the reviewed materials for NETLOGO.

Parameter 3.2: *Equity issues*

While the implications of this parameter are of great importance to the orientation of the TSER Programme, the review of the results of the six projects reveals that it was not addressed by most of them.

Regarding equity issues DELILAH concluded that E&T in general for disadvantaged groups suffers from a serious precariousness of arrangements in all areas of its study. REPRESENTATION reveals that equity differences begin to play less critical role when people (teachers, students) directly implicate in the process and dedicate much effort and enthusiasm towards improving the quality of teaching and learning.

Parameter 3.3: *Socio-cultural aspects regarding the use of ICT*

Research results and their implication are discussed in parameter 1.6 above. What becomes clear is that in the majority of projects the information was provided in several languages. While REPRESENTATION's Computer Based Concept Mapping has multilingual functions and thus allows for multilingual communication/exchange of concept maps amongst teachers and students, the linguistic and socio-cultural aspects were rather poorly dealt in the project. The particular characteristic of IN-TELE in this respect –to deal with intercultural issues, looking at developing a shared identity as European citizens through computer mediated communication, was not adequately demonstrated. In PARLEUNET the fact that tools failed allows us to make clear conclusions on the matter and reflect on the need for further activity regarding the parameter.

Other aspects

The research results of innovation is not a simple process and depends on multiple factors.

- How do projects themselves define innovation as a result of their experiences?

"… a process emerging out of the interplay between on the one hand a learning patrimony, deeply rooted in Western education tradition of bounded institutional forms and a relative autonomy of both the educational sphere and educationalists and, on the other, a series of socio-economic factors and policy reforms mainly driven by such socio-economic factors." (DELILAH)

"… innovative aspects are defined in relation to the pedagogical approach, generating, cultivating and encouraging active and social learning." (NETLOGO)

"… Innovation depends on accomplishing concrete pre-conditions before the implementation begins. Innovation then needs a gradual introduction." (PARLEUNET)

- Other innovation related issues
  Projects appear to regard their pedagogical approaches –as earlier stated student centered in nature, as the most innovative component of their work. Projects like REPRESENTATION and NETLOGO where particular learning tools were applied consider these as innovative components as well. The question arises here regarding the degree to which these "innovative" methodologies and tools are sustainable both within the learning contexts these were developed/tested in and the greater community these came to serve the needs of. In all projects the component of "technology" is clearly supportive of the pedagogical approach applied.

- Learning Innovation: The project's perspective
  - Learning Innovation is mainly defined from the pedagogical perspective with respect to the changing teacher's role and new competencies required for improving teaching and learning by help of ICT (PEDACTICE)
  - Usage of technology/multimedia tools that encourage in teaching the process of learning and thinking (that encourage students to explore, to learn and to think) (NETLOGO)
  - The introduction and implementation of concept mapping, and in particular ICT based –concept mapping, for learning purposes in all areas of the school curriculum (REPRESENTATION)

- Efficiency in the project implementation
  The nature of the work carried out –identification of trends in learning innovation, coupled with the limited amount of time allocated to the work undertaken did not allow for the implementation of a monitoring scheme on the efficiency of project implementation. This parameter will be considered in the work of the three TSER projects that follows in the frame of MERLIN's third Work package

The work undertaken has facilitated the drawing of a provisional set of indicators for the parameters considered. Amongst the critical factors identified is that

- Innovation delivery is determined by the policy and innovation cycle of each country. Countries have different capacities for delivery innovation at a given pace (DELILAH)
- Learning outcomes can be improved by the integration of improved pedagogical concepts which can be applied if ICT is introduced into classrooms. ICT is seen as an important factor for achieving lifelong learning and to decrease barriers between school education and daily life school education and work place (PEDACTICE)

- ICT learning platforms can enhance linkage between the educational actors (NETLOGO)

The predominant critical aspects to consider in the study of learning innovation, as per the six project perspectives, are

- contexts
- local policy
- curricula
- infrastructure
- know-how
- confidence/competence levels
- transversality of factors

4.3 Reflections on the cases analysed

After the completion of the assessment of eight projects financed by the programme 1st and 2nd call of TSER and EMTF it can be stated that a wide area of objectives are addressed in the projects. Selected due to the strong socio-economic nature of components and intended outputs the cases address many important issues as mentioned in the programme calls and European policies. However, it is a challenging task to reach to a scalability of results in terms of the research questions addressed.

It can be observed that different methodologies of analysis and presentation of results in deliverables and final reports contribute to a difficult task to apply the developed research instruments sufficiently and to full satisfaction. Information not given in the reports does not necessarily mean that certain research issues were not addressed since interviews and other ways of interaction are not foreseen at this stage of the MERLIN project the documented material remains the only source for the assessment of issues. Furthermore it must be stated that the communication initiated with all project coordinators is often times not replied or only at an unsatisfactory level which makes a in-depth discussion almost impossible. Furthermore project reports were sent to the coordinators but feedback was low in many cases.

However, interesting results could be worked out so far, contributing to the project objectives and the finalisation of indicators to be applied in future work. Some recommendations can already be drafted at this stage relating to future policy in EU work programmes. It cannot be ignored that all of the cases studied are already completed and in some parts even "out-dated" concerning their degree of innovation. Insights gathered and documented within the projects are often times not anymore up-to-date and relevant for future policies since they were already taken into account at a later stage.

As presented in the previous section, the review of envisaged outcomes reveals that while all projects aim at improving media competence and critical approaches to learning using ICT, there is variation in the scope, focus, and depth. Most of the projects deal with technological and educational issues in school environments. Higher Education is addressed as well, but less present. All are mainly dealing with teachers and students as target population, but other target groups are addressed as well like developers and policy-makers. Although the learning scenarios differ very much from each project, there

is a common technological bases as the platform of research in most of the cases. Usually it is the Internet and its applications as the starting point of the developments and investigations. Collaborative teaching and learning issues appear to be the main issue which was considered to be important for analytical studies and learning scenarios.

RESEARCH QUESTION 1: ***New methodological approaches to learn***

Parameter 1.1: Results of the project with respect to the innovations

The cases demonstrate different levels in which "Innovation" is dealt with:
Development level: products to be developed for implementation and exploration in the educational context like courses, software, applications etc. (NETLOGO, REPRESENTATION, IN-TELE, NETLOGO, PARLEUNET, PEDACTICE, CL-NET, STTIS)

- Design and implementation level: Concept and product design relating to pedagogical, technological and organisational/institutional issues in different environments like schools, higher education etc. (REPRESENTATION, IN-TELE, NETLOGO, PARLEUNET, PEDACTICE, CL-NET, STTIS)
- Pedagogical level: Investigation of concepts, theories, practices relating to ICT in education, teacher/learner roles etc. (REPRESENTATION, DELILAH, IN-TELE, NETLOGO, PARLEUNET, PEDACTICE, CL-NET, STTIS)
- Empirical level : Investigation of experiences and consequences e.g. by the implementation of ICT (REPRESENTATION, DELILAH, IN-TELE, NETLOGO, PARLEUNET, PEDACTICE, CL-NET, STTIS)
- Contextual level addressing factors like social and cultural aspects in education with ICT (REPRESENTATION, DELILAH, IN-TELE, PARLEUNET, PEDACTICE)

All project also mention conditions for effective transfer and use of innovations in the educational context. Here the need of adequate teacher training (improving competence relating to the effective use of ICT) is pointed out as well as other requirements addressing technology, policy and economic issues.

Parameter 1.2: New teacher and student roles identified as a result of ICT based innovative pedagogical practices

The integration of ICT into education obviously changes the roles of the participants being involved. All projects deal with these aspects, some of the cases set a clear focus on the issues relating to new competencies and roles required. Projects mostly concentrate on new roles by teachers and learners, but in some cases other groups are involved in this process were taken into account as well. Management, policy-makers, technical staff, they all are involved in these activities and must be considered as well in order to come to a closer holistic view, necessary to understand the inter-dependencies and pitfalls within this process of implementing innovation into education.

Effects of the ICT implementation were analysed. New roles were described and reflected as well as many projects point out the needs in order to fulfil the requirements of these

roles. Next to teacher training it is the need in more research and investigation relating to teaching and learning as well as measures needed in policy and management.

In conclusion these new roles were related to:

- new pedagogical concepts (PARLEUNET, PEDACTICE, CL-Net, STTIS, IN-TELE, NETLOGO)
- new approaches to learning (PARLEUNET, PEDACTICE, CL-Net, STTIS IN-TELE, NETLOGO)
- new technologies applied in the classroom (PEDACTICE, CL-Net, STTIS IN-TELE)
- new organisational conditions (PEDACTICE, CL-Net IN-TELE)
- new institutional requirements (PEDACTICE IN-TELE)

In many cases the shifting role of the teacher is described as becoming more a learner and moderator, supporting and guiding students work and needing more competencies in ICT and (new) pedagogical methods. Learners have to get used to working in groups, collaborating with others, sharing leadership (IN-TELE, CL-Net, REPRESENTATION, DELILAH, PEDACTICE, PARLEUNET).

Parameter 1.3: Patterns of interactions

All projects stress the difference to traditional teaching when ICT is implemented. In many cases the changes of patterns were stated and explored and needs outlined addressing the new pedagogical functions (REPRESENTATION, DELILAH, PEDACTICE, NETLOGO, CL-NET). These needs are especially related to constructivist approaches and explorative, participative/collaborative learning (REPRESENTATION, PEDACTICE, DELILAH). DELILAH and REPRESENTATION point out the triangle of teacher, student and content, but other factors could be taken into account as well on a broader context like technical staff and management (PEDACTICE). IN-TELE reflects about rich interpersonal relationships in “Virtual communities” which still need more investigation. Different modes of interaction are furthermore demonstrated in PARLEUNET.

Parameter 1.4: Classroom organizational changes emerging as a result of ICT usage

Organisational changes are addressed in most of the projects analysed. Not all of them put a clear focus on it but statements can be found reminding to organisational changes to be taken more into account when CIT is implemented in education. New evaluation and accountability models are proposed by DELILAH, whereas other projects like PEDACTICE point out that traditional organisational concepts need to be abandoned or updated. This applies as well for classroom curricula, time tables and organisational changes needed in order to respond to the new functions of teachers and students. ICT arrangements for classroom teaching are furthermore discussed as well in the PEDACTICE project.

Parameter 1.5: Cognitive aspects of learning mediated by ICT

In most of the projects cognitive aspects are not dealt explicitly. It is therefore difficult to make any statements and reflections on the cases relating to these issues. REPRESENTATION investigates concept mapping as an effective tools for improved teaching / learning activities.

These projects investigating aspects relating to collaborative learning (CL-Net, DELILAH, PEDACTICE, IN-TELE etc.) mention the positive affects of collaborative approaches on learning outcomes. STTIS studied the cognitive demand in students stating a reduction in comparison with traditional learning scenarios (e.g. reasoning).

Parameter 1.6: Teachers and trainers attitudes towards ICT and ICT mediated learning

Attitudes of teachers towards ICT were explored in many different ways and depths resulting in general or specific mostly positive statements in the cases analysed. Some projects (e.g. DELILAH, IN-TELE, PEDACTICE, STTIS) pointed out the inter-dependencies of competence and attitudes as well as the contextual frame which has important impact on the attitudes. As more confident teachers feel with the application of multimedia as better is their attitude towards ICT. But general attitudes towards ICT play a significant role as well as reported by the STTIS project. Furthermore the attitudes are very much depending on the products applied in classroom, but as figured out in the STTIS and PEDACTICE project there are different priorities in the inter-cultural context relating to aspects like contents, navigation, openness, definition of own role etc.

In the PARLEUNET project it was furthermore discussed whether using a questionnaire is an adequate tool for assessing attitudes. In general it remains a difficult task to find indicators and answers relating to attitudes. There are no research methods generally accepted as such. Instead of stand-alone a multi-mode approach is required.

Parameter 1.7: Affective and socio-cultural factors**.**

The results of the analysis of the cases relating to affective and socio-cultural factors are divers, but it can be stated that almost all projects dealt with these issues. Again some projects point out the teacher's competence and self-confidence affecting the use of ICT (REPRESENTATION, PEDACTICE, STTIS etc.). Further influence factors were listed in CL-Net, IN-TELE, PARLEUNET and REPRESENTATION as:

- language
- intercultural stereotypes
- roles and educational context (PARLEUNET, CL-NET)
- gender
- social class
- school achievement (ICT infrastructures) (STTIS, REPRESENTATION etc.)
- computer availability at home
- curricula, time-tables etc. (CL-NET)
- material (Availability, quality) (CL-NET)
- technical support (CL-NET)

Geographical differences (North-South) were stated as well in PEDACTICE and REPRESENTATION but this might be related more to political and other socio-economic factors rather than the geographical position.

RESEARCH QUESTION 2*: Institutional innovation*

It can be stated that little information was gathered within the selected projects on institutional innovation. The reasons might be manifold, very much relating to different project objectives and topics to be investigated. However, a further reason might be that organisational development would need further and deeper consideration in future programmes and Calls.

Parameter 2.1 Main institutional changes

Due to different objectives and intended outputs some projects did not focus on institutional changes. As already stated in deliverable 2 the issue of institutional change is rather poorly addressed in the research of the EMMTF projects. These projects having this issues as a topic of discussion changes are stated but not very much explored. Barriers of using ICT are investigated in some cases (PARLEUNET, PEDACTICE) but there is a clear lack of indicators allowing a further research in depth.

Discussion on on-going institutional inventions on a wider scale deal with funding needed for ICT infrastructure in schools, development of practices and adequate implementation of ICT and applications (CL-NET).

Parameter 2.2: Staff training

It was stressed in all projects that teacher/staff training is a crucial factor for the success of innovative approaches. As in DELILAH, IN-TELE and PEDACTICE the needs were expressed relating to the role of staff training. These needs relate to

- the structure of training activities:
    - time allocations for training
    - training adapted to the user needs and competence (novice, inter-mediate and expert)
    - training prior to the introduction/implementation of the innovation in the classroom to avoid frustration of both teachers and students
    - technical support (CL-NET)
- the contents
    - Media and ICT
    - Theories and pedagogical concepts
    - Applications and integration in tradition classroom education
    - Development and design
    - Evaluation
- the environment
    - training organized on the bases of teamwork teacher groups so as to allow teachers to talk about their experience and reflect the advantages and/or disadvantages of the Internet-method for school learning.
    - support activities for application in the classroom

- different modes as “on the job training” and usage of natural settings for training

Parameter 2.3: Main actors, adopters, and resisters to the adoption of the innovation as identified in the projects

All projects focus on teachers and students as main actors in the process. However , sometimes other groups were taken into account as well: management, policy-makers, developers, technical staff, “content provider”. Furthermore teachers are identified in their different roles in learning scenarios with ICT as moderators, supporters, guiders, content producers, facilitators etc. (PEDACTICE) and in different educational environments as universities, schools and enterprises (DELILAH).

As already pointed out before, constraining factors identified include the lack of preparation of the school sector –both in terms of training of staff, equipment and organization, to adapt ICT in the learning/training process from a holistic perspective. The issue of teachers confidence levels regarding innovative work with ICT is rather predominant in all projects. 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.

Parameter 2.4: Organizational conditions that are supportive to new learning processes

Organisational conditions are linked with certain policy recommendations in several projects like PEDACTICE. The conditions are very much linked to the description of the main actors, adopters and resisters in the previous section. They relate to

- the role of the participating actors and the degree of their integration in the design of the process
- investments on infrastructures, teacher training, material and studies
- setting of ICT implementation (laboratories, integration of ICT in classroom etc.)
- ICT infrastructure
- Multi-dimensional evaluation of the pedagogical efficiency
- School curriculum
- Flexibility of application

Several projects like CL-Net and PEDACTICE point out the need of integration ICT directly into the classroom instead of laboratories. However, it is remarkable, that the organisational context of the discussion is limited to the school environment not taking into account the wider context of teaching and learning outside the classrooms. The learner’s workplace at home and at work should be reflected at well as the overall organisational context of teaching and learning based on different concepts than the traditional ones for education, separating places, actors and purpose of learning in their considerations. Furthermore a competency-based approach of education ignoring current curricula and other cultural specifities (traditions, legislation etc.) might be an interesting starting point of investigation.

RESEARCH QUESTION 3: ***Socio economic aspects of learning innovations***

Relating to this question little information and indications are given in most of the projects.

Parameter 3.1: LLL paradigm

It is difficult to summarize indicators which promote the lifelong learning paradigm, but in general it was pointed out in most of the projects that the active integration of participants (learners, teacher, other actors) are a good measure to support this paradigm. REPRESENTATION mentions the notion of the "community of practice" which make advantage of ICT to organise activities. Social support is one important stimulating factor for promoting lifelong learning as pointed out in DELILAH.

Parameter 3.2: Equity issues

Most of the projects analysed did not address equity issues. Gender issues were discussed in CL-Net as well the equality of chances relating to school equipment and the economical background of education (REPRESENTATION).

Parameter 3.3: Socio-cultural aspects regarding the use of ICT

Socio-cultural aspects regarding the use of ICT are also discussed in Parameter 1.6. Some projects point out the importance of addressing multi-lingual functions in product development (REPRESENTATION), but most of the projects fail to provide answers addressing trans-national and socio-cultural needs. Reports usually describe the differences (as STTIS) but without focussing on the potentials and needs relating to a common European approach.

Other indicators

The synthesis reports of the projects analysed mention and list other relevant aspects to be taken into account for investigation of innovation (see section 4.1 and 4.2). The picture that projects defined as the innovative part of their work is diverse and might not sufficiently contribute to any clearer approach on discussing innovation. Most of the cases point out the goal, objectives and their methodologies to be very innovative but finally fail in the reports to directly address innovative character of their project. Innovation usually relates either to the technological or the pedagogical approach. Information on efficiency and effectiveness are unsatisfactory . This might be important aspects to be promoted in future programme Calls as topic of investigation.

As already stated in deliverable 2, the critical aspects to consider in the study of learning innovation are the contexts, the local policy, the curricula, infrastructure, know-how, confidence/competence levels and transversality of factors.

4.4 Policy implications

So far only some of the projects analysed (DELILAH, REPRESENTATION, STTIS and PEDACTICE) 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. This is the case for STTIS and PEDACTICE, whereas other projects also address more general issues relating to equal opportunities, cross-European school cooperation and institutional and organisational changes. A synthesis of the information provided by the cases contributes to an update of policy recommendations worked out in Deliverable 2.

In general most of the project build on the current situation in education, making this to the starting point of their investigations. However, as discussed within the PEDACTICE project, political considerations should always take into account that ICT and multimedia as such cannot serve as a quick to solve problems of traditional education relating to resourcing, motivation, and standards. First teacher's use of technology must be understood before it becomes related this to policy contexts. 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.

Equal opportunities for ICT access and use for learning

Only a few projects 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 address directly address equity related issues. Research performed by 3 of the reviewed projects (REPRESENTATION, PEDACTICE and DELILAH) 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 apply 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 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 workers who lack the necessary ICT skills may avoid using computers and hence follow 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.

Cross-European school cooperation

Diversity in school curricula in different European countries pose important barriers in developing cross-European school cooperation. Especially, centrally-oriented curricula tend to be less flexible allowing little room for schools, teachers, classes and students 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 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 improves it cannot substitute synchronous communication. The development of educational software that would support alternative forms of representation for communication and knowledge objects' sharing could facilitate the initiation of interaction and collaboration among schools.

Institutional changes in education

The school sector was characterized by the reviewed projects as highly resistant to ICT innovation. The projects although recognize the need for institutional changes that could support innovation did not contributed to any considerable degree to this process because of their short duration. However, what it is suggested is 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.

Some direct suggested institutional measurements is the improvement of competencies as well as rewarding activities of teachers using ICT. Other suggested 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. It was mentioned that team-oriented schools might cope better the current demands related to ICT than other more individual-oriented where the exchange of information and collaboration is dealt on a lower level.

Organisational changes in education

A number of issues at a wide range of organizational conditions that are supportive to new learning processes emerged.. It was suggested by some projects to directly integrate ICT in the classroom instead of equipping computer labs. Equipping all classrooms with computers however may be proved a really heavy financial burden. Possibly it is more realistic to suggest that policies for introducing ICT in schools should consider a mixed solution where apart from a school lab, a smaller number of computers are also distributed to each classroom so that teachers and students may use them as a resource bank, for demonstration purposes or for quick Internet access to on-line learning materials. Next to sufficient infrastructure and online material, local experts should be available in every institution who could also ensure an effective interaction between teacher and developer/content producer. It was pointed by the PEDACTICE project that the use of ICT for educational purposes should be linked to administrative activities in education as well in order to ensure highest efficiency and effectiveness and to improve the overall benefits by providing ONE integrative environment.

Apart for such hardware arrangements, the potentials offered by ICT for communication and collaboration should be supported by policies that encourage cross-school and cross-country participation in joint projects. As it has already been suggested, changes in curricula towards more de-centralised and flexible perspectives could offer a more creative educational context for teachers and students alike. New forms of co-operation and teamwork among teachers should also be supported.

Teacher training

As pointed out in the recommendations given by the STTIS project 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. This position is taken by every project analysed. Policy recommendation should explicitly address the training and provide sufficient support for facilitating the ICT integration in the classroom.

While much emphasis has been placed in ICT introduction in schools, little have been said within policy documents to the effect that 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.

Some recommendations for the improvement of teacher training programs are listed by the STTIS project are:

- Curriculum areas should be addressed which are not presently taught or in which present methods are considered to be ineffective and they should address disciplinary contents which teachers are familiar with, if possible.
- Reasons for innovations should be justified and transparent
- "New" pedagogical approaches should be associated to "old" ones in order to verify benefits and limitations of both
- A holistic view on innovations in terms of topics, concepts, approaches etc. should be encouraged
- Innovation rationale and critical details should be well explained in terms of their potentials and limitations.
- Oral, written and visual language used (technical, scientific terms etc.) should be carefully applied
- Possibilities for reflection on the technology / innovation should be ensured.

All the above, in a very crucial way conclude to the development of new ways of teaching and learning. As it 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 growing student-centered 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.

Implied in the work undertaken by the projects reviewed and clustered in the frame of the MERLIN Project 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.

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. The evidence studied in MERLIN imply that conventional forms of teacher training appear as insufficient means for sustaining innovation in schools. 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.

The results further imply that sustainability and thereafter scalability of innovation in the education sector cannot be achieved unless all parties involved in the process adopt a positive attitude towards the demands attached concerning the changing role of the principle educational actors (teacher-student).

The organizational aspects of ICT based innovation ought to be considered from a holistic perspective and not simply at the classroom and teacher level.

The research results of the projects studied, while building on the effects of ICT implementation –mainly from a collaboration perspective, fail to inform us as to the cognitive effects. This suggests that supplementary research activity from a purely cognitive science perspective is needed, a position believed to have the support of the Research Directorate.

While all projects reviewed implied a constructionist approach to the building of knowledge, the research results do not provide enough quality insights regarding the different modes of interaction between learners and types of relationships achieved. This constitutes still another area for further consideration and investigation.

Likewise, while defining socio-economic factors that impede upon or facilitate ICT based innovation, the work undertaken does not provide sufficient evidence regarding the stimulation of these factors for the benefit of ICT-based innovation. Recommendations provided by the cases either do not cover all the aspects needed to design an adequate policy on a European base or sufficiently explain the needs in details, which could contribute to an effective overall plan. Further attention should be given on policy issues in the future projects to be analysed in MERLIN in order to reach satisfying results by the end of the project. Without question the socio-economic aspects of ICT based innovation in teaching/learning require special attention and perhaps a dedicated Action Plan/Research Initiative from the Research Directorate.

5. Analytical framework

5.1 Analysis considerations and methodological approaches

5.1.1 Aims of next phase

The aim of the following phase is apply the re-fined deductive methodology of research on a further set projects of the 3rd. TSER Call will be reviewed:

- *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 will in turn inform the development of policies and decisions regarding innovative methods and practices in learning environments mediated by the use of ICT. The aim is to deliver an Assessment report identifying the research themes by the indicators worked out so far, which then will be undertaken again by a process of refinement.

5.1.2 Validation of case reports

After two phases of studying analysis, applying and refining the instruments of research indicators a step “back” is needed in order to fulfil and to improve the approach of the following work packages. This mean that in the following phase the case reports need to be validated by the refined instruments, which then as well, will contribute to the validation of the developed instruments.

The case reports will be communicated to the co-ordinators of the selected projects who will then be asked to submit a position statement on these documents. This is an important measure in order to verify deficiencies of the assessment within MERLIN and to improve the quality of the reports on the cases.

5.1.3 Review methods of the next phase

As a consequence of problems already encountered in WP 2, further steps therefore had been implemented in WP 3:

- Double-assessment of cases by the MERLIN Consortium
- Communication of all reports to the projects and request for feedback
- Collection of feedback from co-ordinators of the projects analysed
- Revision of project reports

The template (instruments) developed and refined so far will be applied in the cases of the following WP. However, in order to ensure and even improve the quality of the research performed, additional measures will be envisaged in order to refine the methodology of the remaining cases to be analysed. The collection of evidence will be complemented by "verifying" the perception of the outputs of the projects. Additionally, as pointed out in Section 5.1.2 case reports analysed so far will be validated by direct

communication with the project coordinators. This will contribute to a further upgrade of the quality approach. Randomly selected project partners (2 each), coordinators or authors of Final Reports will be interviewed face-to-face relating to the idea of the MERLIN project and the benefits (value) of the projects outcomes in regard to the TSER objectives. Further indications on the innovative elements of the ICT-based approach will be figured out as well by the interviews. The participative approach adopted ensures quality assurance and reflects on the views of the actual project developers.

The work undertaken so far also contributed to the refinement of the methodological parameters for the subsequent analytical work.

Following the conclusions from section 4 on Policy implications further attention should be given to issues relating to the policy of ICT implementation. Comments and recommendations developed within projects should be focussed more explicitly with the aim to contribute to an improved European Policy on the effective integration of learning innovations in education by the end of the project, and to filter out these elements NOT covered by the cases so far. It is important that this step is taken in adequate time in the subsequent work packages for being able to design a sound framework of policy recommendations useful for future work in Europe, promoted and stimulated by EU programmes or possible action lines which could set a clearer focus on social-economic targets to be reached.

5.2 Indicators of innovation

5.2.1 Indicators of learning innovations using ICT

Wrapping up the analysis of the project done until now, and taking into account the above mentioned refinements of methodology for the next phase, we outline the main findings and a set of indicators that point to these results. Our purpose is not to try to generalise the findings to all contexts and educational sectors, but to shed light to the main characteristics and problems we find in ICT learning innovations, by tackling main characteristics and trends in ICT innovations.

The results presented has the status of provisional (as most of the results from the research in the field of social science) and work more as a reflective tool of analysis of this type of innovations rather than as unchangeable panorama covering all possible factors, or as the state-of-the art in the field. In fact we will use these factors and indicators as the main tool for the analysis during the next phase of the project.

We outline also the indicators of change and the code we have used, and will use, during the next phase of analysis.

5.2.1.1 Pedagogical factors affecting learning in ICT learning environments. Critical indicators

New teacher and student roles

The roles assigned by the society and assumed by teachers are information transmission, leading students actions, knowledge of fixed and precise contents which are capable of being attained by students: How are these roles changed? While new pedagogical strategies and ICT-supported learning are closely linked, it is not clear which of the two triggers innovation in the classroom.

The teacher

MERLIN has identified different teacher roles linked to the use of ICT. The roles are not necessarily new or a direct consequence of, but in some way they emerge from a new understanding of the role of the teacher in ICT and Internet settings in promoting innovations. Here we present some of the identified roles:

Teacher as learner in the classroom: Teachers might see themselves already in a changed role, they accept that students know more than they do in certain and are ready to learn with and from them. This is due to the fact that teachers can not essentially be more experienced than their students concerning competence in using computer and new media, and that could be some common development in project tasks. Such a collaborative approach leads to the acquisition of ICT competence by both actors.

Some of the results also suggest that teachers roles also change when they are not those who decide class activities, and tend to accept students proposals. Traditional teachers role has been altered, however it seems that these changes could be related to a lack of self-confidence more so than to the acknowledgement of the new innovative roles being assigned to the teacher.

Teacher as collaborator of 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 facilitator: teachers do not play a transmissive role. They play the role of facilitator, supporter, coordinator and/or guide of students' work

Teacher as developer: Teachers as educational software developers or input providers to software developers. Teachers also prepare educational materials both using ICT tools or about ICT.

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

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

The student

The roles of students appear to depend on the pedagogical approach used in classroom, on the context but specifically on the roles played by the teacher and the rest of the classroom members. Here we have some of the roles identified in using ICT:

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

Student as collaborator: students collaborate with other students and the teacher in project-based educational activities.

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

Indicators of change

Code	**Indicators**
TLCL	*Teacher as learner in the classroom*
TCST	*Teacher as collaborator of students*
TFAC	*Teacher as facilitator*
TDEV	*Teacher as developer*
TLLL	*Teacher as lifelong ICT trainee*
STEA	*Student as teacher*
SCOLL	*Student as collaborator*
SCOOP	*Student as co-operator*

Changes in patterns of teacher-student and student-student interactions as a "result" of the use of ICT

The research done in learning with ICT indicates the alteration of the traditional pedagogic triangle –learner, trainer, content and that this being sought in the educational sectors particularly with moves towards tutorial support systems which are not merely technical problem-solving aids but afford more personal support and mentoring.

This is connected to the constructivist pedagogical approach, where is seen that interactions among teachers and pupils departed from traditional logo-centric, teacher-

oriented interactions towards informal, exploratory and meaning making negotiation discourse.

With respect to communication, there is tension in the way information is perceived and used, i.e. information as an object versus information as a questionable source and as a means to communicate. A rich ICT learning environment using telecommunications might be a catalyst for the generation of communicative learning processes and the adoption of a social mode of thinking. In fact ICT tools are for students mainly tools of personal interaction, more than productivity and information exchange tools.

The significant changes in interaction among the actors of learning are linked to the changing roles of teachers and students. The fact of working in teams is crucial not only for the student-student relationship but for the teacher-student interaction. The fact that these interactions are mediated by ICT tools suggest that ICT tools for students are tools of personal interaction and not only for productivity and exchange of information.

Indicators of change in the patterns of interactions.

Code	**Indicators**
PEIN	*ICT as a tool for personal interaction and communication*
CLEPR	*Communicative learning processes*
INROL	*Interactions connected to new classroom roles*
VICOM	*Virtual communities*

Changes in the organisation of the classroom environment

In general learning innovations challenge the teaching function and school culture. One of the most significant changes concerns the ways the organisation of the classroom is affected. The changes in the teacher and students' roles and in interactions as a result of using ICT affect classroom organization as a whole. The teachers are required to adapt to these contextual changes.

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

Here we have some of the indicators most observed in innovations:

- *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 others, 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, specially if the learning experiences involve students from other classrooms or countries.

Indicators of change on organisation of the classroom environment

Code	Indicator
OLSP	*Organisation of learning spaces*
FLCT	*Flexible class timetable*

Cognitive aspects of learning mediated by ICT

This parameter, central to the research themes reviewed, requires special attention in MERLIN's subsequent review phases both in terms of outcomes and methodological considerations made by 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, so as to give conclusive results. The complexity involved in the investigation of cognitive aspects of media is recognized, as it can not be isolated from the content and other socio-pedagogical factors.

The fact that there is real relationship between how to use ICT and cognitive changes in learning comes across rather strongly. However, many times this happens not due to ICT in itself, but on suffering the problem of using ICT.

Nevertheless, there are some interesting findings in the projects that are either implicitly or explicitly stated. As stated above there is an epistemological approach to knowledge and learning towards constructivism in innovative experiences using ICT.

Some of the indicators for further analysis of projects are:

- *Knowledge representation*. Exploitation of alternative forms of knowledge representation and less dependence on verbal expression, as for instance concept mapping.
- *Socio-cultural aspects of cognition:* socio-cultural aspects of cognition as result of changing roles and interaction patterns
- *Cognitive strategies*: cognitive strategies used in ICT, as for instance collaborative strategies, open and scaffolding access to information, etc
- *Epistemological beliefs***:** beliefs about how knowledge is influenced by the use of ICT
- *Self-regulation strategies*: strategies to regulate learners' own learning processes
- *Meta-cognitive skills*: meta-cognitive skills involving the use of ICT

Indicators of change on cognitive aspects

Code	Indicators

KNRE	*Knowledge representation*
SCAC	*Socio-cultural aspects of cognition*
COSTR	*Cognitive strategies*
EPBE	*Epistemological beliefs*
SRST	*Self-regulation strategies*
MCOS	*Meta-cognitive skills*

Attitudes of teachers, students and trainers towards ICT

The general trend is that teachers, and students alike, via engagement with ICT tools and products develop positive attitudes. The trends on attitudes observed in innovation with ICT are explained below.

Attitude of teachers towards ICT appear to be depended on the three following components: *attitude of teachers depending on attitudes towards computer tools, towards the role they should play in teaching, towards the way they can facilitate learning and engage students.*

With respect to the *attitudes towards computer tools* there is a strong component of teacher awareness for demonstrating in front of the students to have a compelling media competence. Teachers could be uncomfortable students noticing that might fail when using the tools, and this a result that repeats heavily in all the environments in which the teacher plays very directive roles.

Teachers are also aware of having abilities enough to produce leaning materials using ICT tools. Serious shortage of these abilities might produce as a consequence that teachers wont feel sure with respect t its use.

Finally teachers appreciate the aspect that of products enhance pupils' motivation and partly collaboration and that these products can be used in a variety of different ways

With respect to the *role ICT play in teaching*, there is trend on ICT tools been integrated into the regular courses. Teachers appreciated that ICT use strongly refer to course syllabus.

But in general, 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 but important, and do so without taking too much time, stand a better chance of acceptance.

With respect to ICT *attitudes towards facilitating learning and engage students*, teachers experience concerning planning, implementation and evaluation of the use of ICT in class are strongly referred to the course syllabus, and teachers appreciate the aspect that of products enhance pupils' motivation and partly collaboration and that these products can be used in a variety of different ways

Some value the way the computer use may circumvent student errors. Students will too easily believe the computer, and take opportunities to stress that clearcut results can be wrong.

Attitudes of students towards ICT varies and are heavily dependent on the organisation of experiences and on the functioning of the tools. There are examples on how attitudes of students would dramatically change if these two conditions are not met.

We could barely find mentions about attitudes of Administrators towards ICT, which looks a promising area for further research.

Indicators of change on attitudes of actors with respect to ICT

Code	Indicator
ATCT	*Attitudes of Teachers towards computer tools*
ATR	*Attitudes of Teachers towards the role they play in teaching*
ATLE	***A**ttitude of teachers towards the way they can facilitate learning and the way they engage students*
ASICT	*Attitude of Students towards the use of ICT*
AAICT	*Attitude of administrators towards the use of ICT (not mentioned)*

Affective and socio-cultural factors

Affective factors
For teachers, many of the affective factors that influence the use of ICT are very much connected to their *professional identity*. If the professional identity changes as a result of the needs of the use of ICT and of the new learning approaches used, their professional identity sakes. Teacher identity is personally and socially built, and it is difficult to change

Given this view, it is easy to understand that teachers do not appear confident with respect to mastering knowledge and its classroom application, and that they are concerned that society will not comprehend their new role, for which they wish to be respected. Even if teachers are motivated and willing to apply ICT-based innovations, they confront with the need to reconstructing their own view for themselves as what it means to be a teacher.

Another affective factors are related to the *working habits.* Teachers do have regular working habits that can change as a result of an innovation. A general trend observed is that of teachers adjusting activities to their traditional working habits.

Teaches have limited time to engage in innovations using ICT, since they need to be supported by the institutions at all levels.

There is no doubt that students are influenced by affective factors. Nevertheless, we could not find much on the analysis. Further research is then needed in this area.

Indicators about affective factors

Code	Indicators
PROF	*Professional identity*
TWHA	*Teachers Working Habits*
INSUP	*Institutional support*

Socio-cultural factors

Socio-cultural factors

It is obvious that there are variations between national cultures and between content, kind and context of innovations, which are inevitably confounded (mixed). National cultures, structures and practices themselves help to determine the nature of innovations. Thus innovation can not be 'held constant' whilst national culture and context vary. It follows that analysis must treat this as a real phenomenon rather than as a methodological flaw.
Learning innovations challenge the teaching function and school culture which is dependent on the level of *learning patrimony* and different national learning patrimonies.

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

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.

When in trans-national projects, it should be obvious that *linguistic* and *intercultural* factors are issues to investigate. Intercultural stereotypes are also factors that are present on learners. The use of ICT might facilitate to fight these phenomena, but further research is needed. The use of educational materials in the local language looks 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* constitute constraining factors to a rich and meaningful networking between educational institutions in Europe.

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

Indicators of change on socio-cultural factors (mainly for international experiences)

Code	**Indicators**
PROF	*Intercultural Stereotypes*
TWHA	*Language*
INSUP	***C****ultural diversity*
ORFA	*Organisational factors as curricula, timetable, technical support,*
SOCL	*Social class*
NLPA	*National learning patrimony*
ECSUP	*Economic support to ICT innovations: infrastructures quality materials*

5.2.2 Institutional factors affecting Learning innovations

Main institutional changes and organisational conditions

There are still incredible barriers to the use of ICT in schools –there is not full access to computing facilities and to the Internet; teachers still suffer from a lack of personnel preparedness and teachers need time to adjust to and absorb the implications of ICT in educational contexts; ICT products need planning before entering the classroom.

The issue of institutional change is a rather difficult area of study, although the crucial importance of this factor on any innovation to be successful is well recognized. Introduction of ICT-based innovation require institutional changes of a wide and unexpected range. There seems evidence of a developing "culture of collaboration" among all actors (teachers, students, administrators) for successful institutionalisation of innovations.

Discussion on on-going institutional innovations on a wider scale deal with *funding* needed for ICT infrastructure in schools, development of practices and adequate implementation of ICT and applications.

There are crucial institutional barriers for successful use of ICT in schools, like for instance the *organization of the school or the curriculum* hamper in many cases the potential impact of the ICT innovation.

Furthermore, still many institutions do not have full access to computing facilities and to the Internet; teachers still suffer from a *lack of personnel preparedness* and teachers need time to adjust to and absorb the implications of ICT in educational contexts; ICT products need planning before entering 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 of yet been felt. This is justifiable by the *short duration of research projects* and the short amount of time ICT is being 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.

Although we envision a more large list here we have some of the more relevant for further analysis:

Indicators of change on *institutional changes*

Code	**Indicators**
FUIFR	*Funding for infrastructure, support and training*
INSBA	*Organization of the school or the curriculum*
FUAF	*Full access to facilities*
TPPRE	*Teachers and other personnel preparedness*
DUII	*Duration of innovative initiatives*
CUCOL	*Culture of collaboration among actors*
SUSIN	*Sustainability of innovations*

Organisational conditions

The organisational conditions of ICT innovations are clearly linked to the institutional situation and changes produced by the implementation of the experiences. At the end an ideal situation would be that the organisational conditions were the less disruptive but effective of the regular day-to-day of the institution, and that innovations were fully adopted by doing the necessary changes inside the institution. A fully *embedded innovation* within on-going institutional interventions is one that could be considered as successful.

Noticed was that there are organisational conditions that support the new learning processes. A *flexible school organisation* at all levels is one identified. The innovations need most of the time special conditions, and there are more specific when the ICT innovations are developed in an international partnership. Usually the institution (talking mainly about schools) won't place 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 also to adapt also their *time tables*, specially if the projects are international.

Another 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. The experiences can be facilitated if *network access* is possible from several places in the school and not only in certain restricted areas. In any case a substantial change in pedagogical practices and in the wider culture of schooling is needed. There is a great need to develop a new generation of *school architecture* designed from the beginning for computer supporter learning environments.

At the level of implementation of new learning materials there should be *interaction* between the teachers and the content developers, and investment on multimedia learning material by the school. Provision of *further educational support* via on-line teaching and learning materials is reported to be a helpful tool for schools

Indicators of change on *organisational conditions*

Code	**Indicators**
FLSO	*Flexible school organisation*
EMBIN	*Integration of innovations*
CUFL	*Curriculum flexibility*
FLTI	*Flexible timetables*
NEAC	*Network access*
SCAR	*School architecture*
INTD	*Interaction between the teachers and the content developer*
INMUL	*investment on multimedia learning materials*
EDSUP	*educational support via on-line*

Staff training

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 handling various components of the task, and to adjust their expectation in order to avoid frustration.

There is a recognition of the growing use of ICT in schools together with a recognition of the new teaching roles expected within open systems. The sub parameters pointed out in the cases include the need for:

- time allocations for training
- on line sufficient support provisions for applying the concept in the classroom
- training to be offered depending on teachers' experience novice, inter-mediate and expert levels
- on the job training in the sense of learning by doing, and applying the new knowledge in real learning situations
- usage of natural settings for training
- 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 teacher groups so as to allow teachers to talk about their experience and reflect the advantages and/or disadvantages of the Internet-method for school learning.

A set of competencies are at the heart of this need. Among others this are some of the required *ICT teacher competencies*:

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

Indicators of change on Staff training

Code	Indicators
TALLT	*Time allocations for training*
OLSUP	*On line support provisions for applying the concept in the classroom*
TBTE	*Training based on teachers' experience novice, inter-mediate and expert levels*
OJTR	*On the job training in the sense of learning by doing*
UNST	*Usage of natural settings for training*
TPIC	*Training prior to the introduction/implementation of the innovation in the classroom*

TOTT	*Training organized on the basis of teamwork teacher*
SAAC	*Support activities for applications in the classroom*
TSPEM	*Training syllabi: understanding the potential of educational multimedia*
TSTST	*Training syllabi: ICT-teaching strategies*
TSCAP	*Training syllabi: constructivist approaches in ICT practice*
TSITGM	*Training syllabi: information-management, time–management and group-management*

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

Main actors and adopters of the ICT-based innovations are teachers and students. There is no doubt about it since most projects focus on them. However, other groups need to be taken into account as well: management, policy-makers, developers, technical staff, "content provider".

The *adoption scope* differs: it can range from individual to been part of the teachers' (and students') practices or at the level of the whole institution; at the level of ICT successful innovations is actually close to that, since it improves the efficiency of the investment made. On the other hand, the school sector is resistant to ICT-based innovation due to institutional, organisational, hardware availability and staff-related factors (lack of teachers' training)

Among the constraining factors to take into account is the lack of *preparation* of the school as a whole –both in terms of training of staff (again), equipment and organization, to adapt ICT in the learning/training process from a holistic perspective. Again, the lack of *teachers confidence* levels regarding innovative work with ICT is also a factor worth investigating into. 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

Indicators of change

Code	Indicators
SADI	*Scope of the adoption of innovations*
TRST	*Training of school teachers*
TCON	*teachers confidence*
FIGO	*finances and governance of education*
MMOCE	*means and methods to overcome constraining effects*

5.2.3 Socio-economic aspects of learning innovations

LLL paradigm and ICT learning innovations

It is difficult to summarize trends and indicators which promote the lifelong learning paradigm. Pointed out is that the active integration of actors (learners, teachers,

administrators) into the ICT learning experiences is a good measure to support this paradigm.

The creation of "*community of practice*" which make advantage of ICT to organise activities can pave the way for actors to get used to learn in these environments, and prepare them for further learning. To *get used to participate* in ICT-based educational research, projects and innovations is a prospective measure of future success in lifelong learning.

Social support is one important stimulating factor for promoting lifelong learning.

Indicators of change on LLL paradigm

Code	Indicators
INAC	*integration of actors*
CRCP	*Creation of communities of practice*
SOCSU	*Social support*
PAINN	*Participation in ICT innovations*

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 we have little evidences regarding this issue.

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) are the ones most usual. Such inequalities in ICT access and use are likely to affect students' academic achievement, future job prospects, and prosperity in an information society. In general *disadvantaged groups* suffers from a serious precariousness of arrangements in all areas of its study.

But equity differences begin to play less *critical role* if people (teachers, students) directly implicate in the process and dedicate much effort and enthusiasm towards improving the quality of teaching and learning.

Gender differences has been reported (girls look more sensitive to collaborative components), but this issue together with the equality of chances relating to school equipment and the economical background of education although mentioned need more attention in the future.

Indicators of change on Equity issues

Code	Indicators
DISGR	disadvantaged groups
EQIS	Equity differences
GEIS	Gender differences

5.2.4 Other aspects and innovative factors

Efficiency and effectiveness is a rather special issue in ICT learning innovations needing further research As others identified, this might be important aspects to be promoted in future programme Calls as topic of investigation.

There is a variety of innovation definitions depending on their focus and level of intervention. In general, with respect to innovativeness factor in ICT learning innovations, it usually relates either to the technological, organisational, cultural and pedagogical approach.

- There is a variety of innovation definitions across projects depending on their focus and level of intervention
- 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 improved pedagogical concepts which can be applied if ICT is introduced into classrooms
- ICT is seen as an important factor for achieving lifelong learning and to decrease barriers between school education and daily life school education and work place
- ICT learning platforms can enhance linkage between the educational actors
- Innovativeness in learning is closely related to
- student-centred learning approaches
- changing traditional teacher's role
- new competencies required for improving teaching and learning through ICT use
- the development and use of ICT tools and products
- Predominant critical aspects to consider in the study of learning innovation are
- contexts
- local policy
- curricula
- infrastructure
- know-how
- confidence/competence levels
- transversality of factors
- Sustainability of innovation is questionable in both development-test sites and the wider target contexts
- No monitory scheme for the projects' implementation efficiency was performed due to time-constrains and the nature of work undertaken

Based in these results, and trying to show trends in these area, here we present a list of possible factors to consider in the study of the innovativeness of a particular ICT-based learning experience:

Code	**Indicators**
PICEC	*policy and innovation cycle of each country*
CCDI	*Country capacities for delivery innovation at a given pace*
IIPC	*integration of improved pedagogical concepts in classrooms*
LEDA	*linkage between the educational actors based on ICT*
INNLE	*Innovativeness in learning*
SCLA	*student-centred learning approaches*
CTTR	*changing traditional teacher's role*
NCTL	*new competencies required in teaching and learning through ICT use*
DUTP	*development and use of ICT tools and products*
COINN	*Contexts of the innovation*
LOPO	*local policy*
CURR	*curriculum*
INFR	*infrastructure*
KNHW	*know-how*
COCO	*confidence/competence levels*
TRAFA	*transversality of factors*
SUIN	*Sustainability of innovation*
PIMEF	*projects' implementation efficiency*

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ANNEXES

Annex 1: Project descriptions

The **TSER** projects reviewed in WP 3, under the scope defined in Del. 1, are Project ERBSOE2CT972020 STTIS and ERBSOE1CT961017 CL-NET.

Science Teacher Training in An Information Society (STTIS)

Description from TSER Web-Site (http://improving-ser.sti.jrc.it)

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.

Evaluation of Science and Technology policy option in Europe (CL-NET)
(Description from project Web-Site)
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 teacher, 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.
The main goals of the project are:

1. To synthesize existing research on computer supported collaborative learning that aims to stimulate knowledge building
2. To find effective ways to introduce collaborative learning networks in schools
3. To develop didactical models, design principles and learning scenario's for the use of CLNs in primary and secondary education;
4. To experiment with different kinds of CLN-tools which support the learning process and the acquisition of knowledge building skills;
5. To evaluate the (meta)cognitive, motivational and social effects of collaborative learning, supported by computer networks.
6. To experiment with cross-national communication between schools.

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. They experiment and try to find the best ways to pose questions, to bring in materialized, to connect students with each other, to provide help, etc. Three kinds of methods will be used:

1. Protocols of communications between students and between students and teachers will be saved. Analysis of students' productions will be carried out by looking closely to their writings. They 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.
2. 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, meta-cognitive, and motivational effects of CLN's will be used and further developed.
3. 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

The TSER project reviewed in WP2, under the scope defined in Deliverable 1, is Project SOE1-CT95-2009 DELILAH.

DELILAH: Designing and Evaluating Learning Innovations and Learning Applications

DELILAH's intent was

"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." (http://improving-ser.sti.jrc.it/default/show.gx?Object.object_id=TSER----000000000000061A&_app.page=show-TSR.html)

The Educational Multimedia Task Force Projects offer examples of a wide range of leading-edge services, tools and technologies to support all European learners' needs. These projects involved/involve the full scope of public and private sectors, research centers, universities and cultural centers.

Details on the five projects constituting the sub-set of the reviewed EMMTF projects from the first round assessment, is given herebelow. The presentation here is based on the projects own description of their intended endeavors and results. These descriptions were drafted and provided to the EMMTF by the projects at the early phase of their lifecycles (http://www.proacte.com/projects/emtf/about.htm).

MERLIN anticipates that a certain degree of deviation has occurred between the intended and actual scope of activity and its results. While here the presentation is made in terms of "intends" the chapters that follow will discuss the projects in terms of the actual implementation process and results obtained.

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.

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. 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: 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 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". 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.

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.

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.

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.

Annex 2: Revised template: Instruments for Analysing each Individual Project

Context Related

The first step for the evaluation of the project is to define the operating context within which the project has been delivered. It determines the specific project's characteristics, specifically, those related to innovative approach to the use of ICT in learning.

Title of the project:

Programme and Call	
Research Task TSER	
Theme within TSER task	
Current Status	
Main goal	
Envisaged outcomes	
Socio-economic aspects	

Input Related

The objectives of the second level analysis step are:

- *To identify and assess the capabilities, strategies, and designs available in implementing the project as related to the MERLIN objectives. Determine what internal resources are/were needed.*
- *To identify the implementation process and refine the solution strategies and the procedural designs.*

PROJECT INPUT

Target population (academic level, sector, etc.)	
Statement of the problem	
Specific goal of the project	
Objectives of the project	
Research questions posed	
Methodology used	
Learning technologies applied	
ICT in the innovation studied (ICT arrangements)	
Learning scenario	
Main Learning issue(s) intended to study	

PROJECT-RELATED **OUTPUTS**

Research Question 1: New Methodological approaches to Learning

DIMENSIONS		***Qualitative Indicators of change***
Results of the project with respect to the ICT-mediated innovations		
Roles ***-New teacher roles identified as a result of ICT based innovative pedagogical practices*** ***-New student roles identified as a result of ICT based innovative pedagogical practices***		
Patterns of teacher-student, teacher-teacher and student-student interactions as a result of ICT mediated innovation		
Classroom organizational changes emerging as a result of ICT usage		
Cognitive aspects *(collaborative learning, problem-based learning, learning to learn, etc)*		
Attitudes ***-Teachers/trainers attitudes towards ICT and ICT mediated instructionlearning*** ***-Student attitudes towards ICT and ICT mediated learning***		
Critical Factors ***-Factors that have a influence in learning mediated by ICT, including the affective dimension*** ***-Socio-cultural factors that influence learning via ICT*** *-(both from a positive and negative perspective)*		

Research Question 2: Institutional Innovation

DIMENSIONS		Qualitative Indicators of change
Main institutional changes described as a result of the introduction of ICT into the existing structures.		
Staff Training ***-Staff training approaches tested/applied*** ***-The role of staff training in the project***		
Main actors, adopters and resisters to the adoption of the innovation as identified in the projects		
Organisational conditions that are supportive of the innovation *(short, medium and long term)*		

Research Question 3: Socio-Economic aspect of Learning Innovations

DIMENSIONS		Qualitative Indicators of change
LLL paradigm ***-Evidence regarding the promotion of the LLL paradigm*** ***-The role of ICT in the promotion of the LLL paradigm*** ***-Implied requirements for the promotion of the LLL paradigm***		
Equity issues: Evidence regarding socio-economicchanges promoted by ICT in terms of ***-gender*** ***-citizenship*** ***-socio-economic strata*** ***-age*** ***-other socio-economic parameters*** *(i.e. disadvantaged groups)*		
Socio-Cultural aspects ***-Socio-Cultural aspects regarding promotion of ICT mediated innovation*** ***-Socio-cultural aspects regarding the use of ICT in learning environments***		

Other aspects related to the innovative dimension of the project to be considered by the evaluator:

What appears to be innovative in the project outcomes (external perspective) as compared to what the project participants claimed ?	

What's the implicit definition of learning innovation as result of the project implementation?	

What parameters were considered in defining the "efficiency" of the **a. innovation** **b. the project**	

What parameters were considered in defining the "effectiveness" of the **a. innovation** **b. the project** **(e.g. costs comparison, socio-educational value, educational outcomes, media comparison, or other emergent factors)**	

How critical was the added value of ICT in the innovation(s) studied?	

Are there evidences that would allow the innovations to be sustainable?	

Are there evidences that would allow the innovations to be scalable?	

Are there evidences that would allow the innovations to be scalable?	