DELIVERABLE N 5

Project n°: SEAC-99-00066

Project Title: Monitoring and Evaluation of Research in Learning Innovations

Deliverable Type : Public

Project coordinator:
Mario Barajas Frutos, University of Barcelona (UB)

Partners:
Friedrich Scheuermann, Institute for Organisation and Learning, University of Innsbruck (IOL)
Katerina Kikis, Foundation for Research and Technology Hellas (FORTH)

Deliverable number: 5

Deliverable Title:

Report on the Thematic Review of TSER supported research results: Indicators on ICT-based learning innovations

Starting date: 01/10/01   **Duration:** 3 months

Date of issue of this report: 31/12/01

STATUS: Final

DISTRIBUTION: Public

NATURE: Report

WORKPACKAGE: WP 5

AUTHORS: Mario Barajas
                       Friedrich Scheuermann
                       Katerina Kikis

CONTACT: Mario Barajas (mbarajas@ariadna.d5.ub.es
                       mario.barajas@doe.d5.ub.es)
                       University of Barcelona, Department de Didàctica i Organització
                       Educativa

ABSTRACT: This report is project MERLIN's fifth deliverable. It is an account of the
                       assessment of research results of 11 TSER related projects under a
                       Thematic perspective. The cluster of themes addressed are: teaching and
                       learning methodologies, organizational and cross-cultural issues and
                       policy implications. The work described here draws input from
                       previously done work in the project. It extends the work in MERLIN in
                       that it refines the set of indicators identified through the in-depth reviews
                       on project results and aims to facilitate the subsequent phase of the
                       project which is the validation of the identified indicators. The
                       verification phase calls for the active engagement of partners from the 11
                       cases.

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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You see things and you say 'Why?' but I dream of things that never were and I say 'Why not?'

George Bernard Shaw

Introduction

The aim of this document is three-fold. On the one hand it aims to inform the reader of the MERLIN's objectives and the methodology followed in order to achieve the project goal. On the other hand it aims to provide a realistic account on the extend to which TSER supported research activity conducted in the frame of research projects in the area of Education and Training Innovation addressed and/or provided answers to the Programme's research concerns and on the bases of the results obtained to introduce the set of indicators which forms the bases for a dialogue between assessors and the participants of the cases/projects.

The structure of this report follows this three-fold perspective and is thus divided in three chapters where chapter one is an overview of the objectives and methodology, chapter two introduces, in a concise manner, the results obtained in in-depth review of 11 TSER supported/related projects –under the set of MERLIN transversal research questions, and chapter three describes the set of indicators that emerged from the work done. This set of indicators will be negotiated and refined in the subsequent phase of the project. The final set of indicators on new methods and practices in learning environments mediated by the use of ICT will be presented in the project's sixth Deliverable.

1.   Overview of the Objectives and Methodological Considerations

The principle operational objectives in MERLIN is the review of RTD results of a cluster of TSER and EMMTF projects in the area of learning innovation under a pre-defined set of factors. The project through an iterative process, is developing 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.

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. 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). By reviewing the intermediate and final reports of these clustered projects MERLIN is 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.

A first round review of projects facilitated the creation of the analytical thematic structure for the subsequent work, including the analysis of some TSER projects from the 3rd Call and whose objectives were related to the research concerns embedded in the project objectives.

The projects considered for review in the first round (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, placed in the 1st and 2nd TSER Call of the IV Framework Programme, were CL-NET, DELILAH and STTIS. The assessment of these projects have provided the frame for the in-depth review of the three cases analysed via a refined deductive methodology, in WP4, those being COMPETE, NATCCC-PS and IVETTE. This was done under the scope to inform the development of policies and decision making regarding innovative methods and practices in learning environments mediated by the use of ICT. The analysis of these projects facilitated the formulation of indicators which are reported in the section that follows. In the perspective given above it

is clear that MERLIN's scope of activity is not on the evaluation of the set of selected projects per se but rather on the assessment of their results in terms of their impact on Programme objectives and for the purpose of defining indicators for thematic areas for the assessment of currently on-going projects.

1.1.   Programme(s) Objectives

TSER Objectives and Orientation

The TSER objectives play a principle role in MERLIN in that these constitute the framework of objectives that the project has to respond to via the identification of "indicators of change". 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 below.

The TSER 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 through an investigation of 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 can facilitate the articulation of policy on E&T and the assessment of perspective research projects in the area. Embedded in MERLIN's concerns 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 sought to answer via the review of Community supported projects and their outcomes are based on the orientation and scope of the TSER Programme.

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 has undertaken 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.

Literature on the Task Force's framework and activity regards that the integrated 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 was 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.

1.2.   MERLIN Objectives

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.

As stated above the main aim of MERLIN is to review the results of a cluster of TSER projects from the Second and Third TSER Calls of the IV Framework Programme that have in their objectives an innovative approach to the use of ICT in learning. In doing so the aim is to identify a set of indicators of change which could be applied in future assessments

The project aims to capitalise on the results of the projects engaged as these were implemented in the different contexts, looking for approaches to innovation 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 factors that concern the MERLIN project are <u>efficiency in learning</u>, <u>institutional/organizational</u> and <u>socio-cultural change</u>.

The process which the project proposed to address its research concerns is through a frame which includes the actions of:

- Review and synthesis of results from final reports produced by a series of projects from the Joint Multimedia Call that have a TSER component, as well as from the 1st TSER Call, all of them belonging to the IV Framework Programme dealing with innovative teaching/learning practices mediated by the use of ICT.

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

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

- Assembled a group of experts from the above mentioned TSER projects, who will be asked to relate their results to a joint report about new methods and practices in learning environments mediated by the use of ICT, its efficiency, and its contribution to lifelong learning.

These actions are intended to:

- contribute to the development of policies in the area studied, by identifying common research trends, issues and policy recommendations among the projects selected, and synthesise the findings relevant to policy making in a draft report with recommendations for dissemination to the wider community of experts and policy makers.

- establish a framework for a European-wide discussion by combining results for said projects with experiences made by policy makers throughout the organisation of a workshop in order to prepare final recommendations for a new agenda for research.

1.3.   Methodological Considerations: The process followed in the building of indicators

MERLIN is an evaluation natured project. The project's evaluation orientation is that of Cluster Evaluation. Cluster Evaluation "is evaluation of program that has projects in multiple sites aimed at bringing about a common general change. … Each project develops its own strategy, to accomplish the program goal, uses its own human and fiscal resources to carry out its plans and has its own context" (Chelimsky, 1997, p. 396).

Cluster evaluation addresses the following questions:

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

The said orientation was selected amongst alternatives as its basic characteristics are: that it is holistic, it is outcome oriented, it seeks generalizable learning, and it involves frequent communications and collaborations among the partners. Cluster evaluation can be either formative or summative, but it has most frequently been both (id, p. 401).

Regarding the identification and formulation of "indicators of change" MERLIN is also a project of a *meta-evaluation* and reflective nature. *Meta-analysis* integrates the outcome estimated from multiple studies to arrive at an overall or summary judgement on the evaluation questions. The aim is, through a critical review of the outputs of the recent research projects of similar thematic orientation (Innovation in ICT-Assisted Learning), to activate a discourse between the "projects" (project outputs) and policy makers.

From an operational point of view MERLIN is assessing a cluster of already finished research projects from the Second Call of the former TSER programme as well as projects from the Joint Multimedia Call with a TSER component that have recently been completed. By reviewing the intermediate and final reports of these cases the project task is to identify the main scenarios, methodological trends, and prevailing learning scenarios with the use of ICT, as well as policy recommendations these projects produced.

The MERLIN clustering of cases follows a three steps approach where in the first step reviewed were a set of eight projects which facilitated the creation of an analytical thematic structure. This set of projects combined projects from the TSER Programme and the EMMTF, those being:
- *CL-NET*
- *Science Teacher Training in an Information Society*
- *PEDACTICE*
- *REPRESENTATION*
- *PARLEU-NET*
- *IN-TELE*
- *NET-LOGO*

Additionally, to these the *DELILAH* project was added, which, although belonging to the 1st Call, it in itself holds a methodological approach to the analysis of learning innovations. This project constituted a frame for the analysis/es of the other projects undertaken in MERLIN. (Details on the results obtained are reported on project Deliverables 02 and 03)

The second round assessment concerned the in-depth review of two of the three TSER supported projects (CL-NET and STTIS) under the scope of the factors that emerged after the review of the first round cases.

The work undertaken in the frame of WPs 2 and 3 (rounds 1 and 2) facilitated the identification of "indicators of change" for parameters that emerged from the review of cases. This was done with the design of a project specific instrument that was continuously refined on the basis of evidences supplied by the review of the cases. The second stage (third review round) involved the in-depth review of three Area II TSER projects (cluster: Innovation in Education and Training via Technology), COMPETE, NATCCC-PS and IVETTE, under the scope of MERLIN's thematic perspective with focus on:
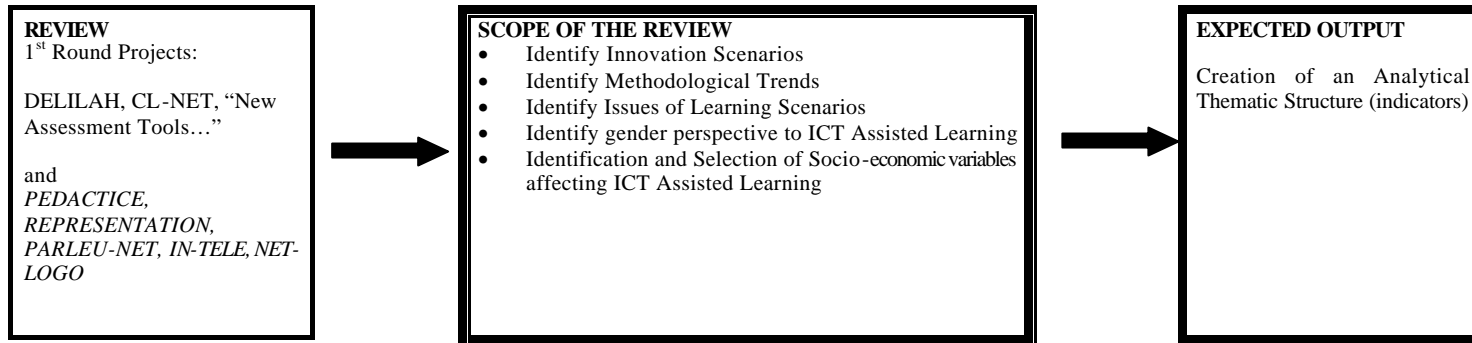
- identification of innovation scenarios
- identification of methodological trends
- identification of issues emerging from the learning scenarios
- identification of socio-cultural, institutional and organisational perspectives to ICT based learning
- identification and selection of socio-economic variables affecting ICT based learning

The review of the three projects considered in this sub-cluster suggests that there are distinct differences in terms of orientation, degree to which the focus was on the development, application and testing of learning technologies, and the extend to which these addressed the issue of innovation in learning. Given this diversity it was not recommendable to cluster the research findings of the three projects, but to rather treat these from a case-dependent perspective.
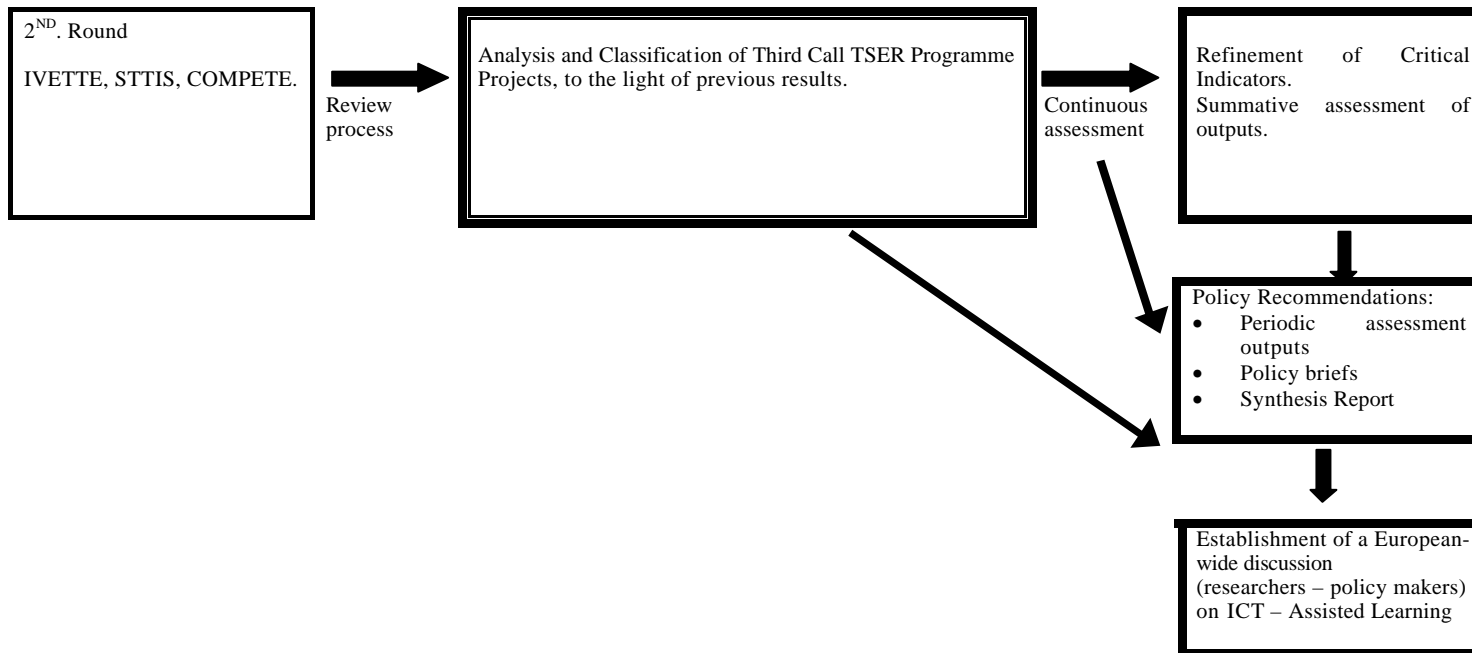
The review of the three projects offered a new insight on the indicators identified in the first stage review and added new ones to the preliminary list formulated by the MERLIN partners. These are outlined in chapter two that follows and are further elaborated upon in chapter 3.

A visual representation of the process followed is given below.

STAGE 1

REVIEW 1st Round Projects: DELILAH, CL-NET, "New Assessment Tools…" and *PEDACTICE, REPRESENTATION, PARLEU-NET, IN-TELE, NET-LOGO*	**SCOPE OF THE REVIEW** • Identify Innovation Scenarios • Identify Methodological Trends • Identify Issues of Learning Scenarios • Identify gender perspective to ICT Assisted Learning • Identification and Selection of Socio-economic variables affecting ICT Assisted Learning	**EXPECTED OUTPUT** Creation of an Analytical Thematic Structure (indicators)

STAGE 2

2ND. Round IVETTE, STTIS, COMPETE.	Analysis and Classification of Third Call TSER Programme Projects, to the light of previous results.	Refinement of Critical Indicators. Summative assessment of outputs.

Review process

Continuous assessment

Policy Recommendations:
• Periodic assessment outputs
• Policy briefs
• Synthesis Report

Establishment of a European-wide discussion (researchers – policy makers) on ICT – Assisted Learning

It should be noted here that in the process of development the project sought collaboration between itself and the cases reviewed. For a variety of reasons, external to the MERLIN partnership, a collaborative process in the review procedure was not possible to the desired degree.

2. Assessment Results of 11 projects/cases under the scope of MERLIN's research concerns

As earlier indicated the project assessed selected projects that revealed strong socio-economic components in a three-step approach. In the frame of the Workpackage Activity breakdown this approach was implemented as per:

>   Workpackage 2: EMMTF projects and DELILAH (six projects reviewed)
>   Workpackage 3: TSER 1st and 2nd round projects (three projects reviewed)
>   Workpackage 4: TSER 3rd Call projects (three projects reviewed)

The assessment revealed that the results of the cases addressed issues of socio-economic nature but the majority of these concentrated their activity in the pedagogics of ICT mediated innovation. The assessment facilitated the formulation of a set of parameters for each of the pre-defined transversal questions put forward by the project. These gave the bases for the formulation of a set of indicators, which were reconsidered in each of the steps taken.

The sections that follow outline the principle findings and place these in the context of the MERLIN research questions which in turn define the "indicators of change".

2.1   The extend to which TSER objectives were addressed in the cases reviewed

The first round review revealed that projects DELILAH, IN-TELE, NET-LOGO, PARLEU-NET, 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 in these projects were slightly different, but all coincided on doing research on *cognitive aspects of the design, application of new technologies in E&T, and evaluation and methodologies for new E&T products.*

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

Both of the second round projects, CL-NET and STTIS, approved in the second call of the programme TSER, 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 COMPETE project contributes to the socio-economic related objectives of the TSER Programme; namely the Programme's Area II (Research on education and training) which recognized on the one hand the demographic change in Europe and its cultural diversity, and on the other, the capabilities offered by new technologies. The perspective under which the Programme was set was:

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

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

Project IVETTE aimed at mapping out institutional, learning and cross-cultural factors that affect the implementation of virtual learning environments (VLE) and on the basis of such mapping to propose recommendations to stakeholders on strategies for promoting the implementations of VLEs.

The project's objectives are highly connected to those of the TSER Programme Area II (3rd Call). The project addressed specific problem areas outlined in the Programme's orientation, namely that of lifelong learning and educational goals, implications of societal developments for the education and training systems, educational implications of the European integration process, and education and training's contribution to fostering innovation.

2.2   Project/cases results under a set of transversal questions on learning/teaching innovations

The goals of the first round review 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 in section 2.1 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.

The main goals of the second review round 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 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.

The COMPETE Project was an attempt to facilitate skills and knowledge validation mechanisms for the purpose of enhancing the employability potential of Europeans. The project's findings suggest that at the current stage in Europe the creation of a European Skills Accreditation System is a rather premature consideration in that a variety of related-to-its-setting parameters need to first be investigated/tested/ developed. Specifically, the project reports that

"*Two key issues for COMPETE can be drawn from these results. Firstly, the complexity and the context-dependent nature of VET, accreditation and occupational/skills classification systems make it highly unlikely that 'skills standardisation' based on cross-walking and convergence between the systems in place in member states, is a realistic, or desirable, goal for COMPETE. This can to some extent be seen as a reflection of the complex 'learning patrimonies' associated with the cultural differentiation of vocational training and accreditation across Europe. A second the key problem for COMPETE is therefore to capture these kinds of 'patrimonies'; make them intelligible to users of COMPETE tools, and more importantly, find some way of drawing out the implications of these patrimonies with regard to factors such as the 'equivalence' of different qualifications. On the basis of a representation of the 'learning patrimony' of a member state, users of the COMPETE tools should be able to gain some sense of the value of qualifications issued within that member state; the way the accreditation system works; the way that work-based and informal learning is organised and accredited.*" [Final Report, p. 38]

The NATCCC-PS project, via its investigative efforts, reports and justifies that there is potential and added value in applying ICT in the assessment of learning activities based on current pedagogical thinking –i.e. problem solving. It further discusses the theoretical concept, model and approaches of the assessment of problem solving seen as one of four elements of the cross-curricular competencies needed to be benchmarked in European education. In an indirect way the project touches on issues of equity suggesting that the definition of indicators for assessment of problem solving learning situations improves the quality of education in European countries, contributes to better outcomes and new strategies and thus results to ensuring equal access and performance.

The project IVETTE research outputs focus on the themes of effectiveness of policies and actions, and methods, tools and technologies. The project brought into light that there is a great deal of diversification in the manner by which the conventional European institutions of higher learning perceive VLE's and the scope of their implementation within the institution. The project research findings are outlined herebelow in terms of the three themes investigated in the project:

Institutional issues
The work undertaken revealed that in many institutions VLEs are embedded within on-going institutional interventions on a wider scale, but in many VLE implementation still remains at the pilot phase, making difficult the way towards adoption.

Teaching/Learning issues
The project saw that within the context of new educational paradigms new functions can be characterised by the shift from traditional teaching as a content provider and "transmitter" towards a mentor guiding and supporting learners through the process of knowledge acquisition.

Cross-cultural issues

The issues of language and cultural differences constitute perhaps the two most important elements for consideration under this theme. Although there have been legislative resolutions referring to cultural diversity at the level of the member-states and Europe, it is observed that these have not been embraced by the educational policies of national educational authorities.

The assessment of cases of this selection relating to the 3rd Call of TSER programme demonstrates a low relevance of two projects in terms of the contribution to the MERLIN objectives. This is the case for "NATCCC-PS" and "COMPETE". Although the projects orientation and research issues clearly are of socio-economic nature focussing on important aspects in education the outcomes do not sufficiently contribute to new insights relating to educational innovation with ICT. The COMPETE research work was directed towards competence building, or better towards systems/platforms of competence tracing/ recording the definition of standards and the monitoring of skill development. NATCCC-PS concentrated on problem-solving issues, especially from a psychological point of view aiming at the definition of assessment tools for competencies in European education in order to contribute to improvements in process of (school) education. Both projects had been chosen for this cluster of research due to their high potential in addressing and providing useful information to some of the transversal MERLIN research questions. The results of the assessment of both cases finally came to the conclusion that they do not provide significant information in terms of the objectives raised by the MERLIN project in gathering monitoring phenomena and trends of innovation in education relating to teaching and learning methodologies, organisational and cross-cultural issues and related policy recommendations. Although indirect impact is given if target groups (esp. policy makers, stakeholders for educational strategy development) are sufficiently addressed by their needs and the outputs of the projects work, the orientation of the cases is too much focussed on topics which hardly can be transferred to the objectives posed by MERLIN.

In contrast to these cases "IVETTE" turned out to be highly valuable since its main goals and outcomes can directly be related to the MERLIN work. The goal of this project was to map out institutional, learning and cross-cultural factors that affect the implementation of virtual learning environments and to provide recommendations on strategies promoting its implementation. Based on the discussion of case studies, a set of reports on each factor and dimension was produced providing sufficient information on all transversal questions of MERLIN research. One of the reports reviewed is addressing directly the issue of innovative teaching and learning experiences while the others investigate results regarding experiences and potential in terms of pedagogy, the European diversity and institutional/organisational factors.

Concisely, major findings of IVETTE concern the financial restrictions regarding ICT innovation, the demand for more effective and efficient instructional structures, and the rush toward using the internet as a technical platform for the distribution of online study perpetuating the assumption that learning with ICT is the answer to the current problem. Our traditional models of designing education with ICT are insufficient to effectively deal with the challenges and barriers that we face as we create these new learning communities. Maintaining a balance between the interaction of the facets of organization, cooperation, collaboration, and learning against the needs and challenges presented by new media and new technologies requires new thinking with flexible models for education.

Relating to new methodological approaches to learning the IVETTE contributes to the definition of indicators for innovation by pointing out the differences between traditional education and education in virtual learning environments. Furthermore the "new" users of such environments were identified by defining their new roles (and attitudes) in virtual environments. This applies for teaching staff as well as for learners, technical staff and administration. But a clear focus is set on learners and teachers by the investigation of their relationships and aspects of "collaboration". Pedagogical concepts which were considered to be innovative very much relate to learning theories of constructivism. But "traditional" teaching methodologies are also present, which cast shadows over the innovative potential of virtual learning environments. Pedagogical models combining at different stages autonomous learning and project-based team work are usual, stressing the importance of the authonomy of the learner.

One strong dimension elaborated in the report is directed towards socio-cultural aspects that influence learning with ICT and cross-cultural barriers which can be characterised by several aspects such as language, calendar of courses and syllabus (curriculum). As language concerns, a careful language management approach is necessary, otherwise we wouldn't take advantage of the potential of virtual environments for crossing geographical borders.

Institutional innovation was mainly defined by new organisational structures required, cost-effectiveness and efficiency. Here, again, differences to traditional structures were worked out. The outlining of potentials contributes to the verification of MERLIN indicators for innovation. Flexibility is one important issue to be related with the requirements for the implementation and use of ICT in education. This influences the whole organisational structure of institutions to a large extent, including new needs for staff development and training and presents a crucial element for organisational conditions supportive for making benefit of ICT potentials. However, one of the main aspects for introducing innovation in education might be the question of financial support and funding of innovative initiatives.

Socio-economic aspects of learning innovation are identified in IVETTE in outlining the general role and benefits of ICT for the promotion of life long learning. Although these issues were not directly addressed within the projects there are numerous implicit factors which can be filtered out of the projects case studies and reports. Here, the influence of ICT on the society and user groups addressed is made clear but special attention is given to the need of available technical infrastructures for providing ACCESS and ensuring the APPLICATION and USE of educational innovation with ICT.

2.3   Cases response to MERLIN's Assessment Reports

In an attempt to minimize the extend to which the assessment of projects reflected only the views of the assessing team, requested from selected partners of the cases was the review of the assessment reports and responses as to the degree of their accuracy.

This exercise had a hidden agenda built into it as it aimed in an indirect manner to link the cases with MERLIN's forthcoming workshop. The level of response to the assessment reports is considered rather low. Amongst the reasons for the low response level is that partners in the cases reviewed are currently committed to other endeavours

which suggests that the interest in work conducted in the frame of EC supported research projects is significantly reduced once projects reach completion. Another reason might be connected to the high mobility of persons engaged in research activity.

MERLIN's request for review of its assessment reports of the cases clustered was responded to by participants of projects:
- REPRESENTATION
- CL-NET
- DELILAH.

All three report that the assessment reports produced in the frame of the MERLIN projects accurately describe their project's activity(ies) and research conclusions. None provided MERLIN with comments regarding the content of the reports.

The responses were of the forms
"*I declare that the report about … is a correct representation / summary of our project and results*",
"*In all it is my opinion that the report produces an adequate overview of the project*" and
"*I have reviewed the report and found only some minor formal issues:*
   1. *Many sentences are in present or future, while they should be in past.*
   2. *The way in which the results are presented could be improved by using assertive sentences instead of headings. For example: say "Disadvantaged groups suffer from precariousness of arrangements" instead of "Equity issues" only (p. 8). I think this could help to improve the readability of the report.*
   3. *I do not understand the last part, Other issues for the evaluator... I assume that your report follows a pre-established framework. If so, it's ok.*
For the rest, I feel very comfortable with the report. It reflects how ambitious the project was –and how abstract, as well."

2.4   Considerations for the building of indicators of change

As earlier stated the MERLIN project conducted its assessment activity under the scope of a set of three transversal research questions, those being:

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?*

The work conducted in MERLIN suggests that the prevailing factors for consideration relating to the project's first transverse research question (see section 1.2 above) are:

- New teacher and student roles
- Changes in the pattern of teacher-student and student-student interactions
- The ways the application of ICT changes the organization of the classroom
- Cognitive aspects of learning mediated by ICT
- Attitudes of teachers, students and trainers
- Socio-cultural backgrounds

The issues that emerged regarding institutional innovation are:
- institutional change
- staff training
- main actors involved
- adopters and resisters to the adoption of innovation
- organizational conditions supportive to new learning processes.

Aspects of socio-economic nature that appear to be addressed in the first level analysis include:
- ways of promotion the LLL paradigm by ICT based experiments
- equity issues
- socio-cultural aspects

The assessment done over a period of nine months facilitated the drawing of a provisional set of indicators for the parameters considered in the project. Amongst the <u>critical factors identified</u> in the cases reviewed are the following

- 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 <u>critical aspects</u> to consider in the study of learning innovation, as per the eight project perspectives, are
- contexts
- local policy
- curricula
- infrastructure
- know-how
- confidence/competence levels

The assessment of eight projects financed by the programme 1st and 2nd call of TSER and EMTF suggests 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. It is a challenging task however 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 project outcomes reveals that while all projects aimed 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.

3.   Research Trends, indicators of change and policy implications

3.1   The set of Indicators of change

The assessment, review and analysis of cases clustered in the MERLIN project have through an iterative process, guided the formulation of "indicators of change", which upon their validation by experts in the area of innovation in education, can contribute on the one hand to the assessment of research endeavours in the area under concern and on the other to the articulation of research policy. Reported in this chapter is the set of indicators which form the basis for a discussion amongst a group of European experts on innovation in Education, issues on research trends that emerged and the subsequent activity to be conducted in the project.

In doing the analysis o the projects we offer an insight on the indicators that point out to the uses of ICT in learning and on the more relevant functions and characteristics of that are present in the learning environment. In this section we outline the contribution of the analysis done to the refining of the parameters and the definition of the indicators previously used. The indicators are

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

Predominant Teacher roles

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

It is generally recognised that the roles 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? Linked to the use of the Web and other multimedia resources, in most of the ICT based learning settings, the role of the teacher as the *"knowledge" authority or as the transmitter of knowledge is in danger* when using extensively sources of information different than of the teacher, or changing the traditional roles of the teacher. Here we present some of the predominant roles found:

- *Teacher as learner in the classroom*: Teachers are accepting that students might 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.

- T*eachers as tutor:* among the many roles supporting the learning process, the tutoring role is one of the most recognised. The tutor's role is not just the subject matter expert but help to focus on the learning activities, solve doubts, update the contents.

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

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

- *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 developer*: Teacher develops learning materials mainly in electronic format, or provides input to professional developers.

- *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.

- *Teacher as a team of teachers:* In distributed *e*-Classrooms the teacher is more a "team of teachers" rather than an individual. This is because of the complexity of collaborative courses, as the international ones or other types of distributed learning arrangements.

Predominant Student roles

Teachers and students' roles are interdependent. If the role of the teacher is of moderator, tutor, etc, learners have to be self-reliant, active searchers for relevant information. A role of *self-reliant student* is connected to a less directed role of the teacher. This raised the level of students responsibility in learning.

The roles of students appear to depend on: a) the pedagogical approach used in classroom, b) the context but specifically on the roles played by the teacher, and c) the classroom piers. 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. This is particularly important in *e*-learning

- *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).

Patterns of teacher-student and student-student interactions

The significant changes in interaction among the actors of learning are linked to the changing roles of teachers and students. The fact of working in teams is crucial not only for the student-student relationship but for the teacher-student interaction.

In ICT-based learning there is an modification of the traditional pedagogic triangle – learner, trainer, content and that this being sought in the educational sectors. 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. This is particularly certain in a move towards tutoring functions of the teacher; even ICT-based tutorial support systems are not merely technical problem-solving aids but afford more personal support and mentoring.

With respect to communication patterns, 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.

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

Online interaction: the interactions based in the model of the *online community of learning* is strongly supported by ICT tools. Considerations about the type of communication should be taken into account at the time of studying the interactions: *one-direction or bi-directional, communication synchronous or asynchronous, spread geographically or not, one-to-one, small or large groups, moderated or unmoderated*, etc. Nevertheless, interactions among learning actors distributed geographically in large groups hold huge organizational problems**.**

Free interactions and relatively *unstructured discussions* amongst the group of learners on the different sites are common in teleconferences, but less in videoconferences. In these environments, if the pedagogical model is transmission-based *interaction is less direct* than in in-class learning, and possibilities for intervening are less than in traditional educational environments.

There are other drawbacks in online learning. Communication is currently done mainly by writing. *Writing poses many limitations: s*ince the style of writing tends to be minimalistic the choice of words get a different weight. This can lead to misinterpretations which trigger unforeseeable emotional reactions.

The establishment of *interactivity among tutors of learners* is then of crucial importance for the success of the learning experiences, no matter are one-to-one (individual learning) or one-to-many (learning in group).

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.

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:

-      *Flexible organization of learning spaces*: experiences using ICT change the physical location of the classroom from regular classroom to the lab, from the located classroom to the virtual classroom with more learners spread through other centres. The effectiveness of the different classroom organizations is a matter of discussion (for some teaching with ICT is more effective in classrooms than in labs) and there is not a conclusive solution. Computer availability in classrooms and/or labs affects, among 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.
  - *Teachers' workplace might be independent* of the course and there is some flexibility as to the hours of work.

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

- *Local virtual classroom,* done by only one institution, combining face-to-face with elements of virtuality in terms of classroom timetable, and virtual classroom space, is closer to the regular in-class model. The advantage is creating experiences with other learners from other institutions that otherwise couldn't be done. This model keep the local cohort of students as the centre of learning.

- *Virtual-centralised-classroom*, where the classroom and course organisation is set by only one institution. This model is fully virtual and fully distributed in terms of participants. Only one institution is in charge of or

- V*irtual distributed classroom* offering common courses, designing common course materials, seminars, distance tutoring with students of differing nationalities and cultures across Europe. A coordinating institution is necessary in order to manage the organisational problems.

Pedagogical strategies in using ICT

Although there is no given pedagogy in ICT-learning innovations (we might find very traditional strategies in using the most modern technologies), specific technologies tend to support particular models of teaching and learning. The didactical model is embedded in the experiences and mediated by the ICT tools.

The main pedagogical strategies used in most of the experiences are linked to *cognitivism* and *constructivism* paradigms. According to *cognitivism* learning is the process in which the learner acquires a proper understanding of the problem space; instruction consists of activities designed to facilitate the acquisition of the correct representation of knowledge by the learner.

With respect to *constructivism*, knowledge is distributed but constructed individually. So the focus is on the development of a suitable environment for acquiring knowledge rather than for its transfer. No major findings in this parameter.

Collaborative project learning methods based on inquiring learning require certain autonomous study skills from the students.

A pedagogical foundation spread in virtual learning is the model of *self-learning (also called independent work, autonomous learning, etc)***:** the learners in the model of virtual-centralised classroom are more self-reliable students seeking information interactively and managing their own learning than students in the other models.

Other usual pedagogical models *combine self-learning (specially in tertiary education and in training) and project-based team work***.** *Communicative* approaches to learning are a pedagogical approach in online learning that take advantage of the possibilities of communication among actors, and information seeking strategies.

Cognitive aspects of learning mediated by ICT

This parameter, central to the research themes reviewed, required special attention in MERLIN's subsequent review phases both in terms of outcomes and methodological considerations 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 found 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. For instance, in videoconferencing an interesting finding is that in discussions distance reduce the fear about speaking in one's mind.
- *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

Attitudes of teachers, students and trainers towards ICT

Teachers attitudes towards ICT are connected to socio‑cultural, professional and technological barriers (learning patrimony). It is not only a matter of individual attitude, but social, professional and personal attitude.

A 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 four following components: *a) attitudes towards computer tools, b) towards the role they should play in teaching, c) towards the way they can facilitate learning and engage students, and d) towards the activity focus of the institution.*

- *Attitudes towards computer tools* 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

- *Attitude towards the role ICT play in teaching* With respect to the *attitude towards 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, 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

    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.

    For many faculty there is also a *negative attitude towards online learning* as compared to face-to-face interaction; virtual learning represents a drastic departure from prevailing practice that it's incongruous with their understanding of the essential nature of teaching and learning.

    There are also *negative attitudes* against ICT, ranging from the traditional technophobic presumptions against technology, based in wrong dilemmas about the effects of technology in the learning processes, to the socio-economic effects of ICT in the employability of staff, as for instance the *fear of replacing traditional teaching and teachers by ICT tools.*

- *Attitudes towards* ICT *facilitating learning and engage students.* With respect to *attitudes towards* ICT *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 clear-cut 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.

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

Affective factors present in learning innovations with ICT

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 mentioned are related to the *working habits.* Teaches have limited time to engage in innovations using ICT, so they need to be supported by the institutions at all levels. Furthermore, 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.

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.

Socio-cultural factors affecting learning innovations with ICT

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

Also, 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.

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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* constitutes 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 online learning is that teachers and students being able to explore the potential communication partners from other cultures and countries involved.

3.1.2   Institutional factors affecting Learning innovations in institutions

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. Discussion on on-going institutional factors on a wider scale deal with funding needed for ICT infrastructure in schools, development of practices and adequate implementation of ICT and applications. In this section we outline the most prevalent indicators of change in this area.

The 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.

In schools, there are crucial institutional factors for successful integration of ICT, as for instance the *necessary flexibility on organization of the school or the curriculum* help the potential impact of the ICT innovation.

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

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

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

There are many barriers to the use of ICT in schools and in other educational establishments –e.g., full access to computing facilities and to the Internet; teachers still suffer from a lack of training and need time to adjust to, and to fully understand 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.

Still many schools do not have full access to computing facilities and to Internet; universities need to *secure funding, or assure their technical possibilities.* Teachers still suffer from a *lack of personnel preparedness* and confidence. It is prominent the *resistance to change by the institution's faculty members;* they need time to adjust to and absorb the implications of ICT in educational contexts.

Organisational factors affecting Learning innovations in institutions

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 timetables*, 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 online learning materials* is reported to be a helpful tool for schools.

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

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

- *Parallel Structures alongside 'Traditional' ones:* there is a plan for going deep in the line of using virtual learning inside the institution. This is characterised by the existence of an strategic plan that promote the integration of ICT in the academic and research arena
- *Mixed mode structures:* change in the organisation of the institution, transforming the structure from single-mode to dual mode institutions
- *Full online education organisations: traditional face-to-face or* distance education institutions in process of transformation towards full online operations.

Staff training and its relation to ICT-based learning innovation

Staff training is crucial for the success of innovative approaches using ICT. Teachers should become acquainted with new methods, to get a full understanding of the educational functionality of technological tools, to become confident in handling various components of the tasks, and to adjust their expectation in order to avoid frustration. Training and new qualifications for teachers and other participants are absolutely necessary.

There is a recognition of the growing use of ICT in schools together with a identification of the new teaching roles expected within open systems and mentioned above in this report. 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 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.
- *Staff training awareness-raising type*. Many of the lecturers are not happy with the traditional classroom methods

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.

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

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

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

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

The adoption scope of ICT-based innovations varies: it can range from individual to been part of the teachers' (and students') practices or at the level of the whole institution. On the other hand, the school sector is resistant to the adoption of ICT-based innovations due to institutional, organisational, hardware availability and staff-related factors (lack of teachers' training).

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

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

Among the constraining factors to take into account it is easy to find the lack of *preparation* of the school as a whole –both in terms of training of staff, equipment and organization, to adapt ICT in the learning/training process from a holistic perspective. Again, the lack of *teachers confidence* regarding innovative work with ICT is also a factor worth investigating further. These factors require further attention at two levels, first regarding their detailed definition and contingencies to other factors such as finances

and governance of education; and second regarding the *means and methods* to overcome their constraining effects on innovation.

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

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

3.1.3   Other 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. 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.

To *get used to participate* in ICT-based learning innovations, educational research, or collaborative projects might be a prospective measure of future success in lifelong learning of a particular learner or practititoner. 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.

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

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

Equity issues

While the implications of this parameter are of great importance to the orientation of the TSER Programme, this is an area that needs further research projects since 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. Nevertheless, equity differences begin to play less *critical role* if teachers and students are directly implicated in the innovation processes and dedicate much effort and enthusiasm towards improving the quality of teaching and learning.

In general *disadvantaged groups* suffers from a serious precariousness of arrangements in all areas of the studies.

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.

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

Efficiency and effectiveness

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

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

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

Effectiveness of virtual learning hold some characteristics:

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

Sustainability of innovations

This is an area that lacks data in most of the projects analysed. Seldom in the reports analysed, the issue of sustainability is treated as a key point for the success of the projects beyond the end of it. This area definitely needs further investigation in the EU educational establishments.

There are serious doubts about sustainability. Since technology changes so rapidly, we can barely measure sustainability by how the innovations become adopted by the institution, but how these innovations are able to adapt to or keep pace with technological changes. Sustainability is then vicarious of further technological and social trends.

In virtual learning there is a long term feeling that *VLEs may either provide new sources of income or reduce current costs.* It seems that at the current level of development of virtual learning, *postgraduate and further education have more chances of been sustainable.*

Scalability of innovations

This is definitely an area for further research. Little information on projects.

Implicit definitions and added value of ICT learning innovations

A learning innovation is a complex phenomenon that emerge historically, and is culturally mediated. Learning innovations are framed by socio-cultural, technical, learning and organisational factors.

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

In general, with respect to innovativeness factor of ICT usually relates either to the technological, organisational, cultural and pedagogical approach:

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

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

- *student-centred learning approaches*
- *changing traditional teacher's role*
- *promoting new competencies required for improving teaching and learning*

Virtual learning has been reported that it is critical with respect to the following:

a) *reaching more students;*

b) *giving more learning opportunities to those who can not come to in-class learning;*

c) *creating learning communities both in national and international setting;*

d) *breaking the traditional face-to-face learning classroom;*

e) *providing for more resources to learning for both independent and project work learning.*

3.2   Research Trends

The cases that were undertaken in stage one revealed far more indicators of change than did those reviewed in stage two. Project IVETTE however, did provide new insights on the indicators of change in learning innovation with ICT in all three thematic areas addressed by MERLIN.

The cases reviewed in stage two while not making a substantial contribution to the building of indicators did enrich the project with problem areas for further research.

The research issues that emerge from the COMPETE project, as considerations for further RTD, include:

- the issue of scenario building for use of tools/services
- the impact of socio-cultural and knowledge acquisition factors in mapping skills, so as to set the parameters for an accreditation system or an alternative to it
- the application (and full development of the appropriate toolsets) in environments (with real users) and investigation of its potential in terms of diagnosis and decision analysis as well as acceptability of the service of the users (both job seekers and employees).

As indicated in section 2.2 above the NATCCC-PS project demonstrates the potential and added value in applying ICT in the assessment of learning activities based on current pedagogical thinking –i.e. problem solving. It further discusses the theoretical concept, model and approaches of the assessment of problem solving seen as one of four elements of the cross-curricular competencies needed to be benchmarked in European education. In an indirect way the project touches on issues of equity suggesting that the definition of indicators for assessment of problem solving learning situations can improve the quality of education in European countries, by contributing to the design of strategies that can more adequately address the issues of equal access and performance in education.

The results of this project suggest further development work on the definition of indicators for ICT-based assessment across the curricular spectrum.

The research findings of the IVETTE project propose a rich research agenda for the future. Amongst the issue outlined for further consideration under a thematic perspective are:

Institutional perspective
- What is the institutional perspective to the undertaking of VLE implementation?
- What are the factors that led institutions to consider using VLE?

- Do all institutions regard VLE as the best approach to meet social and in some cases market needs?
- What type of networks/collaborations are being formed for VLE undertaking?
- What type of institutional change is being sought?
- What is the management approach to institutional change?

Teaching/Learning perspective
- The emergence of new educational paradigms
- The context of teaching and learning in VLEs
- The changing nature of the learning materials
- The pedagogical design and teaching within VLEs
- Accountability of VLEs to learners' expectations
- New strategies for teaching

Cross-cultural perspective
- What are the cross-cultural elements embedded in the current VLEs and to what extend do these facilitate their intercultural orientation?
- Is linguistic adoptability sufficient to ensure the effective application of a VLE in a context different than the one that it was developed in/for?

3.3   Research areas underrepresented in the projects

Having traced the main traits of ICT-based learning innovations in the project documentation (mainly in the final reports), it is obvious that some of the parameters were not found satisfactory in terms of information collected, or that the outcomes were partial or not satisfactory. A different reason might be the fact that MERLIN did not deal with the whole corpus of documentation; finally a more plausible reason might be that the projects did not consider these missing factors important enough or part of the research.

In the following section we outline the parameters that we found underrepresented in the study, which, although been part or not of the TSER priorities at the time of the Calls, are considered of crucial importance in the review of literature. These ill-represented areas can be considered for further discussion with the project representatives, and with the research community:

We could barely find mentions about attitudes of administrators and managers towards ICT in the school sector, whereas attitudes of direct actors of the innovations (as teachers and students) were usually studied. Certain that we could find attitudes against ICT in learning, or simply passive ones. However, we need to investigate further what cause these attitudes towards ICT-based learning; we usually look at early adopters of innovations, but we need to know more about the attitudes of people that step behind the innovation processes. Furthermore, even in the case of active innovators we need to know what attitudinal patterns of change emerge as regard to many parameters involved in learning innovation practice.

Also, there has been mentioned differences in attitudes when comparing geographic areas in the EU, as mentioned before in this report. Nevertheless, the information gathered is not enough, to the point that we can barely ascertain that these differences hold a

marginal role in ICT-based learning in the EU or not. We then suggest to look thoroughly at this factor through comparative research in the near future. This might shed light to an issue for EU future research policy in this area.

We hold similar position with respect to intercultural differences among countries, recognising the importance and consequences of this factor for trans-national projects. Although we found interesting results in the study of virtual learning as regard to these issues, linguistic and intercultural differences need more attention, specially on how the use of ICT might facilitate to fight these phenomena.

It has been recognised in the literature the importance of affective factors for the institutionalisation of innovations, since there is no doubt that learning actors are influenced by affective factors. Nevertheless, we could not find much on that in the projects. We strongly think that more research is needed in this area, since the affective domain is of chief importance in any type of innovation.

Another important area to look at more is the study of institutionalisation of learning innovations. The short duration of projects and short amount of time ICT is being utilized in the teaching/learning processes do not allow to assert the role of particular innovation in an institution. Only those institutions that have a record of been involved in innovations with ICT on regular basis might allow more definitive results. Longitudinal projects dealing with long duration innovations (or with several innovations taking place in particular institutions) should be welcome. This will offer also good insights with respect to sustainability and expansion of ICT innovations within the institutions.

Equity issues has been underrepresented in the projects. 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. We recognise a certain disenchant on that, since almost none of the projects care enough about this issue. More insights are necessary since the rapid evolution of the information society is leaving behind many sectors of the learning population.. We can not make clear conclusions on it, except the need for further research specially on what are the factors and policies that contribute to ICT-based learning been accessible to all students and to all sectors, and what are the new learning arrangements (in formal, and informal settings) that contribute better to this goal.

Efficiency and effectiveness was also relevant to our study, but again, we barely found contributions of chief importance in the projects, including the pure or implicit conceptions about these concepts (for instance, social efficiency is something that has little to do with the traditional economicist efficiency conception). These issues need further research. As identified, these aspects might be important aspects to be promoted in future programme Calls as topic of investigation.

The same can be said about sustainability and scalability (not in technical, but in social matters) of innovations. We found little information about these parameters of chief importance. This area definitely needs further investigation in the EU educational establishments.

3.4   Policy Recommendations

The research trends reported above suggest an agenda for policy articulation in the area of Innovation in Education via Technology. In this chapter we base this work on the policy recommendations given by the analysed projects which will contribute to a framework and the production of policy recommendation as the result of the intended MERLIN workshop.

3.4.1   Results from the cases

One of the aims of MERLIN is to 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. There for by reviewing the intermediate and final reports of these clustered projects special consideration was given to the aspect, if recommendations are given. A several projects especially contributed to this output: Delilah, Representation, Pedactice, IVETTE, STTIS and CL-Net The results of the project review in terms of these issues are presented in deliverable 2 -4. They will be summarized in the following section.

- DELILAH: The development of effective evaluation tools has been approached within this project with the development of a pedagogic audit methodology for innovative HE institutions, support tools for teachers involved with ICT innovation, and policy recommendation guidelines related to the sector of social disadvantage.

- PEDACTICE: Policy recommendations were given for improving current situation in the school context : 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. The issue of investment focusing on the study of implementation of multimedia material, content and tool evaluation and teacher training are also considered .

- REPRESENTATION: A similar outcome is found under the scope of "space for innovation in the curricular structures".   Amongst the recommendation is 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.

- CL-NET: Here as well certain organisational issues are as the need for better integration of ICT directly into the classroom are pointed out.

- COMPETE: Given the face that the nature of the project does not call for application of learning technologies, the project recommendation is more technologically oriented: smart card technology does not appear as a sufficient solution to address the problem investigated and that considered should be Internet, intranets and digital television. In terms of delivery systems and applications the project saw a demand for distributed databases that allow for the co-production of knowledge, and supporting Internet-based platforms and client-server technology and representation software that can represent experience and cultural context, rather than formal qualifications. Partnerships for skill development of socially excluded groups should prioritise the inclusion of the target groups themselves as co-collaborators in the development of new skills 'asset bases'. The most effective way of improving the asset base of the socially excluded is to provide basic building blocks rather than technical qualifications.

Technical skills (linked to specific occupations) and cross-job skills are less important than: meta-cognitive skills (learning to learn); information handling and processing skills and presentational skills. Top-down and instrumental approaches that emphasise widening participation (by bridging it to formal qualifications, for example) are unlikely to succeed. If training is provided, it has to be embedded within a holistic and strategic environment in which learning is linked to associated strands of community life – such as environmental improvements; health and political engagement, and it has to be designed in part by target users themselves.

- STTIS: Suggestions were presented relating to internalising innovative approaches, appropriate teacher training programs, focus on holistic view, transparency of reasons for innovations, innovations' take-up, effective integration of the "new" approaches with the "old", linking innovation rationale and critical details, attention to language and reflections about possible transforming trends in taking up innovation. Some recommendations for the improvement of teacher training programs are listed by the STTIS project are:

  o 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.

  o Reasons for innovations should be justified and transparent

  o New" pedagogical approaches should be associated to "old" ones in order to verify benefits and limitations of both

  o A holistic view on innovations in terms of topics, concepts, approaches etc. should be encouraged

  o Innovation rationale and critical details should be well explained in terms of their potentials and limitations.

  o Oral, written and visual language used (technical, scientific terms etc.) should be carefully applied

  o Possibilities for reflection on the technology / innovation should be ensured.

- IVETTE: This project identified policy implications at different levels relating to institutional issues (Initiation phase; Implementation phase; Diffusion phase, Adoption phase, Strategic Plan, Revision and update and Formative Evaluation), teaching/Learning policy implications (Developing new strategies for teaching/tutoring; Supporting the development of "innovation units"; Looking for a balance between the pedagogical model and the potential of technological tools.; Designing materials specifically for teaching in VLEs; Setting new working conditions for tutors and lecturers and other staff involved in the virtual campus operations) and cross-cultural policy recommendations (Setting the management conditions of international cooperation; Overcoming intercultural communication problems; Including language differences in the course design and in the course delivery)

Due to their scope within the project work and the special consideration of policy recommendations the 2 projects STTIS and IVETTE are of main interest here. Their detailed recommendations are listed in Deliverable 3 and 4 and annexed here. In general it can be stated that different levels are addressed among the projects relating to different categories as well as to a different approach in the formulating recommendations on a more or less macro- or micro-oriented level.

So far some of the projects analysed contain parts and conclusions which can be identified as recommendations for policy or at least as a contribution to the development of recommendations. Most of the aspects mentioned by the projects deal with needs for improving teaching with ICT. Some also address more general issues relating to equal opportunities, cross-European school cooperation and institutional and organisational changes. In general most of the projects build on the current situation in education, making this to the starting point of their investigations. However 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. 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.

Organisational conditions are linked with certain policy recommendations in several projects. The conditions are very much associated 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

The development of equal opportunities for ICT access and use for learning are further issues considered in several projects. 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 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.

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.

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 they suggest 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.

A number of issues at a wide range of organizational conditions that are supportive to new learning processes emerged. An important issue is that teaching with ICT is more effective when computers are placed in regular classrooms than 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. 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.

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. 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.

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.

3.4.2   Requirements for future considerations

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.

Most of the projects were focussing their organisational recommendations on the school environment but other contextual elements should be taken into account as well 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.

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. 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.

Other important sources to be considered for the development of adequate policy recommendations are available via the Internet. Organisations, ministries and official committees periodically publish their analyses from empirical research in form of recommendations or summaries of "lessons learnt". Some examples for such references at a national base can be found at:

- **http://www.bced.gov.bc.ca/technology/advisory_report/recommen.htm**: Conditions for Success; Report of the Teaching, Learning and Education Technology Advisory Committee to the British Columbia Ministry of Education, June, 1999; outlining visions and principles and pointing out the recommendations for several areas, such as: Student Needs and Expectations, Curriculum and Learning Resources, Educator Training and Support, Social Impact, Electronic Delivery, Research, Decision-Making and Funding.
- http://www.uvm.dk/eng/publications/10InformationCom/1.htm.   Information and Communication Technologies in the Education System; Action plan for 1998-2003. The Ministry of Education 1998; Denmark, defining an action plan for 5 different areas: The pupils and ICT , The teachers and ICT, The subjects and ICT, Equal and flexible access to lifelong education , Coordination of ICT-based research and education

Strategies and policies are well explored at a European level as well. The elearning Action plan (http://europa.eu.int/eur-lex/en/com/cnc/2001/com2001_0172en01.pdf): Designing Tomorrows Education outlines several sectors of Actions undertaken by the Commission. It furthermore introduces to key measures supported by the Elearning Action plan, such as: key measures relating to infrastructure and equipment; key measures on training; key measures on services and content; key measures to strengthen cooperation and dialogue.

However, despite the fact that such action plans established at a European and national level are adequate for stimulating research and development, there is still a gap to be filled contributing to a final overall implementation of ICT and innovations in education. Perhaps it is a lack of scalability and measurability of research outcomes which finally prevent decision-makers to benefit from the results in terms of the definition of adequate policies as a consequence of scientific outputs.

As a result of the project assessment, literature review and current discussions relating to future needs in education the MERLIN workshop needs to set a clear focus in the areas of:
- equal access to educational opportunities

- cross institutional cooperation
- institutional transformation
- organization parameters regarding the educational praxis
- knowledge sharing and knowledge negotiation mechanisms

Project MERLIN's Policy Recommendations will be formulated in the frame of its Workshop, details of which are given below.

The work reported in this deliverable constitutes "input" to MERLIN's Workshop. The aim of this Workshop is to validate the work done thus far and refine it with the support of a group of experts in the area Innovation in Education. The Workshop has been scheduled to be held at the University of Barcelona, on May 12th to 13th. It is to be attended by a set of 15 researchers who will, jointly with MERLIN, "generate" recommendations for further research in the area under concern.

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And ***Final Reports*** (as well as some deliverables of specific projects) of the projects analysed.

ANNEXES

Annex 1: Policy recommendations of STTIS project (Extract of Del.3)

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.

Annex 2: Policy recommendations from IVETTE project (Extract of Del. 4)

Policy implications at institutional level

In the analysis I identified different institutional factors that need to take into account. Since institutions are currently in different phases of utilisation of VLEs the interpretation of the factors needs to be situated in the specific context of institutions individually, rather than viewing them as blanket recommendations.

a) *Initiation phase*. Production of a Green Paper as the basis for decision‑making on implementation of VLE. b) *Implementation phase*. i) Preparation of the technical Infrastructure; ii) organisation of Training and development courses for staff; iii) promotion of a new organisational culture through dissemination activities inside the institution. c) *Diffusion phase*: i) development professional development programs and overt institutional support structures; ii) promotion of a higher status of "research in teaching"; iii) to facilitate team‑work in VLE adding to the teams well known lecturers and professors; iv) diffusion of good practices. d) *Adoption phase*. Publication of the institutional *White Book* including: i) Business plan; ii) Survey of most used pedagogical model(s); iii) Descriptions of case studies concerning the implementation of VLEs; iv) Research documentation, and conference reports related to University development, to learning and other topics connected to VLEs; v) Surveys of existing hardware, software and communication networks; vi) Report about the likely future development of hardware, software and communication networks for VLEs; vii) Identification of potential populations for VLEs innovations and description of their main interests, characteristics and needs; viii) evaluation of the existing infrastructure; ix) market research report. e) *Strategic Plan*. Embedding the White Book approaches inside the Strategic Plan of the institution guarantees the success of the innovation. f) *Revision and update*. We need to consider to revise and update the strategic plan often, since this area changes rapidly. g) *Formative Evaluation* of operations over time is then necessary.

Teaching/Learning policy implications

-   Developing new strategies for teaching/tutoring
We saw that within the context of new educational paradigms that new functions can be characterised by the shift from traditional teaching as a content provider and "transmitter" towards a mentor guiding and supporting learners through the process of knowledge acquisition. In an open learning environment, the learners themselves can largely direct learning.

People tend to transfer the way they think is the "best way" to teach into the new way of delivery. According to that, many VLE are been developed under the same pedagogical assumptions that face‑to‑face teaching. Nevertheless, I consider also the adoption of VLEs in the context of the traditional paradigms of teaching a very important phenomenon that cannot be rejected. It implies for the institutions involved a step in the evolutionary transition from traditional teaching environments towards newer models of education.

Whatever kind of teaching approaches are being used it becomes patent, that teachers need special training for online-education. Implementing teaching in Virtual Learning Environments needs competence in technological (called *hard skills*) and organisational aspects as well and new skills in applying relevant didactical methods, moderating/facilitating, etc. (called *soft skills*). Any new professional development program for training the trainers needs to deal with new skills. For instance, tutors who are going to engage in VLE activity should consider the following outcomes as part of their personal development:

- To know and understand the philosophy of distance education.
- To master different virtual teaching and learning software
- To be able to communicate with students using new IT
- To react very fast and properly, and do everything to helping students to complete their studies.
- (Possibly) to study a course through distance/open/VLE learning to gain experience as a user.

- Supporting the development of "innovation units"

Because VLE activity requires a large number of different skills, its design and implementation is generally conducted by teams.

In most cases there are areas within a University where these skills have been developed. Typically these are in service units: the unit that supports all computer activity in the University or units specifically established to develop audio-visual material and publications. The other source of knowledge in Universities are usually departments of education, art and design, or of information technology (and occasionally psychology) that have experience in pedagogy or the development of significant technologies like computer supported co-operative work, and other innovations.

These groups tend to work in collaboration with academic departments and involve a team of teachers. In this way they work towards bringing about a change in teaching practice. In some cases groups drawn from these environments have evolved to become "units" within Universities on their own accord. A recommendation in this area might be to promote the establishing of such "units" within Universities by integrating interdisciplinary teams made up of academic staff (subject-matter experts), pedagogical advisors and technical support.

- Looking for a balance between the pedagogical model and the potential of technological tools.

When teaching and learning take place in VLEs it should be kept in mind that there is already a didactical concept incorporated within the environment determining the scale of pedagogical functions. It could also be observed that there are pedagogical barriers to overcome and compromises to be made when commercial products are chosen. A decision to adopt a given VLE does in fact make specific decisions about the pedagogic model to be adopted by an institution.

A trade-off has to be made between bottom-up and top-down strategies for implementation. When a top-down strategy is chosen, the variety of pedagogical functions is reduced to the tools offered by the pre-defined and standardised environment. A bottom-up strategy, however, can entail other problems such as technical instability, incompatibility of the software developed by different actors.

- *Designing materials specifically for teaching in VLEs*

In most of the experiences analysed, there are not genuine strategies and methods specifically developed or created for VLEs. As I pointed out before, many VLE are developed under the same pedagogical assumptions that face-to-face teaching, so the materials and resources used. For instance, it may be a serious mistake to use multiple choice in Web-based learning environments for it is a waste the potential of the tools and medium, like reinventing an inferior wheel. A better approach in this case would be to develop VLE materials based on free-form student input.

Obviously, the other side of the problem in the case we are not adapting already made curriculum materials, is to face a more important investment to create them from scratch. Again, having institutional innovation units should ease the process.

- *Setting new working conditions for tutors and lecturers and other staff involved in the virtual campus operations.*

Division of labour in VLE differs from the traditional one in institutions. As much work in VLEs is done as pilot/development/research projects, the additional funding to support such activity creates a new employment structure on a temporary basis to sustain VLEs. However in many institutions this is not institutionalised. There are different actors involved as teachers, course designers, tutor, technical support, etc. This needs to be taken into account, and clearly set the working conditions.

There are other problems to overcome. For instance, institutions are not managing teachers' overload well. It is necessary to recognise that teaching overload in VLEs is the first step towards managing it. Teachers and support personnel need to keep details of all time they spend supporting online learning. Although it is necessary to consider some technical solutions to this problem (for instance on-line FAQs), reducing the amount of courses and students might be the only way to keep the interactive "potential" of VLE.

Any institutional plan should also consider the impact of VLEs on many different groups of university staff who might apparently be uninvolved:
- administration (engaged, for instance, in accountancy, marketing, and providing residential services),
- ancillary staff (engaged, for instance, in estate maintenance and catering), and,
- those whose employment depend on the physical location of universities.

Cross-cultural policy recommendations

This section addresses cross-cultural issues that arise when involving co-operation between institutions (local and/or international), teachers and learners that belong to different cultural and/or linguistic environments. The issues of language and cultural differences constitute perhaps the two most important elements for consideration. Indeed, one of the main characteristics of the European continent is its linguistic and/or cultural diversity. This diversity should be taken into account in any educational and training programme that is organised in each European country or Europe-wide. Although there have been legislative resolutions referring to cultural diversity at the level of the member-states and Europe, I observe that these have not been embraced by the educational policies of national educational authorities.

This fact gives rise to a number of questions, such as:

i)   Should relevant European bodies formulate stronger supplementary resolutions and recommendations to national governments on the necessity of implementing concrete measures in the field of intercultural approaches in their educational and training system? Also, should these resolutions and recommendations contain some concrete measures that will facilitate their implementation in the various member-states of the European Union?

ii)   Can the member states of the European Union implement already existing and forthcoming recommendations of the relevant European bodies (such as the European Commission, the European Parliament, the Council of Europe etc.) referring to the intercultural approach in education and training? These are issues of cross border accreditation and harmonisation of qualifications. Implementation has been slow.

We do recognise that there are potential dangers in internationalisation. There needs to be a protection for cultural minorities and those who prefer to learn through their mother tongue. Among the recommendation identified in the project I might point out the following:

-       *Promoting the use of VLEs through collaboration at European level and vice versa*

A strong feature of VLEs is their potential to operate at an international and even at a global level. VLEs allow institutions to extend their reach beyond local and national geographical borders. Universities do not always optimise on the advantage of this challenging possibility. The element of collaboration turns out to be stronger at the intra and inter university (national) level than it is at the European level (independent of whether it is university-university or university-industry collaboration). It seems necessary to arrive to a level of maturation beyond the "post pilot study phase", in order to envisage the establishment of collaboration with other European and international institutions and markets.

-       *Setting the management conditions of international cooperation*
The presence of an international component in the virtual learning environment asks for appropriate tools, methodologies and management. Experiences dealing with cross-cultural audiences identified that international VLE activities demonstrate problems of legal and economic nature as well as problems that emerge from the differences in the learning patrimonies of the audiences.

Financial considerations are important. VLE's can be expensive to develop. Since the course offer is not limited to students of the particular university, the sharing of cost for the other has to be discussed. International participation lifts the quality level, however, an increase in participation should not allow the quality of the course to be diminished.

-   *Overcoming intercultural communication problems*
In catering for cultural diversity in VLE, we need to be mindful of linguistic and cultural diversity rather than viewing it as a problem. Best practice views multiple perspectives as a strength. Different languages facilitate different thinking. Different academic traditions (e.g. empiricism vs. theorisation) at first can create disjuncture in a learning group but

later can deepen understanding. These must be addressed in promoting inter-cultural VLE.

We have very little knowledge of the full extent of problems of participants with different first languages coming from numerous different contexts, and with different historic, socio-cultural and professional identities, meet for moments of a learning experience. High level skills require collaborative learning where the negotiation of meaning is important for participants learning identity. It is necessary to see international learning projects as involving new relations of identification, new forms of membership and ownership of meaning and thus changing positions within communities. This clearly needs careful consideration and planning if it is to include all types of students from different cultural learning backgrounds. VLE's need to build in such language support. Machine translation is not a solution to such complex creation of meaning and identity. Neither is it totally appropriate to standardise on one language for the creation of all meaning.

My approach should be less about having to "overcome" problems and "promote" solutions and more with concerning ourselves with the ongoing process of developing integrated approaches to learning and communication.

In this sense, identity and negotiation of meaning is the primary focus of learning, the dynamics of which become much more complex when talking about international learning communities.

-   Including language differences in the course design and in the course delivery
From this approach, which methodologies do we recommend, in order to enhance the intercultural communication among tutors and learners? Initial suggestions for going about this are partly practical and partly about developing an approach to course design and in the course delivery considering these factors:

- View language and intercultural issues as an integral and dynamic part of the whole learning process and not as something separate or add-on representing different methodologies and approaches.
- View language and intercultural issues as identity factors representing the socio-educational contexts of the course participants which will be interacting and changing throughout a course.
- View language and intercultural issues as important factors in the ongoing process of negotiating meaning throughout the learning experience.
- Value and include participants' socio-cultural and educational identities and histories in the course trajectory. The methodologies and approaches that people are accustomed to will help shape their interpretation of and performance on the course. How people have learned will affect what they learn.
- Be very explicit about all parts of the learning process and structure regular reflection about it. Never assume that understanding the words means that someone understands the conceptual thinking behind them.
- Structure reflection about international and intercultural communication throughout the course.
- Consider pre-course language tests to alert students to possible difficulties in participating in the types of discourse of online learning discussions.

- Account for and make explicit the different discourses (and from different cultures) of a wide range of communities of practice.
- Consider adopting VLE technology where language support can be easily integrated.