ITEC - WP <5>

<D5.1> - <EVALUATION PLAN>

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V2	28/02/2011	2nd draft	Official	MMU
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V4				
V5				
V6				

[1] PU = Public
PP = Restricted to other programme participants (including the EC services);
RE = Restricted to a group specified by the Consortium (including the EC services);
CO = Confidential, only for members of the Consortium (including the EC services).
INN - Internal only, only the members of the consortium (excluding the EC services)

Executive summary

The first deliverable of WP5 is the Evaluation Plan; a comprehensive plan detailing all the evaluation activities that will be carried out throughout the period of the project in order to evaluate the impact of the scenarios, in each of the 5 cycles of validation, on teaching practices, engagement with all stakeholders, individualisation, collaboration, creativity, expressiveness, overall transformative effect and the design of the future classroom, including underlying change processes.

WP5 is not concerned with the holistic evaluation of the iTEC project; it is concerned with the pedagogical strand of the project and what happens in classrooms as a result of teachers participating in the iTEC project.

The Evaluation Plan presents the objectives and research questions that underpin the evaluation and includes sections that detail the underlying evaluation methodology, data collection methods and workflow, and the approach to data analysis including criteria for success.

This is a revised version of the Evaluation Plan originally submitted on 4.03.2011. The criteria have now been updated following discussion by the Steering Committee in Aarhus, Denmark on Thursday 10th March 2011.

In order to ensure that all partners have a shared and common understanding of some of the terms and phrases used in the evaluation criteria, WP5 sought to define the complex terminologies. iTEC partners were asked to contribute to the development of a set of agreed definitions. Discussions based on partners' contributions as well as relevant authoritative sources have helped to create a set of Agreed Definitions and Descriptions which are included as Appendix A.

Also included is the Knowledge Map which was undertaken as the first task of WP5. This provides an overview of current innovative practices across Europe and reviews current practices in the countries participating in iTEC validation cycles. The Knowledge Map helps to provide a base-line context in the use of learning technologies and innovative practices that currently exist in the participating countries. WP5 will continue to work on the Knowledge Map in order to capture important research as it emerges throughout the year. This will help to ensure that the Knowledge Map provides the most current picture of teachers' uses of ICT across Europe and beyond. A final and completed version of the Knowledge Map will be submitted together with D5.2 - Evaluation Interim Report, due July 2011.

The emerging findings from each data set will be used to review the collection and analysis procedures and if necessary the evaluation process will be adapted for further cycles thus developing an iterative evaluation approach.

The evaluation report for each cycle will be shared with WP5 partners, other members of the iTEC team and participating teachers and the Evaluation Plan, including all research instruments and protocols, will be reviewed and updated at the end of each project cycle.

Because the Evaluation Plan will be reviewed and possibly adjusted by WP5 partners at the end of each Cycle, the dates included in the Data Collection section of the plan are necessarily those that relate to Cycle One, though no significant changes to the overall pattern of activities is anticipated.

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1 INTRODUCTION

1.1 REMINDER OF THE CONTEXT

WP5 is concerned with the evaluation of the large-scale piloting of selected scenarios in 1000+ classrooms. In order to ensure that this is conducted systematically and rigorously all partners in iTEC need a shared understanding of the evaluation process. In addition, colleagues from WP4 including National Pedagogical Co-ordinators (NPCs) need an awareness of the commitment required to support the evaluation process fully. For example, NPCs will need to convey the requirements clearly to participating schools and teachers. This deliverable also includes a Knowledge Map (a working document which will not be finalised until M11). The Knowledge Map will support a shared understanding of current innovative practices using technological tools in classrooms, together with summaries of the scope and level of practices in each participating country.

1.2 PURPOSE AND SCOPE OF THE TASK

The purpose of the Evaluation Plan is to map out the evaluation activities that are required to be carried out in order to evaluate the impact of the scenarios, in each of the 5 cycles of validation, on teaching practices, engagement with all stakeholders, individualisation, collaboration, creativity, expressiveness, overall transformative effect and the design of the future classroom, including underlying change processes.

The Evaluation Plan provides a rationale for the evaluation methodologies and data collection methods as well as specifying evaluation criteria and setting out WP5's schedule of evaluation activities.

1.3 RELATIONSHIP WITH OTHER TASKS

The Evaluation Plan will serve as a reference document for all partners involved in the preparation for and implementation of the large-scale piloting of selected scenarios as it informs MoEs, National Technical Co-ordinators and National Pedagogical Co-ordinators (and through these, the teachers in the pilots) and Work Package partners of the evaluation requirements and provides clear guidelines and time-scales for the collection of qualitative and quantitative data and for the translation of research instruments.

It will also be a key guide for National Pedagogical Co-ordinators who will be instrumental in the collection of qualitative data from selected case study schools throughout the project. Detailed guidance, protocols and research instruments will be provided in an Evaluation Handbook for all National Pedagogical Co-ordinators.

Liaison and collaboration with WP4 has ensured consistency and agreement between D5.1 The Evaluation Plan and WP4 documents such as the "School Pilot Protocol" (Task 4.2) and the "Scaling up of Scenarios" (Task 4.3).

1.4 STRUCTURE OF THE DOCUMENT

The Evaluation Plan is structured in the following way:

Section One: Provides a brief summary overview of the evaluation plan;

Section Two: Introduces the objectives of the evaluation before attempting to define certain terms relevant to the evaluation as a whole. The research questions are also introduced;

Section Three: Discusses the methodological approach taken by WP5 and draws on relevant authoritative sources to support the discussion.

Section Four: Describes the iTEC classrooms' selection process and includes:

- the selection criteria **(revised)**
- required number of classrooms
- selection of case study schools (including the commitment required of case study teachers)

Section Five: Explains the requirements and provides time-scales for all data collection and presents the WP5 Conceptual Framework as well as the 20 key descriptors of educational change developed in WP2, Cycle One.

Section Six: Discusses WP5's approach to data analysis and includes evaluation criteria for success in relation to the evaluation of the large-scale pilots

Section Seven: Explains WP5's self-evaluation plan

Section Eight: Presents the References

Section Nine: Presents Appendix A: The Agreed Definitions and Descriptions (of the complex terminology used in the evaluation criteria)

The Knowledge Map provides 2 parts, the first presenting the key thematic areas in the review of innovative classroom practices, and the second presenting the participating country summaries.

1.5 IMPACTS OF THE DELIVERABLE

This document was scheduled to be one of the first project deliverables in order to ensure that all partners involved in supporting the evaluation of the large-scale piloting of the scenarios will be well-informed early in the project of the evaluation requirements so that they will be able to take these requirements into account in their own planning.

It will underpin the development of the research instruments and the protocols which will form the detailed guidance for the conduct of the evaluation of large-scale pilots in each of the participating countries.

The Knowledge Map will serve to:

- Situate the evaluation in general and national contexts;
- Show progress beyond national baselines/benchmarks;
- Support the interpretation of the findings in terms of the underlying national conditions (political, educational, socio-economic, technological).

1.5.1 iTEC PROJECT

1.5.1.1 Review 'milestones' and 'degree or level of achievements'

1. Throughout the preparation of the Evaluation Plan, WP5 has worked closely with its Work Package partners and has forged excellent working relationships, particularly with project colleagues in WP4. Many aspects of the work of WP4 and WP5 are intrinsically bound and agreements have had to be reached on key evaluation requirements such as numbers of classrooms required for the pilots and the roles and responsibilities of the National Pedagogical Co-ordinators' in the collection of evaluation data. There has been a great deal of liaison and collaboration in order to ensure consistency and agreement between the Evaluation Plan and WP4 documents such as the "School Pilot Protocol" (Task 4.2) and the "Scaling up of Scenarios" (Task 4.3).

2. The Evaluation Criteria included in the Evaluation Plan are complete. **However, the iTEC Steering Committee proposed that the criteria be discussed and agreed collectively at the March face-to-face Steering Committee meeting in Aarhus, Denmark (10th March 2011). This**

change request (reference: ITEC_CH1) was approved in March 2011. The Evaluation Criteria have been updated following these discussions. In addition, the Evaluation Criteria may need to be re-considered when the scenarios for large-scale piloting are selected (for example, specific criteria may not be appropriate).

3. Although the Knowledge map is complete at the time that this deliverable is being submitted, WP5 will continue to work on the Knowledge Map in order to capture important research as it emerges throughout the year. This will help to ensure that the Knowledge Map provides the most current base-line picture of teachers' uses of ICT across Europe and beyond. A final and completed version of the Knowledge Map will be submitted together with D5.2 - Evaluation Interim Report, due July 2011.

4. **The Evaluation Plan (D5.1) is now complete.**

1.5.1.2 Review 'Risk Analysis'

With regard to 1.5.1.1.2/3/4 above:

There are no financial implications of these possible adjustments.

The evaluations will go ahead as scheduled and there is no expected impact on the overall timing of the project.

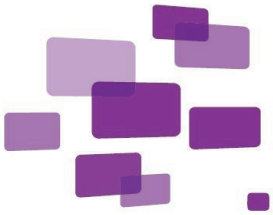
1.5.2 ETHICAL ISSUES

There are no ethical issues in relation to the Evaluation Plan and Knowledge Map. Detailed guidance on ethical issues in relation to data collection will be prepared and included in the Evaluation Handbook.

1.5.3 IPR ISSUES

We do not believe that there are any IPR issues related to this document.

APPENDIX 1 : EVALUATION PLAN



iTEC

Designing the future classroom

WP5: Evaluation Plan

D5.1

March 31st 2011

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1 SUMMARY

This document outlines the approach that will be undertaken when evaluating each of the 5 cycles of validation in the iTEC project. WP5 is not concerned with the evaluation of the project per se but of the pedagogical strand of the project. It is concerned with what happens in the classroom as a result of participating in iTEC through WP4 and how that affects teachers' pedagogical practices. It outlines the objectives and research questions underpinning the evaluation, the underlying methodology, the data collection methods and workflow, and the approach to data analysis including criteria for success. We include the Knowledge Map undertaken as the first task of WP5 which provides an overview of current innovative practices across Europe and reviews current practices in the countries participating in iTEC validation cycles. The Knowledge Map helps to provide a base-line context in the use of learning technologies and innovative practices that currently exist in the participating countries.

In addition, we have sought to define some of the complex terminology used within the evaluation criteria in order to develop a shared understanding of the focus of the evaluation. The WP5 Agreed Definitions and Descriptions is included as Appendix A.

2 INTRODUCTION

2.1 The objectives of WP5

- To produce a knowledge map of current evidence of the use of innovative tools in classrooms.
- To engage with teachers to record the process of operationalising scenarios in classroom settings, within each project cycle.
- To establish how teachers integrate innovative technological tools within their pedagogy.
- To evaluate the impact of the scenarios in each cycle on:
    - teaching practices;
    - [teachers' scenario-specific] engagement with all stakeholders;
    - individualisation;
    - collaboration;
    - creativity;
    - expressiveness;
    - overall transformative effect and the design of the future classroom, including underlying change processes.

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The purpose of an evaluation is to identify 'merit and shortcoming' (Stake, 2004, p16) of an event, practice or programme.

iTEC's working definition of **impact** in the Project Proposal, Part B: page 71 of 79 is as follows:

> Impact is the overall achievement of an intervention on the educational system and can be described by a variety of qualitative indicators such as 'improvements in national test' or 'improved learning in schools' depending on the policy target. It is the end point of an intervention involving input, process, output and outcome. Isolating the variable that caused the impact is problematic in education.

Therefore, WP5 will consider the overall achievement and outcomes of scenarios on teaching and learning with particular regard to:

- what is considered to be good practice (by teachers and other stakeholders);
- what the enablers and barriers are;
- how the barriers may be overcome;
- whether the innovation is sustainable, transferable and scalable.

We are interested in **change** and **innovation** as follows:

> On the pedagogical level innovations are defined in terms of novel didactic solutions reflecting theoretical shifts (e.g., from a behaviourist to a constructivist perception of the learning process) or technological changes – as in ICT implementation. Pedagogical innovations may take the form, for example, of novel instructional formats, increased delegation of responsibility and control over the learning process to the students, or alternative methods for the assessment of learning. (Mioduser et al, 2003, p26)

Judgements will need to be made about the extent of change (which can vary from replication of existing practice through the implementation of technology to radical transformation) and the temporal nature of the change. The definition of pedagogical change and innovation will vary from country to country (Kozma, 2003): '*innovation often depends on the cultural, historical, or developmental context within which it is observed*' (p17). Therefore, we will work closely with the National Pedagogical Co-ordinators (NPCs) to define innovation in the context of their own countries ensuring that the definition does not include technological change alone (i.e. the adoption of technology to replicate existing practices). This country-specific perception of innovative practice will be documented in the Knowledge Map as part of each participating country's profile. In addition we can draw onreviews of current practices in participating countries in the Knowledge Map to consider progress beyond national baselines/benchmarks and explain results in terms of the underlying national conditions: the political, educational, socio-economic and technological context

Transformation is a term commonly found in educational literature and policy rhetoric, particularly in relation to the use of technology to support teaching and learning. It means more than change alone; rather it is radical or fundamental change (Fisher, 2006). Here we are adopting the following definition that: *'[t]ransformation is significant, systematic and sustained change'* (Caldwell, 2009, p4). That is it *'implies a profound or fundamental change, a metamorphosis that involves some radical innovation, not just incremental innovation. The difference is important'* (Hargreaves, 2003, p1 cited in Fisher, 2006, p294). Furthermore, a significant change in a teacher's practice must be multidimensional including changes to resources, teaching approaches and beliefs (Fullan, 2001). Sustainability will be explored as far as possible but, due to the timescales in iTEC cycles, it may be difficult to obtain more than a teacher's intention to continue with a particular scenario in the future. We will therefore consider each scenario which is selected for validation in WP4 with regard to its potential to lead to transformation in the classroom, as perceived by teachers and other related stakeholders. We will capture the change process and consider what needs to be in place in schools and national policies in order to take scenarios to scale.

The research questions are outlined below. We acknowledge that the concepts underpinning the focus of the evaluation with regard to teaching practices are complex and difficult to define precisely, particularly given that multiple interpretations may exist across national and local contexts. However, we have created, through a collaborative process, a set of working definitions (see Appendix A: WP5 Agreed Definitions and Descriptions) which define our understanding of the more complex terms. Also, we will consult with NPCs regarding the ways in which these terms are conveyed in research instruments. Additionally, the actual focus of the inquiry will depend on the specific scenarios put forward for large-scale piloting in each cycle.

2.2 The research questions

The research questions that WP5 will address are as follows:

1. What are stakeholder[1] perceptions of the impact of scenarios on:
    - Teaching practices including assessment; constructivist pedagogies: e.g. student-centred, knowledge building, self-directed, problem-based, active, peer-support; roles of teachers and learners; new learning spaces; effective uses of digital tools; and specifically:
        - Individualisation (differentiation/personalisation);
        - Social/collaborative elements of learning;
        - Creativity;
        - Expressiveness;

[1] These are the "school-based stakeholders", ie: Students, Teachers, ICT Co-ordinators (where appropriate), Head Teachers. We refer to this group of stakeholders as "S-B stakeholders"

        - Engagement with a wider range of stakeholders.[2]
    - Teacher attitudes (motivation and engagement) and teacher identity.
    - Learner attitudes (motivation and engagement), and learner attainment (skills, knowledge and understanding).
2. To what extent does scenario implementation lead to any form of transformation and which scenarios have the maximum potential to have a transformative effect?
3. How effective are iTEC national and local support and mechanisms for local implementation (including the development of technical and pedagogical knowledge and skills)?
4. How do teachers perceive the scenarios in relation to quality (how easy it is for teachers to implement a scenario including the selection and combination of a range of people, tools, resources and services; connection to current practice; what works and what doesn't work)?
5. What are the enablers and barriers to the process of implementation?

The audience of the evaluation will include members of iTEC, the commission and reviewers and other interested parties including teachers, policy makers and the wider research community. In particular, the evaluation outcomes of cycles 1-3 will be used by members of WP2, WP3 and WP4 to inform cycles 3-5 of the iTEC project.

3 THE METHODOLOGICAL APPROACH

Mixed methods in research and evaluation have been commonplace for quite some time, but in the last 20 years a mixed methodology has emerged as an alternative approach to qualitative and quantitative methodologies (Teddlie & Tashakkori, 2009). This has been evidenced by the growth in studies adopting these approaches (Bryman, 2006), a dedicated journal and mixed methods conferences and an increasing body of literature which identifies itself within this tradition (Creswell & Garratt, 2008). The following definition by one of the key contributors to this field is broad and inclusive: '*mixed methods social inquiry involves a plurality of philosophical paradigms, theoretical assumptions, methodological traditions, data gathering and analysis techniques, and personalised understandings and value commitments*' (Greene, 2007, p13). Furthermore, it is described as '*research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry*' (Taskakkori & Creswell, 2007, p4, cited in Teddlie & Taskakkori, 2009, p7). In addition to integrating the findings, however, integration can take place at any stage of the process (including data collection and data analysis) (Greene, 2007; Bazeley, 2009).

[2] These are the "scenario-specific stakeholders" with whom a teacher may engage whilst teaching with a particular scenario and with whom the teacher would not usually engage. These may include, for example, parents, members of the community, local/national/international subject experts and/or professionals, students from other countries etc.. We refer to this group of stakeholders as "S-S stakeholders"

We have adopted a mixed methods approach because '*any given approach to social inquiry is inevitably partial*' (Greene, 2007, p20), whereas mixing methods will provide additional insights and fresh perspectives for understanding the impact of ICT on teachers' pedagogies, enhance knowledge about phenomena and strengthen the credibility of the findings (Greene & Caracelli, 1997; Greene, 2007; Teddlie & Tashakorri, 2003). The main purpose is for 'complementarity' to '*seek broader, deeper, and more comprehensive social understandings by using methods that tap into different facets or dimensions of the same complex phenomenon*' (Greene, 2007, p101). However, following Greene (Green & Caracelli, 2007; Greene, 2007; Greene & Hall, 2010), we are mindful of the value of a dialectical stance to mixed methods. We agree with Greene and Caracelli (1997, p12) that *'[c]ontrasts, conflicts and tensions between different methods and their findings are an expected, even welcome dimension of mixed-method inquiry, for it is in the tension that the boundaries of what is known are more generatively challenged and stretched*.' The dialectical '*design is interactive and recursive, featuring intentional "conversations" among the data sets from the different methods at multiple points in the study*' (Greene & Hall, 2010, p139). Given the cyclical design in iTEC, there will be many opportunities to generate such conversations between data sets and the outcomes of this endeavour will both inform findings and further iterations of the evaluation process.

The quantitative and qualitative data collection methods will follow the component design (Greene & Caracelli, 1997) and be conducted independently of each other but the analysis will be integrated. Data will be collected concurrently in each cycle; all methods will have equal status. A survey of participating teachers will be conducted towards the end of each cycle to obtain an overall picture of their perception of the innovation, including the change process and impact. In addition, case studies of individual teachers, capturing their perceptions from the start of their experience and drawing on a variety of data collection tools (interview, observation, teacher multimedia stories), will enable the complexities of innovation and change in the real classrooms to be teased out. The data will be analysed in an integrated approach as outlined in section 6 below.

An online questionnaire survey will be used to collect perceptions from all participating teachers during each cycle. Whilst response rates for surveys are declining globally (Krosnick, 1999) we assume that the National Pedagogical Co-ordinators will take local action to ensure that response rates are maximised (preferably 100% and no lower than 80%). The questionnaire will be administered through the online teacher community of practice set up through WP4. In negotiation with NPCs, alternative forms of the questionnaire may be offered in order to maximise response rates (for example, paper-based or via email). A survey is necessary due to limited resources. It will provide data through systematic collection which can be aggregated and explored for patterns and trends. However, it is not possible to develop such instruments to the extent that the complexity of innovation can be teased out and explored in depth. To minimise translation requirements we will be reliant on closed questions rather than open-ended questions resulting in statements. In addition localisation may be necessary given the potential for cultural understandings of complex terms to differ. Therefore, the data collected will

necessarily be reduced to a series of pre-specified responses. Any differences in wording due to localisation will be taken into account when decisions about aggregating questionnaire data across countries are taken.

To complement this, case studies will enable us to focus on the particularity and complexity involved in the implementation of scenarios (Stake, 1995). The boundary of each case will be a teacher implementing a scenario with a particular class of learners (see below for further information on sampling and selection criteria). It is a multiple-case design (Yin, 1994) involving two/three cases from each country, during each cycle. Furthermore, the stance will be evaluative, not only describing the implementation process and outcomes, but also making judgements about the 'success' of each (see evaluation criteria for success below) such that teachers, education managers and policy makers '*will use [our] findings to decide whether or not to try to induce change*' (Bassey, 1999). As the case study schools will be selected prior to the implementation according to selection criteria, each one will be judged as being successful to varying degrees and case studies may include implementations that are problematic and not sustainable, as well as those that may be transferable and scalable. The data collection will be semi-structured through the use of semi-structured interview schedules and templates for case study reporting. A lesson will be observed and "S-B stakeholders" (see foot-note 1 above) will be interviewed (as described below). In addition, teachers will produce multimedia stories of their journey which will describe the implementation process in greater detail and enable them to reflect on the outcomes. We acknowledge that this process of engagement and reflection in the evaluation may well influence the outcomes, but we see this as a positive and welcome aspect of the evaluation design. Indeed, it is a natural process that many teachers will adopt (perhaps less visibly) when considering change to their practices. We believe that, although a case study teacher will be required to commit more time to the project than other teachers involved in iTEC (see 4.3.1 below), the approach will provide mutual benefit: teachers usually welcome the opportunity to share their reflections with other professionals (via the interview and via the multimedia stories); researchers are able to access specific data related to specific teaching and learning activities.

3.1 Selection of iTEC classrooms

For clarification we are defining "classrooms" as "classes of learners" simply because one teacher may engage with one scenario narrative with more than one of his/her classes (for example 2 classes in the same year group but of differing abilities OR 2 classes in differing year groups etc.) As teachers and educationalists know, no two classes have the same "chemistry" and therefore the different "class" responses to the same scenario could vary (and, indeed the same classroom might be differently managed/arranged/organised for different classes of learners even if they are engaged in the same scenario).

The teacher implementing a scenario could teach all the lessons in the same "classroom" (for example a secondary science teacher might teach in the same lab all the time), but having used the same scenario with 2 different classes, that one teacher will contribute 2 of the 1000 "classrooms" expected to validate the scenarios developed in the project. Teachers will need to be aware that, if they use the same scenario with more than 1 class, they will need to complete a questionnaire for every class that is involved in the scenario pilots. For this reason, it is recommended that no teacher uses more than 2 classes for any one scenario.

Although a teacher may have taught several lessons to one class (related to one scenario), that one class of learners would only count as one 1 of the 1000; i.e. "class" does not equate to "a single lesson".

The term “classroom” will continue to be used in all iTEC documentation in order to ensure linkage with all work packages, but “classes” as described above will be assumed throughout.

The Performance and Research indicators have been used to generate the sampling strategy and selection criteria for schools and for case study schools (separate criteria). They are explained in the DoW Part B on page 20. They are important for the success of the validation and the evaluation processes.

Indicator	Minimum	Maximum
Number of scenarios taken to large scale per cycle min/max (decision taken by all WPs)	2	3
Minimum number of classrooms involved per cycle in large-scale testing (WP4)	250	
Minimum number of countries involved in testing each scenario in a large-scale pilot (WP4)	5	13

A country must participate in at least 4 cycles.

Each country must participate in the first cycle and provide a minimum of 10 classrooms. Please note that the indicator relating to the number of classrooms involved in each cycle will not be met in the first cycle – this is an exception. For example, a MoE could involve a small number of schools (i.e. only 3-5). It is actually preferable in the first cycle to start with a small number of schools in order to try out the implementation and evaluation procedures.

Our assumption is that a scenario may be piloted in more than one cycle, possibly with some form of further refinement or additional development. If so, then it would be desirable to pilot a scenario for a second time with schools which piloted it the first time and also new schools which have no prior experience of the scenario.

New classrooms can be introduced to the project during any cycle.

3.2 iTEC School selection criteria

To be an iTEC school, the school should have:

- A supportive head teacher/senior management team who will commit to the project and who will provide feedback on the organisational changes that may be required by some of the iTEC scenarios in order to ensure their full implementation within their school.
- At least two ICT confident teachers (who could also be the headteacher or a senior manager) who are:
    - Making innovative and effective use of learning technology/technologies in a classroom (preferably a learning environment other than the school's computer suite/ICT room).
    - Motivated to experiment with new learning technologies and innovative pedagogical approaches and who are willing volunteers and prepared to commit to the project.
    - In a permanent post in the school, in order to warrant continuity of work in the school over a sustained period.
    - Willing and committed to be involved and deeply engaged in a long term project (that could be linked with graduate studies in the field of ICT in education,) From a range of teaching subjects and school levels to ensure that a variety of subjects and levels are represented across iTEC as a whole (teachers from the same school need not be from different teaching subjects but it would be preferable if they were).
    - In an influential role such as ICT co-ordinator, lead teacher or school-based teacher trainer.
- A designated ICT co-ordinator (in primary schools this may be one of the above ICT confident teachers) willing to commit to and support the project.
- ICT technical support for the teachers involved in the project (desirable).

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Therefore, the selection strategy is purposeful and those involved will represent innovative ICT teachers, but not necessarily all teachers. This approach is considered to be essential in order to avoid drop-out or limited progress. The teachers involved need to be willing to try out new approaches and to be innovative in the classroom.

3.3 Meeting the required numbers of classrooms (classes)

- Over the course of iTEC each country will provide data from an agreed number of classes as negotiated with the WP4 leader on a case-by-case basis (typically around 80). However, the same teachers (and, indeed, the same classes) could be involved in more than one cycle in order to achieve this. And the same teacher could provide data for more than one class.
- We do not expect any one country, over the life of the project, to collect data from more than the agreed number of classes. MoEs may wish to identify several teachers from within a single school, though no teacher should engage with the scenario with more than two classes (see Section 4, paragraph 2)
- It will be acceptable for a country to involve more than the agreed number classes if they wish to do so.
- Each country needs to identify **at least** 40 classes for **at least** one cycle (which we suggest should be in cycles 3, 4 or 5).
- The selection of scenarios to be implemented in each cycle will need to be negotiated with the leader of WP4 as we need to ensure that at least 5 countries pilot each available scenario during each cycle. In the cycle when a country offers 40 classrooms it would be preferable for those classrooms to pilot the same scenario in order to be able to conduct quantitative analysis on a country-by-country basis as well as aggregate responses across the whole project.

The following is an example of what one country's involvement might look like:

- A country agrees to provide 80 classrooms
- 5 classrooms participate in the first cycle
- 15 classrooms participate in the second cycle
- 40 classrooms participate in the third cycle
- This country does not participate in the fourth cycle
- 20 classrooms participate in the fifth cycle

3.4 Case study selection criteria for each country participating in a single cycle

Case studies are likely to include scenario implementations which will be judged as being 'successful' to varying degrees. In each cycle, each participating country's NPC should identify 2-3 case study schools PRIOR to engaging in the pilot. This is necessary in order for teachers to fully document the process of implementing the scenario. 3 case studies are required from each participating country in each cycle and NPCs will need to identify 3 case study teachers from their selected case study

schools. The same case study schools (and teachers) could be used in every cycle if preferred, but this is not a specific requirement. There will inevitably be greater demands on case study teachers (see 4.3.1 below) and NPCs should consider possible incentives for these teachers. In addition, these teachers will be acknowledged in all applicable evaluation reports unless they request otherwise.

3.4.1 What is a case study teacher's required commitment?

It is worth noting here, that the time a teacher uses to engage with the scenarios in each cycle could be highly variable as teachers understandably will want to make use of the scenarios in their own particular ways (eg: one teacher may wish to use the scenario during one lesson, whilst another teacher may wish to use the same scenario over a series of lessons). Any variation in engagement with the scenarios is acceptable for the purpose of case study evaluation (as long as scenario engagement falls within the specified piloting period). However, it is the responsibility of the NPCs to discuss issues related to time allocation with the selected teachers and their Head Teachers/school managers.

In order to show the extra commitment a case study teacher needs to make, the requirements for all iTEC teachers are listed below and requirements that are **additional** for fully engaged case study teachers are highlighted in bold.

All teachers new to the project will first be introduced to iTEC and then will engage in the following:

1. Training and introduction to the scenario.
2. Planning one or a series of lessons to teach using the scenario (including resource preparation).
3. Teach one or a series of lessons using the scenario.
4. **Be observed whilst teaching one of the scenario lessons.**
5. **Be interviewed after observed lesson *(approx 20-30 minutes).***
6. **Arrange for a group of 6-8 students (from the observed lesson) to be interviewed by the lesson observer as soon after the lesson as possible *(approx 15 minutes to select students and to book interview room).***
7. Reflect on and evaluate the observed scenario lesson **(using a template provided by WP5).** Although it is assumed that all teachers engage in reflective activity, the case study teacher would be required to reflect specifically on the lesson that has been observed and to submit this on a profoma to be sent to the NPC as soon after the lesson and interview as possible. ***(approx. 20 minutes added to their usual lesson evaluation time)***.
8. Communicate/network (throughout the above activities) with other teachers involved in scenario piloting.
9. **Write a multimedia story in diary/journal style about their holistic experience of the scenario (using a template provided by WP5) *(approx. 2/3hours over the scenario implementation).***

10. Complete the on-line questionnaire as soon as their scenario pilot has been completed.

The 2-3 schools selected as case study schools from which the 3 case study teachers will be chosen must:

- Be representative of the range of schools involved in iTEC nationally (ie according to proportions of primary and secondary schools) in the cycle.
- Be representative of all schools in the country (as far as possible given the school selection criteria) with no more than one classroom from a school that is considered to be highly innovative (i.e. atypical) in terms of the use of technology to support teaching and learning.
- Have access to the appropriate technology to support the scenario implementation (the technology available may or may not meet the requirements for the scenario; in the latter case the scenario may be partially implemented or alternative tools may be adopted).

The teachers involved must represent a range of teaching subjects including at least two from Science, Technology, Engineering or Mathematics.

4 DATA COLLECTION

Data will be collected from the following sources and events (detail is presented in the relevant tables) for each cycle in iTEC. Examples of dates are given for the first cycle. Data will be obtained for two purposes: firstly to document the context of the development of the scenarios prior to implementation in the classroom and secondly in relation to the specific research questions as presented in the introduction above.

Please note the role played by the National Pedagogical Co-ordinators in WP5. This work has been described in the document entitled “iTEC National Co-ordinators: profile, role and tasks” circulated via the iTEC email distribution list on November 26th 2011.

As the NPCs will be responsible for ensuring that data collection follows the evaluation guidelines, protocols and instruments, these will be provided as an Evaluation Handbook for NPCs at a virtual meeting in M9 (June).

4.1 Focus of evaluation of large-scale pilots

The main focus of the evaluation is presented in the diagram below. However, data relating to the following preparatory events/processes (carried out by WP2/WP3/WP4) will be collected in order to provide a context for the evaluation:

- 20 scenarios proposed
- Scenarios transformed to prototypes
- Pre-pilots of prototypes
- 2-3 scenarios selected for large-scale pilots

4.2 Scenario Development and Selection

Data will be collected to capture the scenario development and selection processes in order to provide a context for the evaluation of the large-scale pilots. All data

collected to inform this part of the evaluation will be drawn from reports and documentation as indicated below.

Where WPs have no documentation specific to the evaluation context requirement, they will be required to complete a short pro forma provided by WP5.

Scenario Development and Selection		To capture data, WP5 needs: *what, from whom and when collected?*	*Research Questions*
A1	Jan: Scenarios proposed	Documentation/reports relating to the start of the scenario development and selection process **From:** WP2; **When:** M8	Context
A2	Feb-April: Scenarios transformed to prototypes to be tested in pre-pilot schools	1. Feedback from the Participatory Design workshops 2. Other documentation/reports relating to the continuing development of the scenarios **From:** WP3; **When:** M11-M12	Context
A3	April: NPCs run pre-pilot sessions with up to 9 scenarios	Documentation relating to pre-pilot testing of the scenarios, including any evaluation/feedback from teachers/school staff **From:** WP3; **When:** M11-M12	Context RQ3 RQ4
A4	May (beg): Selection of 2/3 scenarios for large-scale pilot	Documentation/reports relating to scenario selection process **From:** WP4 (with WP3, WP5 and WP6); **When:** M11	Context

4.3 Workshops and Training (Cycle 1 only)

4.3.1 Workshop One: (for all National Co-ordinators).

Mar 28/29: The first National Co-ordinator Training workshop for all NPCs and NTCs. This is a face-to-face workshop to introduce National Co-ordinators to iTECs expectations, workflows and tools and is provided by WP3, WP4 and WP6. WP5 will have an opportunity to provide a brief overview of the large-scale pilot evaluation procedures. WP5 will also make field notes from observation of event. (A3)

4.3.2 Workshop Two: (for National Pedagogical Co-ordinators).

May: NPCs will attend one half-day online workshop during which the evaluation approach, protocols, research instruments and all evaluation/data collection requirements will be explained and discussed in detail. WP5 will provide all those involved in data collection with an Evaluation Handbook which includes full and detailed guidance on all aspects of data collection. (A6)

Workshops		To capture data, WP5 needs: *what, from whom and when collected?*	*Research Questions*
A5	March 28/29: Workshop One: NC Training	Documentation relating to the training process (including participant evaluations of the event) **From:** WP3, WP4 and WP6; **When:** M8	Context RQ3
A6	May: Workshop Two: NPC Evaluation briefing	Participant evaluations after the event **From:** NPCs; **When:** M10	Context RQ3

4.4 National Pedagogical Co-ordinators' Preparation for implementing the Large-scale Pilots

As well as attending the two workshops described above, NPCs will be involved in a series of activities in preparation for the implementation of the large-scale pilots. WP5 will require data from the following preparatory activities:

1. Early May: In order to capture each country's baseline expectation of "innovative practice" (that includes the use of ICTs/learning technologies), NPCs are required to provide WP5 with up to 1 side of A4 describing what they might expect to see in classrooms where teachers are engaged in "innovative pedagogy" and their learners are engaged in "innovative learning". This will be entered in the Knowledge Map as The Knowledge Map helps to provide a base-line context in the use of learning technologies and innovative practices that currently exist in the participating countries.
2. End of May: deciding on scenarios to run in their countries (A7)
3. June-August: EUN; Promethean, Smart, Icodean help NPCs to "localise" the scenarios (A8)
4. Early June: identify schools, school iTEC Co-ordinator, teachers and classrooms according to selection criteria (as outlined above). (A9)
5. June: NPCs profile schools, teachers and classrooms and information fed into EUN data-base. (A10)
6. June-Sept: identify 3 teachers from two-three **case study schools** who will participate fully in the evaluation (see 4.3.1). (A11)
7. June/July: NPCs prepare all iTEC teachers for pilots per scenario: design and deliver local face-to-face and online workshops; animate online Communities of Practice. All iTEC teachers attend preparation workshops to include:

    - Project overview
    - Introduction to scenarios

- Online facilities for their use
- Communications/Communities of practice
- Evaluation requirements (individual stories, online questionnaires etc) (A12)

In addition to the preparatory activities involving teachers as outlined in point 7 above, NPCs will arrange translation of research instruments in June (at least 2 weeks prior to their planned use) and introduce all case study teachers to multimedia stories and the protocols for their lesson observation/s and subsequent interviews.

September: A questionnaire for NPCs is prepared by WP4 to capture the NPCs' reports on the workshops, the training and teacher support.

WP5 will interview NPCs online during the fourth month of each large-scale pilot cycle. Interviews will last for approximately one hour.

NPCs' Preparatory Activities		To capture data, WP5 needs: *what, from whom and when collected?*	Research Questions
A7	Select scenarios	Interview data **From:** Interview with NPC; **When:** M16 (see above)	Context RQ3; RQ5
A8	"Localised" scenarios	Docs/reports related to process of "localisation" **From:** Commercial Partners and EUN **When:** M10 Interview data **From:** Interview with NPC; **When:** M16 (NPC interview)	RQ3
A9	Select iTEC schools etc	Docs/reports related to school selection process; **From:** WP4; **When:** M10 Interview data **From:** Interview with NPC; **When:** M16 (NPC interview)	RQ5
A10	Profile schools etc	Information exported from the EUN Teacher data-base **From:** EUN; **When:** M11/12	RQ5
A11	Identify 3 case study schools	Docs/reports related to school selection process; **From:** WP4; **When:** M10 Interview data **From:** Interview with NPC; **When:** M16 (NPC interview)	RQ5
A12	Prepare and train teachers	Access to the results of WP4's questionnaire on the outcomes of teacher preparation **From:** WP4; **When:** M11/12	RQ3; RQ5

4.5 All iTEC Teachers (during the large-scale pilots)

In all iTEC schools, the NPC (through and with support of the school iTEC Co-ordinator) ensures implementation, monitors progress, provides support and enables peer support using online tools and services. Of course the NTC will also have a role to play here but as the NTC's role does not include evaluation we are not outlining the role of the NTC in detail here.

Throughout each of the scenario implementation cycles (M13-16 for Cycle One), all iTEC teachers will be encouraged to share their individual experiences through the iTEC online community of practice and to complete an online questionnaire.

4.5.1 iTEC online community of practice.

Where possible (depending on translation requirements) **qualitative** data will be collected from contributions iTEC teachers make to the community of practice. Data from these may be used to illustrate different approaches to change and to provide exemplars of good and interesting practice. (A13)

4.5.2 Online questionnaire.

At the end of each scenario implementation cycle, **all participating iTEC teachers** are required to complete the online questionnaire/survey. It will take no longer than 20 minutes for teachers to complete. This will be verified by piloting the questionnaire prior to cycle 1.

The online survey will collect **quantitative** data to capture perceptions from all participating teachers in relation to:

- The impact of the technology/scenario on:
  - teaching practices;
  - learner attitude and attainment;
  - individualisation;
  - social/collaborative elements of learning;
  - creativity;
  - expressiveness;
  - engagement with stakeholders.
- The overall transformative effect of the technology/scenario.
- Classroom design.
- National approach to project introduction and implementation.
- Local support for the project; technical and professional.
- What works and what doesn't work.
- Barriers/enablers.

- Good practice.
- Overall perceptions of the project, scenario and technology. (A14)

Activities for all iTEC Teachers		To capture data, WP5 needs: *what, from whom and when?*	Research Questions
A13	iTEC community of practice	Access to teachers' community site in order to collect data from on-going online discourses relating to teachers' experiences of implementing the scenarios **From:** teachers' community site; **When:** M13-16	RQ1; RQ2; RQ3; RQ4; RQ5
A14	Online questionnaire	Access to completed online questionnaires **From:** teachers (encouraged by their school iTEC co-ordinator); **When:** M15/16	RQ1; RQ2; RQ3; RQ4; RQ5

4.6 Case study schools

4.6.1 National Pedagogical Co-ordinators and case study schools.

a. NPCs will identify **2-3 case study schools** in each of the four or five cycles in which they participate. (A11)

b. Data collection is conducted in the 2-3 case study schools (one day per case study teacher) in each cycle. NPCs should choose a day when the case study teacher(s) will be implementing the scenario with at least one class. (A15)

c. Data will be collected from these schools (using the guidelines from the Evaluation Handbook provided by WP5) by:

- Observing and taking field notes of at least one scenario lesson (30-60 minutes). Lessons may be visually recorded (with relevant permission granted) for the NPC's personal recall purposes.
- Collecting any documentation related to the lesson (e.g. Lesson Plan and teacher evaluation [pro forma provided by WP5], copies of any resources used etc). Pictures or video clips may be included on condition that relevant permissions are granted. This should be undertaken following local/national guidelines. Exemplar forms will be provided if local/national guidelines do not exist.
- Interviewing the teachers whose lesson they have observed (20-30 minutes). The interviews with teachers will be digitally recorded and will focus on the impact of the technology/scenario on their teaching practices, learner attitude and attainment, engagement with stakeholders, individualisation, social/collaborative elements of learning, creativity, expressiveness, the overall transformative effect and implications for the design of the future classroom.
- Interviewing 6-8 students (representative of the whole class in terms of gender and ability) from the observed lesson (20-30 minutes). These will focus on student perceptions of changes in their engagement in and attitude to learning, their attainment, individualisation, social/collaborative elements of learning, creativity, expressiveness, the overall transformative effect and implications for the design of the future classroom.
- Interviewing case study schools' ICT co-ordinators (20-30 minutes) and Head Teachers (20-30 minutes).These interviews will capture qualitative data on the change management process and will facilitate the generation of lessons learned and key success factors in operationalising the scenarios. (A15)

d. The NPC, making use of the collected data, writes a short report for each case study school, (approx 3 sides A4 per school using a pro forma provided by WP5). (A15)

e. In Cycles 3, 4 and 5, the NPC selects one of the case study schools and arranges transcription and translation of all the data. The translated data from this school is then passed on to WP5 for analysis. The NPC is not expected to write a report on this selected case study school.

f. Multimedia Stories

Data will be collected from the online multimedia stories that **all case study teachers** are required to write in order to capture their experiences of:

- how they integrate technologies in their existing pedagogies
- pedagogical change
- CPD design/effectiveness
- barriers/enablers

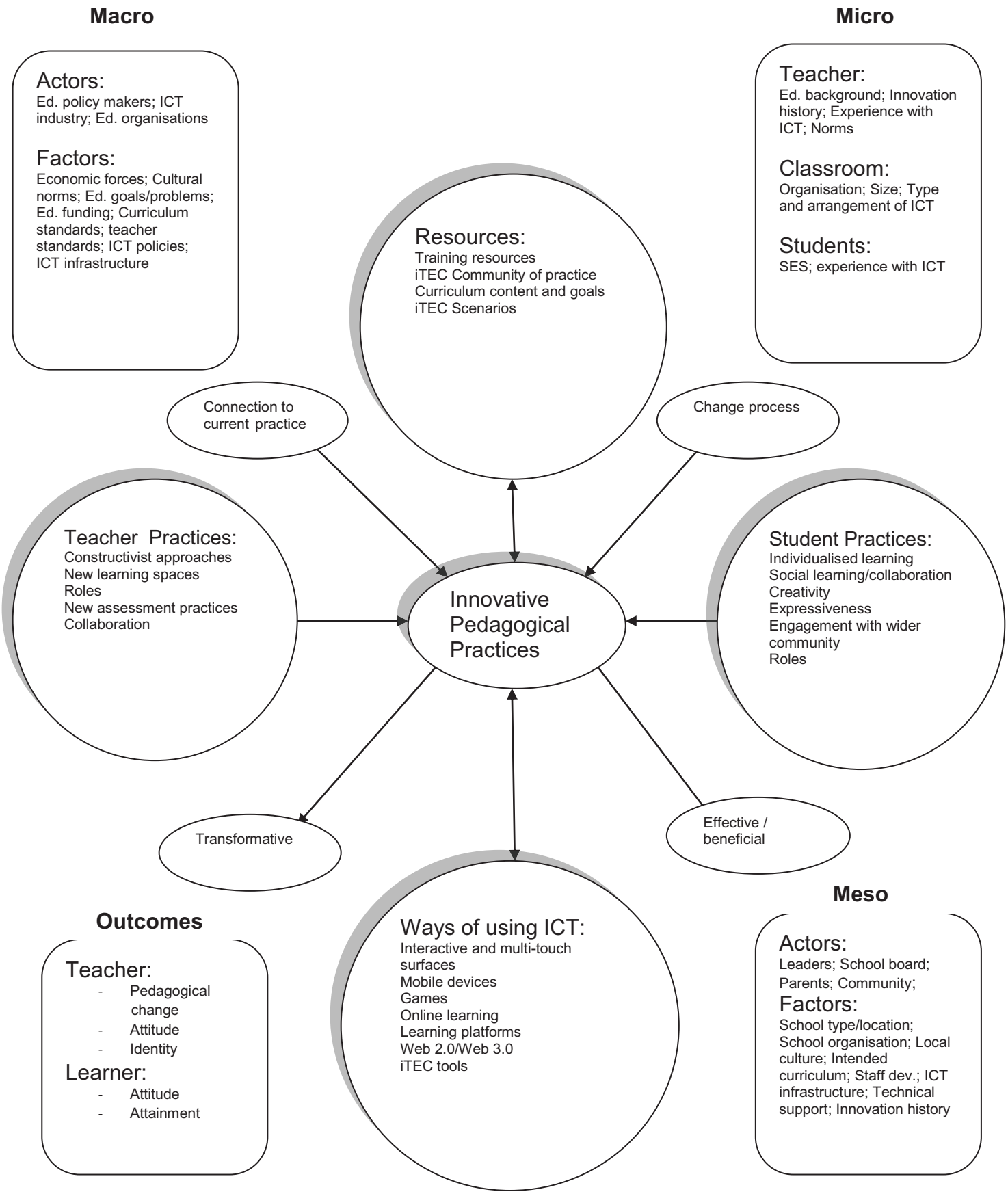
Teachers should start their multimedia stories as soon as they become involved in iTEC and they should be completed when the scenario implementation cycle ends. Multimedia stories will include media such as photographs, video clips, text, diagrams and voice (as appropriate and depending on local availability of suitable technologies) to capture the process in ways which are not time-consuming or intrusive. They do not need to be polished pieces – rather they will be collections of media from different stages of the implementation process, documenting teachers' experiences and brief reflections (similar to keeping a diary). We estimate that this might involve 2-3 hours work over a four month period (for example spending 10-15 minutes at regular intervals documenting the process in the fastest possible way, perhaps 30 minutes when the scenario is actually implemented in the classroom). Completed multimedia stories should be uploaded to the Community site. (A16) Guidelines on the outline requirements of a multimedia story and an exemplar multimedia story will be provided online (by WP5) to support this activity.

NPCs data collection in CS schools		**To capture data, WP5 needs: *what, from whom and when?***	**Research Questions**
A15	NPC carries out case study data collection activities as described in 5.6.1.c above	A short report on each case study school using a pro forma provided by WP5 (approx 3 sides A4 per school). **From:** NPCs; **When:** M16 Interview data from NPC interview **From:** NPCs; **When:** M16	RQ1; RQ2; RQ3; RQ4; RQ5
A16	Multimedia stories as described in 5.6.1.d above	Access to online multimedia stories **From:** teachers (encouraged by their school iTEC co-ordinator); **When:** M15/16	RQ1; RQ2; RQ3; RQ4; RQ5

WP5 will undertake three two-day visits to separate countries (each country to be visited once during the lifetime of the project; three countries each cycle). The visit will be timed to coincide with the National Co-ordinator's data collection in schools such that the WP5 team member will accompany the NC in an observational role. This and the NPCs' interviews will offer a form of triangulation for data analysis.

Deadlines indicated in the tables above are dictated by WP5's need to ensure "Timely provision of data (WP5) that enables each iTEC cycle to be distinctively shaped by the findings of the preceding cycle." (Part B: page 20 of 79)

4.7 WP5 Conceptual framework (adapted from Kozma, 2003, p12)



The conceptual framework adapted from the SITES 2 study (Kozma, 2003) will be used to inform the development of the data collection instruments for both the survey and the case studies together with the research questions (outlined in the introduction) and key descriptors of educational change underpinning the scenario development in each cycle (see below for cycle 1).

4.8 The 20 key descriptors of educational change developed in WP2, Cycle One

The following descriptors were developed during the first cycle by WP2 and have been used to underpin the development of the scenarios in the first cycle. They have been included here for completeness. They will not be used as evaluation criteria in their own right but they will be checked against the data collection instruments to ensure that the descriptors are covered.

Roles

There is an increase in child centred learning with the teacher building links between children's interests and curricula

All learners have opportunities to work and collaborate with learners in other places

Learners are able to access formal education at any time of the day

Teachers become more involved in helping students learn autonomously at their own pace

Aims, objectives, curriculum and assessment

Digital technologies allow schools to use assessment data to personalise their teaching

Teachers use bodies of connected evidence from a variety of media to assess students

Teachers focus on developing '21st century skills' e.g. collaborative and social skills

Learners work on projects, doing authentic tasks and using technology creatively to tackle real challenges

There is an increased focus on 'new media literacies'

More creative approaches are used in education

Schools begin to develop courses and careers advice for a variety of mixed aged learners, including older and younger students

Influential corporations and global organisations have agreed standards of 21st century skills, such as problem solving, collaboration, negotiation

Spaces

The needs of students with special educational needs are taken into account when planning new schools (classrooms, furniture, technology)

The flow of information between home and school becomes seamless, possibly using digital technologies

Learning spaces are designed to accommodate different learning activities

The school library becomes a multipurpose learning space

Technology and resources

Collaborative web 2.0 technologies allow learners to learn from each other as part of their formal education experience

Use of interactive touch surfaces increases

Schools use technology that can automatically adapt to the ability of the students in order to teach them more effectively

Learners can search across repositories on the web, where contents are categorised and checked for quality and reliability

5 DATA ANALYSIS

5.1 An integrated approach to data analysis

Survey data will be aggregated. This will enable the identification of common patterns but responses from individual teachers may be 'qualitised' to provide examples of particular experiences. Data will also be explored for potential differences along dimensions such as country/gender, gender and teacher experience.

In the case study data we will be mindful of absence as '*there is no guarantee that all participants in the research process will be equally comprehensive in their discussion of the topic, raising the issue, for example, of whether absence of mention of a topic represents lack of importance, deliberate omission, or a temporary lapse in attention*' (Bazeley, 2006, p71). Drawing on the approach undertaken in SITES Module 2 (Kozma, 2003) we will ensure that the case study reports are comprehensive by

providing National Pedagogical Coordinators with a structured template which will include narrative prose and a data matrix requiring short answers with any assertions warranted by evidence. The narrative summaries and responses gathered through the data matrix, together with relevant data gathered by WP4 in the school and teacher database, will be 'quantisised' through systematic coding, to be undertaken by MMU staff – the WP5 co-ordinators. The consistency of coding across WP5 co-ordinators will be checked through inter-rater reliability procedures at each cycle. The case study data will then be subjected to a cross-case analysis in order to seek patterns across the data set. In addition, individual case studies may be used to illustrate interesting (possibly unique) change processes and emerging practices through the development of short pen-portraits (short pieces of text describing a particular event or practice). These will be identified through an iterative selection process involving all members of WP5 to avoid individual bias and to ensure that the selected pen-portraits will be informative for the audience of the evaluation including teachers and policy makers.

In cycles 3, 4 and 5 we will also receive fully translated and transcribed original data (e.g. interview transcripts, lesson evaluation) from one of the three case studies conducted in each country. This will enable triangulation to occur but will also enable us to analyse the data in more depth, using the same coding framework as applied to the case study reports written by the National Pedagogical Co-ordinators but also subjected to narrative analysis, if appropriate, for illustration purposes.

The emerging findings from each data set will be used to review the other. For example, patterns emerging in the survey data could be used to interrogate the qualitative data and patterns arising in the 'quantisised' qualitative data will be compared with those arising in the survey data. Therefore we will adopt an iterative thematic analysis – drawing on both an initial (and continually revised) conceptual framework and also any additional themes emerging from the data. Computer based analysis of the qualitative data will enable this integration to happen more readily (Bazeley, 2006). As described above we will also continually check data sets and the outcome of analytical stages for tensions and dissonance to bring into focus any further investigation required and if necessary we will adapt the evaluation process for further cycles thus developing an iterative evaluation approach.

At the end of each cycle, the inferences (conclusions, explanations and understandings) from each data set will be integrated to form a single set of warranted assertions (supported by data of all types) in relation to the evaluation objectives outlined above (Greene, 2007) and also the evaluation criteria for success below. The evaluation report for each cycle will be shared with WP5 partners, other members of the iTEC team and participating teachers.

Both qualitative and quantitative data and the evaluation reports from early project cycles (Cycles 1-3) feed back into the later cycles of scenario development (Cycles 3-5). The Evaluation Plan, including all research instruments and protocols, will be reviewed and updated at the end of each project cycle. The Tables above are, therefore, necessarily focused on activities specific to Cycle 1.

Both qualitative and quantitative data and the evaluation reports from each project cycle also feed into the work of the high-level group (Cycles 1-5) of policy shapers in WP11. Conclusions will be drawn from iTEC data, therefore, in order to help define strategies for TEL in schools at both national and international level and also to help inform Commission research programmes.

5.2 Evaluation criteria for success in relation to the evaluation of large-scale pilots

The use of evaluation criteria in iTEC will inevitably include a degree of subjectivity (Stake, 2004) particularly as the data collected will largely concern teacher and stakeholder perceptions. However, the criteria for success will offer a framework for analysing the data such that specific characteristics will be fore-grounded when making judgements about merit and short-comings (Stake, 2004). Rather than a standards-based approach to evaluation we are adopting a responsive approach (Stake, 2004) with '*more attention to interpretive observation rather than criterial measurement*' (ibid, p90).

NOTE: Where the criteria below refer to "scenarios", the following definition (from the iTEC Global Glossary of Terms; accessed: 14.3.11) is assumed:

Definition: A narrative description of a preferable learning context that takes account of user stories, including the description of resources and the functionalities needed, the interactions they have, the tasks they perform and the aims of their activities, set within a description of the model learning environment.

Characteristics/Relations: An Educational Scenario is supported by a set of technological tools already available at school (local technology) and the iTEC project (iTEC technology).

The evaluation criteria below are not presented in priority order. They are numbered only for ease of access.

1. The set of training resources produced for teachers is perceived by the teachers to be supportive of their continuing professional development in relation to the technical and pedagogical skills required to integrate digital tools into their teaching practices.
2. There is evidence that the training resources are:

    a. made available to support all teachers;
    b. perceived by teachers to be useful and appropriate to their needs;
    c. easy to locate and access;
    d. easy to adapt to suit local contexts.

3. Software developed specifically for iTEC (e.g. composer, shells, registry, SDE) is perceived by S-B Stakeholders[3] to be fit for purpose and easy to use.
4. Teachers' technical skills and understanding of the pedagogical use of digital tools increases.
5. Communities of practice, supported by online communication and collaboration tools, are established and are:

    a. Actively used by teachers;
    b. Perceived by teachers to be easy to use and fit for purpose.

6. The scenarios used by teachers in the pilots are perceived to be innovative by all stakeholders, whilst remaining connected to current practice, in the context in which they are adopted (nationally, regionally, locally).
7. Scenarios used by teachers in the pilots are successful and of good quality when they are supported by evidence that they:

    a. Engage and enthuse teachers and students;
    b. Are perceived to contribute effectively to teachers' and students' objectives and practices;
    c. Have a positive impact on learner attitudes and attainment (teacher perceptions, other measures such as national test outcomes or end of term grades);
    d. Have a positive impact on teacher attitudes to their use of technology to support teaching and learning;
    e. Require relevant and appropriate use of digital tools (ie: the scenario could not be undertaken just as appropriately/efficiently without the use of the digital tools);
    f. Present achievable technical challenge (ie: they are challenging, but not too difficult to adapt/implement);
    g. Are perceived by S-B stakeholders and NPCs (who will liaise with NTCs) to be technically sustainable and scalable;
    h. Would be recommended by participating teachers for regional/national dissemination.

8. There is evidence that the adoption of a scenario will lead to a long-term change for a teacher (and possibly for the school overall) in relation to one or more of the following teaching practices:

    a. New approaches to assessment procedures which are considered to be more authentic (valid, reliable and useful to teachers and students) than previous assessment practices;
    b. Adoption of approaches to teaching that change the ways students learn (e.g. student -centred, knowledge building, self-directed, problem-based, active, peer-support);
    c. Shifts in the roles of, and relationships between, teachers and students;

[3] "S-B stakeholders" are school-based stakeholders, ie: Students, Teachers, ICT Co-ordinators (where appropriate), Head Teachers.

d. Creation of new learning spaces within and/or beyond the boundaries of the classroom;
e. Appropriate, innovative and effective uses of digital tools;
f. Teachers' approaches to:

    I. Individualisation/personalisation (differentiation);
    II. Social/collaborative elements of learning;
    III. Creativity;
    IV. Expressiveness;
    V. Engagement with a wider range of stakeholders;

9. Scenarios with the maximum potential to trigger the transformation of teaching and learning are identified.
10. Underlying change processes necessary to bring about transformation are identified.

6 SELF EVALUATION

At the end of each cycle WP5 co-ordinators together with WP partners will review all evaluation processes (using a template) in order to identify:

- What worked well;
- What did not work as anticipated and how it might be addressed for subsequent cycles.

In addition we will adopt and review the following quality assurance criteria:

- A handbook for NPCs with clear guidance on how to conduct the data collection and analysis is produced to ensure a consistent and reliable approach.
- A template for case study reports including prompts for specific data (to ensure consistency) and a short narrative (to ensure that NPCs provide sufficient detail) is produced.
- All qualitative data is analysed using NVivo; data is coded; inter-rater reliability is established.
- All research instruments are piloted prior to the first cycle.
- Assertions in case study reports are warranted by detailed descriptions and/or triangulated with data from multiple sources.
- The potential for bias in the development of data collection instruments, analysis of data, and interpretation is addressed through the involvement of 21 partners in addition to MMU staff in WP5. All partners will be invited to comment on drafts of instruments and also evaluation reports, including the final report. In this way colleagues with a wide range of perspectives and particular understanding of local contexts will be able to critique and refine the focus of the evaluation in each cycle and the interpretation of the findings.

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APPENDIX A - WP5: AGREED DEFINITIONS AND DESCRIPTIONS

WP5 is required

> "to evaluate the impact of the scenarios in each cycle on: teaching practices; engagement with all stakeholders; individualisation; collaboration; creativity; expressiveness; overall transformative effect and the design of the future classroom, including underlying change processes."

In order to ensure that all partners have a shared and common understanding of these elements, we asked iTEC partners to contribute to our thinking around the terms and phrases presented below. We have discussed all the contributions and considered authoritative sources provided by partners as well as others that we have identified ourselves.

The descriptions and definitions below are working definitions for WP5. They will serve to guide and inform our evaluation and we would like to thank all those who so kindly made such valuable contributions to our thinking.

Term/Phrase	Working Definition	Sources/References
1) "teaching practices"	The processes, procedures, strategies and methodologies used by a teacher when planning lessons, teaching students and reviewing/evaluating.	

2) "stakeholders"	There are two groups of "stakeholders" that we refer to in our Research Questions (see: section 2.1). We differentiate the two groups in the following way: 1. *"What are **stakeholder** perceptions of the impact of scenarios on . . . "* These are "**School-based stakeholders**", ie: Students, Teachers, ICT Co-ordinators (where appropriate), Head Teachers. We refer to this group of stakeholders as "**S-B stakeholders**". 2. *"Teaching practices including . . . Engagement with a wider range of **stakeholders**"* These are "**Scenario-specific stakeholders**" with whom a teacher may engage whilst teaching with a particular scenario and with whom the teacher would not usually engage. These may include, for example, parents, members of the community, local/national/international subject experts and/or professionals, students from other countries etc. We refer to this group of stakeholders as "**S-S stakeholders**".	
3) "individualisation" and "personalisation"	"Individualisation" requires intentional teacher consideration of and provision for the learning needs of individuals within a group or class of students. It is not about letting students work and/or learn alone. "Individualisation" includes elements of "personalisation" in that	*Department for Education (DfE):* http://nationalstrategies.standards.dcsf.gov.uk/node/83603 (Accessed 1.2.11)

	it . . . "has an emphasis on: • identifying what individuals already know, what they need to do to improve and how best they can do so. • . . . developing effective teaching and learning skills through a range of whole class, group and individual teaching, improving learning and ICT strategies so as to best transmit knowledge, to instil key learning skills and to accommodate different paces of learning." (DfE; accessed 1.2.11)	
4) "collaboration"	"Collaboration" is the way individuals work together in order to achieve a goal and Michinov and Michinov (2009:43) suggest that "(collaborative) learning is a result of interaction or transaction between students."	*Michinov,N. & Michinov, E. (2009) Investigating the relationship between transactive memory and performance in collaborative learning. Learning and Instruction. 19 (43-54)* *See also:* *Smith, B. L., & MacGregor, J. T. (1992). "What Is Collaborative Learning?". National Center on Postsecondary Teaching, Learning, and Assessment at Pennsylvania State University. http://learningcommons.evergreen.edu/pdf/collab.pdf* (Accessed: 1.2,11) *Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), Cambridge handbook of the learning sciences (pp. 409-426). Cambridge, UK: Cambridge University Press. Available at: http://GerryStahl.net/cscl/CSCL_English.pdf*

		(Accessed: 1.2.11)
5) "creativity"	"Creativity" expresses an open-minded way of approaching a task or a challenge in order to come up with new or unconventional solutions to a given task. "Creativity" begins with imaginative activity and the National Advisory Committee on Creative and Cultural Education (NACCCE) suggests that "creativity" is: "Imaginative activity fashioned so as to produce outcomes that are both original and of value." (1999:30)	*Loveless, A., Burton, J. and Turvey, K.(2006) Developing conceptual frameworks for creativity, ICT and teacher education. International Journal of Teaching for Thinking and Creativity. 1,1.(3-13)* (Accessed: 1.2.11) *NACCCE. (1999). All our futures: Creativity, culture and education. Sudbury: National Advisory Committee on Creative and Cultural Education: DfEE and DCMS.* http://www.cypni.org.uk/downloads/alloutfutures.pdf Pages 30-32 (Accessed: 1.2.11)
6) "Expressiveness"	"Expressiveness" is a basic ability to transform and communicate clearly, thoughts and ideas through language (spoken, written and non-verbal communications [facial expression/body language or NVCs]). "Expressiveness" can also be evidenced through the languages of music, art and movement.	
7) "21st Century Skills"	"21st century skills" implies the skills and habits of mind that allow people to participate actively in society using all forms of media available. They are required as individuals need to think and reflect critically on what is happening around them and to develop creative solutions that serve personal and social needs. Digital and media literacies feature predominantly in educators' notions of what skills are required for life in the 21st Century. (See: **"Digital Literacy"** below)	(2003). enGauge® 21st Century Skills: *Literacy in the Digital Age.* North Central Regional Educational Laboratory and the Metiri Group. Department of Education. USA http://eric.ed.gov/PDFS/ED463753.pdf (Accessed 10.2.11)

8) "Digital literacy"	"Digital literacy" is the ability to locate, organize, understand, analyse and evaluate information using digital technology. It involves a working knowledge of current technology and an understanding of how it can be used. Digital Literacy involves skills that are seen to go beyond functional practices which enable ICTs simply to be used. Instead, "digital literacy" demonstrates the ability to enable: "critical, creative, discerning and safe practices when engaging with digital technologies in all areas of life" (Hague & Payton, 2010, p. 19) According to Jenkins et al (2006:4), the new skills include: **Play:** the capacity to experiment with one's surroundings as a form of problem-solving **Performance:** the ability to adopt alternative identities for the purpose of improvisation and discovery **Simulation:** the ability to interpret and construct dynamic models of real-world processes **Appropriation:** the ability to meaningfully sample and remix media content **Multitasking:** the ability to scan one's environment and shift focus as needed to salient details. **Distributed Cognition:** the ability to interact meaningfully with tools that expand mental capacities	Hague, C. & Payton, S. (2010). Digital literacy across the curriculum. Bristol: Futurelab. See also: http://ec.europa.eu/information_society/tl/edutra/skills/index_en.htm (accessed 1.2.11) *Leu, D. J., & Zawilinski, L., Castek, J., Banerjee, M., Housand, B. C., Liu, Y., & O'Neil, M. (2007).* http://teachers.westport.k12.ct.us/ITL/wkspmaterials/NCTE%20chapter.pdf (Accessed: 1.2.11) Jenkins, H., Clinton, K., Purushotma, R., Robison, A.J. and Weigelin (2006). Occasional Paper on Digital Media and Learning: *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. MacArthur Foundation http://digitallearning.macfound.org/atf/cf/%7b7e45c7e0-a3e0-4b89-ac9c-e807e1b0ae4e%7d/jenkins_white_paper.pdf (Accessed: 2.2.11)

	Collective Intelligence: the ability to pool knowledge and compare notes with others toward a common goal **Judgment:** the ability to evaluate the reliability and credibility of different information sources **Transmedia Navigation:** the ability to follow the flow of stories and information across multiple modalities **Networking:** the ability to search for, synthesize, and disseminate information **Negotiation:** the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms."	
9) "Educational Scenario"	"A narrative description of a preferable learning context that takes account of user stories, including the generic resources and tools they use, the interactions they have, the tasks they perform and the aims of their activities, set within a description of the model learning environment. *Characteristics/Relations*: An Educational Scenario is supported by a set of technological tools provided by a school and the iTEC project (Technical Setting)." *From iTEC Control Board Doc: CBESv9 (1.2.11)*	*From iTEC Control Board Doc: CBESv9 (1.2.11)*

APPENDIX 2 : KNOWLEDGE MAP

iTEC

Designing the future classroom

The Knowledge Map: Innovative Classroom Practice with Digital Technologies

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EXECUTIVE SUMMARY

The purpose of the Knowledge Map is:

- To situate the evaluation in general and national contexts;
- To reveal progress beyond national baselines/benchmarks;
- To help to interpret the evaluation findings in terms of underlying national conditions (political, educational, socio-economic and political).

This document provides a review of current innovative practices in classrooms rather than a review of the potential of emerging technologies to change practices. That is, the focus is on teachers' actual use of technologies in the classroom drawing on recent literature (2008 to date) of innovative uses. In addition summaries of the national contexts for all the countries participating in the large-scale pilots are provided.

Technologies and software which are already making a difference to pedagogical practices in the classroom include learning platforms, social software, collaborative environments, augmented reality, tablet PCs and netbooks, smartphones and handheld devices, interactive whiteboards, multi-touch surfaces, learner response systems, and games-based learning. These technologies are supporting pedagogical changes such as increased collaboration, group work, cross-curricular approaches, self-regulated learning, and changes in the roles of teachers and learners.

Despite a plethora of literature and advocates for the potential of technology to support teaching and learning, we are also mindful that transformation is not readily realized. The process of change is extremely complex and affected by a wide range of factors from provision of technology in the classroom to teacher beliefs and attitudes. Whilst the studies reported below (primarily small-scale studies involving early adopters and highly innovative teachers) suggest that change is possible in the majority of larger-scale studies (representing levels and patterns of adoption across typical schools) suggest that pedagogical change (if it occurs) is by no means substantial. In many cases this is attributed to a focus on technical skills in professional development, the influences of educational policies, and the importance of developing a shared understanding of educational goals.

These studies provide an important cautionary note for anyone seeking to transform 'potential' into practice, and emphasize the need to engage in rich debate about educational goals rather than technological potential alone. Projects also need to take account of national contextual factors such as assessment frameworks, professional development and existing cultures of schooling if real innovation is to be achieved.

Summary of Innovative Practices presented in Part 1

The pilot studies selected for inclusion in the Knowledge Map illustrate a range of practices. In many cases it is suggested that the adoption of new technologies has led to changes in pedagogical practices. However, we must remember that these studies largely involve early adopters and innovative teachers. The studies do not represent levels and patterns of use across regions and nations. In addition, some of the teachers involved in the studies outlined below had already adopted student-centred practices. That is the technology was appropriated to support a constructivist approach to teaching and learning, rather than driving pedagogical change.

- The perceived benefits of pedagogical changes include increases in:
  - Learner independence and autonomy;
  - Indidivualised/personalized learning;
  - Peer learning;
  - Self- and peer-assessment and evaluation;
  - Learner engagement with wider stakeholders such as the local community, businesses and experts;
  - Groupwork;
  - Problem solving and other exploratory approaches;
  - Collaboration;
  - Variety of learning activities;
  - Authentic learning experiences;
  - Learner engagement;
  - Coaching;
  - Creativity;
  - Classroom interaction, communication and discussion;
  - Digital literacy skills;
  - Lifelong learning skills including critical thinking;
  - Positive impact on learning outcomes;
  - Multimodal presentation:
    - Visualization of complex concepts;
    - The use of video, animation, diagrams, photographs, as well as text;
    - New forms of text production and literacy practices.

- Handheld devices, learner response systems and mobile phones
  - There are many studies of these different devices; uptake is still limited for a variety of reasons (primarily funding, interoperability issues, e-safety concerns);
  - Can support whole class participation;
  - Networked devices can facilitate capture of individual screen displays to share with the class and support collaborative learning;
  - Supports assessment – self-assessment, formative assessment, immediate feedback;
  - Learner response systems are generally perceived to be easy to use, lead to learning gains, engage learners, can increase learner confidence (particularly when responses are anonymized), can provide

teachers with feedback about overall understanding, pace and particular difficulties and misconceptions, can provide an assessment record, can now support text entry as well as multi-choice responses;
  - Can support augmented reality experiences;
  - Can support authentic and engaging tasks;
  - Supports communication;
  - Some increase in use of audio and video-based resources;
  - Some studies suggest that the use of handheld devices to support assessment including learner response systems can be perceived as being time-consuming when compared to traditional approaches – that is practices can be technologically driven rather than pedagogically driven;
  - Learner response systems can constrain assessment choices (e.g. multi-choice) and correct responses may not provide an accurate picture of understanding;
  - Some studies suggest replication of traditional practices.

- Virtual classrooms and learning platforms
  - Uptake of learning platforms has been slower than anticipated;
  - Facilitate access to subject specialist;
  - Facilitates anytime, anywhere access;
  - Asynchronous and synchronous communication;
  - Can support self-paced, independent learning;
  - Can support collaborative learning;
  - Positive impact on learner outcomes;
  - Blended learning more effective than wholly online provision;
  - Can re-engage disaffected learners;
  - Can support parental engagement;
  - But often replicate traditional pedagogies or used to organize resources.

- Tablet PCs, laptops and netbooks
  - One-to-one provision is growing in many countries (for example, UK, Spain, Portugal);
  - Have been used to support student-centred approaches in a very small number of studies;
  - Common outcome of studies is increased technical skills;
  - Often used to support traditional pedagogies;

- Social software:
  - Use of tools which support public access are still at an early adopter stage across Europe although some elements such as blogs and wikis have been incorporated into learning platforms;
  - Supports communication, collaboration and discussion;
  - Co-construction of knowledge;
  - Participatory approaches;
  - Authentic tasks;
  - Facilitates anytime, anywhere learning;
  - Supports student-centred approaches;
  - Digital literacy and critical thinking skills.

- Games-based learning, virtual worlds and simulations
  - Is still at an early adopter stage across Europe with some countries at more advanced stages (Scotland, Catalonia, Denmark);
  - There is a need to identify sustainable and scalable uses of game-based learning across Europe;
  - Can support student-centred approaches;
  - Support increased motivation, engagement, digital literacy skills, social skills and other metacognitive skills;
  - May not necessarily support subject knowledge development; teachers need a good understanding of the curriculum and may need to think creatively in order to maximize learning opportunities – can be time-consuming for teachers;
  - Supports student autonomy and engagement;
  - Supports increased social interaction and collaboration;
  - With mobile devices can support location-based gaming;
  - Student-authored games can be particularly engaging and support the development of media-literacy skills, as well as promote deeper engagement with learning;
  - Can support language learning;
  - Virtual worlds can support inquiry-based learning;
  - Virtual worlds can distract learners from the learning objectives;
  - Limited evidence to date on impact on student learning outcomes, with some studies reporting learning gains;
  - Can require significant time-investment from learners to achieve mastery.

- The key success factors include:
  - Supportive school leaders;
  - Flexibility within curriculum implementation;
  - Clear rationale for integration of technology;
  - Careful planning and structuring of tasks;

  - Appropriate and timely professional development which focuses on ICT pedagogies;
  - Effective and adequate technical support but also ICT pedagogical support.

- Barriers
  - The speed of technological developments;
  - Technical problems;
  - Classroom management concerns;
  - More complex planning required;
  - Lack of task structure can lead to lack of focus;
  - Perceived impact on workload (for example communication demands in online learning);
  - Learner digital cultures and practices are highly complex, and often not as sophisticated as we sometimes assume;
  - Traditional pedagogies which can shape and restrict the ways in which technologies are appropriated;
  - Lack of metacognitive skills;
  - Lack of awareness of contemporary pedagogical approaches;
  - Funding;
  - Interoperability issues;
  - E-safety concerns together with safety concerns in relation to handheld and portable devices;
  - Concerns about curriculum demands and high-stakes testing;
  - Cultural barriers and attitudes to games-based learning;
  - A perceived lack of quality software for supporting some subject areas.

The implications for iTEC are as follows:

- The studies reported here indicate that pedagogical change is possible although it is unlikely to be substantial, particularly initially, and will require teachers to engage in professional development, invest time, and possibly take a degree of risk. The potential gains are extensive and as the studies summarized here suggest possible to achieve to varying degrees.
- The key success factors and barriers to appropriation of technology are not surprising; they have been identified in much of the research conducted over the last 20 years. Clearly policy makers, leaders and practitioners must continue to consider and address cultural change through professional development but also through reconsideration of educational policies (including those on assessment and curriculum as well as technology).
- The barriers to the appropriation of technology have meant that the uptake of many of the technologies and tools which have emerged in recent years has been low. iTEC can engage teachers across many schools and with appropriate support through training, communities of practice, scenarios, and new technological tools, can support change and identify potential technology-

supported pedagogical approaches that are scalable and suitable for widespread adoption.

INTRODUCTION

Rationale

The aim of this document is to present an overview of innovative pedagogical practices using ICT, both within and beyond Europe, gathering evidence from a wide range of sources including traditional and grey literature.

In order to build the map, a literature search has been conducted of the British Education Index, Australian Education Index and ERIC databases using the search terms 'pedagogy' and 'school' and ('ICT' or 'computer' or 'technology') and restricting the search to the years 2008-2010. A similar search was conducted using Google Scholar which brought up over 16,000 links. These were scanned and selected until the titles of documents suggested that the literature was not very relevant. A hand search of research reports published by Becta, Futurelab, European Schoolnet and the OECD has also been conducted. References in literature gathered in this process and published during 2008-2010 have also been scanned. All gathered literature has been reviewed subsequently and only those that clearly offer insight into current innovative practice have been included in the knowledge map.

The focus of the iTEC project is on classroom practice and literature has therefore been selected for inclusion in the map on this basis. Literature concerned with teacher attitudes and professional development has been excluded (and will be reviewed in Work Package 4). Some literature which focuses on the learner rather than the teacher has also been excluded unless it is deemed to be innovative. Literature concerned with linking home and school, and parental engagement has also been excluded unless clearly linked to classroom practice although it is acknowledged that these aspects are part of a teacher's pedagogy. Literature relating to the potential (rather than practice) of technology to support teaching and learning more generally has also been discarded with the exception of a small number of recent reports concerned with current trends in the classroom which have been used to sketch out how different pedagogies could be supported in the near future.

This document presents the state of the art in terms of what is *actually happening* in primary and secondary school classrooms in terms of innovation. The first part of the report is structured around an overview of key thematic areas.

The second part of the report, an analysis of ICT in education on a country by country basis, draws on the European Schoolnet Insight reports as well as literature and personal comments put forward by the relevant Ministries of Education to provide a brief summary of current practices for each of the countries participating in the large scale pilots.

Key Innovation Trends

Before describing the current innovative practice it is important to flag up the key trends in innovation in classroom practice that are expected to continue over the next five years. The key trends likely to influence school education in the next five years and identified in the 2010 Horizon report (Johnson et al, 2010) are listed as:

- Technology is increasingly a means for empowering students, a method for communication and socializing, and a ubiquitous, transparent part of their lives.
- Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed.
- The perceived value of innovation and creativity is increasing.
- There is increasing interest in just-in-time, alternate, or non-formal avenues of education, such as online learning, mentoring, and independent study.
- The way we think of learning environments is changing.

Furthermore, emerging technologies likely to influence pedagogies are identified as: cloud computing, collaborative environments, game-based learning, mobiles and smartphones, augmented reality and flexible displays/multi-touch surfaces.

Manches et al (2010) summarize the findings of the Capital research project in England which was designed to inform future educational technology policies for schools prior to the change of Government in May 2010. They argue that:

- Technology can make assessment more efficient, timely and flexible. However it can be constrained by national assessment practices and demands reliable infrastructure.
- Social tools can support collaboration including the creation and sharing of content by learners, and peer-review. However use is currently limited, with teachers requiring greater support to integrate such technologies in the curriculum, and some learners are resistant to shifting personal practices into formal settings.
- Games have great potential to support learning through increased motivation and opportunities for construction, reflection and collaboration. However their use is constrained by e-safety concerns, particularly as development costs and the limited education market mean that the focus of industry is the domestic market. In addition, as with social tools teachers need support to understand how to adapt and integrate games (commercial off the shelf games in particular).
- Mobile technologies, the increase in learning platforms and the growth of cloud computing mean that learning can be extended beyond the school wall and blur the boundaries between formal and informal learning. However there are concerns over the use of mobile devices in school settings relating to technical issues of supporting multiple devices, and the risks involved and the required teacher skills.

Further they suggest (Crook et al, 2009, p.3) that potential new pedagogical practices facilitated by technology include:

- Live reflection: Stimulating self-awareness in personal study, with a particular emphasis on new technological possibilities for prompting, supporting and recording reflection 'in the moment'.
- Rich feedback: Promoting learning dialogue within formative and summative assessment, with a particular emphasis on new technological tools to support rich media exchanges.
- Learning community trails. Expanding and exploiting collective classroom memory, with a particular emphasis on the use of new technological means of capturing, storing and making available the results of previous activity.
- Gaming to learn: Exploring the motivational and learning potential of massively multi-player online games for purposes associated with the formal curriculum and subject disciplines.

There are also a set of consistent messages emerging about the ways in which, when appropriate conditions prevail, the potential to use digital technologies to change educational practice significantly can be realised.

In a study of innovative use of ICT in 15 schools from five countries (Fredriksson, Jedeskog & Plomp, 2008) pedagogic changes included increased collaboration, more group work, a shift in teacher roles (coach/counselor) and less formal interaction between teachers and students. There was also a greater focus on cross-curricular projects and independent learning, as well as new uses of physical spaces to facilitate this (e.g. in the library).

Crook et al (2010) conducted a study of 9 secondary schools in England which were considered to be innovative in terms of practices with ICT to support teaching and learning through the collection of data about 85 lessons. In summary they argue that ICT enables new forms of classroom practice including greater mobility and flexibility as well as making a difference to the kinds of activities that can take place; and extends the range of learning practices including richer multimodal teaching resources, more readily supporting research activities and learner construction of digital artifacts and knowledge.

These key trends and observations have structured our literature search and informed our presentation of evidence of current innovative practices in the remainder of the report.

From 'Potential' to Practice

Any review of research into innovative classroom practice needs to recognize the ways in which *ideas* or *aspirations* about the potential of digital technologies to radically transform education are often not realized or tend to mutate in the process of being incorporated into the real life settings of schools and classrooms (Selwyn, 2010). Our review of contemporary research in this area continues to provide

evidence of this process even thirty years after the early introduction of computers into schools.

There are some high profile examples of the clash of aspirations and reality. For example, the School of the Future in Philadelphia, supported by Microsoft, was an attempt at rethinking school design, including pedagogical approaches and integrating technology to a greater extent (Cullinane & Hess, 2010). The school opened in September 2006. There were no books and all learning resources were provided through a learning platform. Every learner was provided with a laptop. Staff set out to develop a project-based curriculum from scratch and dropped traditional summative assessment practices. Discipline policies relied on learners taking responsibility for their actions. Unfortunately the vision was challenging to realize – the wireless network was unreliable, the learners unfamiliar with technology and from challenging backgrounds with behavioral and learning issues. Following the sudden departure at the end of the first year of the school leader, the flexible curriculum was replaced by the traditional district curriculum and teachers were encouraged to abandon innovations that were perceived to have been ineffective. Currently the school blends self-directed learning, technology and standard core curricular subjects. With Microsoft's continued support, it is claimed that most teachers use blogs and wikis to support teaching and learning, students manage their assignments online, and some of the project-based activities have been successful (Mezzacappa, 2010).

Studies of the adoption and use of Interactive Whiteboards also foreground the importance of a range of contextual factors in the appropriation of this technology for innovation. These included: the ability of teachers to focus on the learning goals and to review their assumptions about power and control in the classroom (Northcote et al, 2010); the importance of ensuring that technology is actually working and accessible in the classroom; and that software resources are easy to search for and download rather than hidden behind password protected sites (Winzenreid et al, 2010)

Law (2009) examined teachers' pedagogies from three perspectives: traditionally important, lifelong learning orientation and connectedness. She found that the traditionally important perspective was the strongest and the connectedness orientation the weakest. Moreover, ICT usage was relatively low although all teachers worked in schools which had reasonable levels of infrastructure. Law concludes that ICT provision alone does not lead to pedagogical change and that teachers need professional development in 21st century skills and pedagogies for ICT. A similar argument is made by Beauchamp & Kennewell (2008) who argue that technology (in this case the IWB) has the potential to support dialogic interactive teaching but that teachers in their study worked predominantly at lower levels of interactivity (teacher-centred, didactic, authoritative).

These findings are mirrored by two studies of innovative schools and research programmes by Shear et al (2010 and 2010a). In the evaluation of the Microsoft Global Innovative Schools Program, Shear et al (2010) report that students developed digital literacy skills but that substantial pedagogical change did not take

place in all of the 11 schools participating. This was ascribed to the lack of pedagogically appropriate professional development. In one school (in the UK) pedagogical changes included project-based learning, and a focus on learning to learn skills in the first two years. The same team's evaluation of the Microsoft ITL research program focuses on innovative classroom practices (integrating pedagogy with technology). They concluded (Shear et al 2010a) that whilst the goals of many of the participating teachers were to change their practices data suggest that these have yet to be realized. The most common uses of technology to support teaching and learning were described as 'basic' (e.g. finding information, writing a document using a word processor). Professional development which focused on the integration of technology with pedagogy rather than just on ICT skills was associated with more innovative practices. The limited professional development support and subsequent lack of impact of technology on pedagogical practices in the classroom is common to many studies (Pennuel, 2006; EUN, 2009).

The critical influence of factors outside the school in shaping innovation was also made visible in a study by Bryderup, Larson & Quisgaard Trentel (2009). In their report on the SITES study in Denmark, these researchers argue that teachers' pedagogies shifted from the late 1990s to 2006 in unexpected ways. Teachers in Denmark moved from student-centred, active and autonomous learning, to curriculum-centred teaching and instruction partly due to changes in educational policy (e.g. a greater focus on tests).

At the same time, other studies show the need for clarity about educational goals when seeking to innovate with digital technologies. A study of handheld graphing calculators in secondary mathematics classrooms by Pierce, Stacey & Wander (2010), for example, highlights a mismatch between student and teacher perceptions of the learning objectives, with students associating the learning with technological skills and teachers with mathematical skills and concepts. The authors conclude that pedagogical practices did not change significantly during the early stages of adoption and that the focus on the development of technical skills also acted as a barrier to transforming pedagogical practices.

These studies provide an important cautionary note to any project seeking to transform 'potential' into real classroom practice, and emphasize the need to engage in rich debate about educational goals rather than technological potential alone, and to take account of assessment frameworks, professional development and existing cultures of schooling if real innovation is to be achieved.

PART 1: KEY THEMATIC AREAS

1.1 Innovation in Core Subject Areas

1.1.1 Science and Mathematics

The use of digital technologies in science and mathematics has a long history and indeed has often influenced pedagogic practice across a range of other subject areas (e.g. Papert, 1983). Today, we can see that the tradition of innovation in this area is continuing, whether using familiar tools such as data loggers and dynamic geometry packages, or newly emerging resources. Innovative projects range from using collaborative tools to promote group work and inquiry, to connecting students more seamlessly to the 'real world' of scientific exploration. Indicative projects from our review include:

Voogt (2009) compared secondary science teachers who made regular use of ICT with science teachers who did not. Teachers making regular use of ICT perceived an impact on student learning outcomes (motivation, ICT skills, information handling skills, knowledge). Changes in pedagogy included increased independence and autonomy, and an increase in group work, problem solving and collaboration. There was also greater variety in learning activities, and perceived improvements in coaching and classroom discussion. The teachers made regular use of media production tools, tutorial software, digital learning resources and communication tools. They also made occasional use of data logging tools, simulations, mobile devices and interactive whiteboards.

In a similar study examining mathematics, Pelgrum & Voogt (2009) looked at school and teacher level factors for high levels of ICT use in mathematics. They suggest that teachers' pedagogies are more learner-centred and focus on lifelong learning orientations. In common with much research on ICT in schools, this project found that school leaders played a key role in supporting collaborative approaches and a flexible approach to interpreting curriculum requirements.

Crook et al (2010) present a case study of the use of data loggers in a UK science classroom with 14-16 year olds. Students used the devices to create time-distance movement graphs which were then shared with the whole class and discussed. The teacher noted that the project approach enabled a shift towards greater collaboration, learner autonomy, peer learning and peer reflection, as well as supporting authentic learning through the analysis of real-time data.

Slangen, van Keulen & Gravemeijer (2010) describe a researcher-led project with primary aged pupils who worked with Lego Mindstorms NXT robots. The authors argue that robotics is a current and future technology which everyone should be familiar with (so it should be in the curriculum) and that working on such projects will increase technology literacy. The analysis is presented in relation to pupils' understanding of robotics rather than in relation to teachers' practices and pedagogies.

Veletsianos & Doering (2010) describe a study of an 'adventure learning' project in which learners interact with a team of scientists exploring the arctic. Such projects are often implemented using collaborative learning approaches and tools which support this. 30 learners from a primary school in Australia participated in this project during 2005-2007. The teachers involved adopted a mix of constructivist and traditional teaching approaches, readily facilitated by the project website which was designed to support different pedagogies. The teachers appreciated this flexibility. The authors conclude that the environment supported 'dynamic, participatory, engaging, collaborative, and social' (ibid, p293) experiences for learners.

Shirley et al (2010) report on a study of networked graphing calculators to support mathematics and science in secondary school. With features offered with audience response systems teachers are able to set multiple choice or open ended questions via these devices, or share a student's work with the whole class by capturing individual screen displays. In addition the devices can be used with sensors to record data such as temperature, speed and force. Here the researchers focused on 'congruence with classroom practice' highlighting the use of the devices for assessment practice in relation to high-stake tests although immediate feedback was cited as a benefit. The facility to capture all students' screens was also noted to be beneficial in terms of classroom management.

Another exploratory study of the use of networked graphical calculators to support mathematics instruction in a UK secondary school with 2 teachers (Wright, 2010) argues that the teachers felt that the learners had greater autonomy, and that the facility to share graphs and aggregate the learners' findings in one shared space supported collaboration and peer review.

Duncan (2010) reports on a study in Scotland which focused specifically on the use of graphing calculators to support dynamically linked multiple representations of mathematical concepts. The 12 teachers from 6 secondary schools, providing data from 66 lessons overall, reported changes in their pedagogy and that student learning outcomes were improved. In terms of pedagogies teachers reported a shift to more investigative, exploratory approaches and a more student-centred approach. The amount of discussion between teacher and student, and between students increased, as did group work.

Warwick et al (2010) report on the use of Interactive Whiteboards to promote collaborative group inquiry in Science with 8-10 year olds. The project involved the use of resources designed specifically for the whiteboard to promote dialogue and collaboration. Explicit 'group rules' were developed by the teachers to ensure productive talk took place and these were embedded in the software. Teacher interpretation of interactivity and creativity were also critical in shaping classroom dynamics. Interactive Whiteboards were also used by primary teachers in a study by Murcia and Sheffield (2010) to display the teachers' own interactive notebooks. These notebooks were designed in ways that built connections between student and teacher activity and classroom conversations. These notebooks included virtual demonstrations, documentaries, pictures, diagrams, animations, films and photos.

The teachers used these as part of a shift towards a pedagogy focused on dialogue and discussion.

Needham & Crellin (2009) report on a project investigating the use of data logging devices and visualization software in science in UK secondary schools. Students used the location based data logging approach to capture data and used online mapping applications to create visualizations of pollution and other environmental data. Students also incorporated photographs and video, as well as use Web 2.0 tools to share their findings publicly. Teachers worked together to create open-ended investigations which supported the curriculum. Students were asked to make sense of the data using the visualization tools and explain their findings. Students appreciated the increased autonomy.

Baki & Çakıroglu (2010) evaluated the use of learning objects to support teaching and learning in mathematics in a secondary school in Turkey. The teacher sometimes designed a lesson around one or two of the learning objects and on other occasions allowed students to choose which ones to engage with. Students were positive about their use appreciating the autonomy offered and the underlying pedagogy of problem solving as well as finding the experience engaging.

1.1.2 Literacy and Digital Participation

A second major current in innovation in classroom practice with ICTs has always been in their exploitation as tools to support students to engage in rich multimodal communication practices. These tools, when combined with innovative pedagogy, allow students allow students to participate in what danah boyd calls the new 'networked publics' (2009) and enables the school to act as what Henry Jenkins calls a 'first public' for students developing a voice and citizenship identity in the digital world (Jenkins, 2009). Indicative projects relating to developing literacy and participation practices are in evidence in our review (practices relating to the use of social software for these purposes are discussed later):

Burnett et al (2006) reported on a study of transforming literacy practices in the primary classroom which led to new kinds of texts, peer-support and a change in the role of the teacher. Children from two primary schools in the UK emailed each other, sending digital photos of artifacts important to themselves and then produced a presentation in a face-to-face setting. The authenticity of the task contributed to the children's engagement but also allowed them to use and explore "a mode of communication in which focused exchanges of information, playfulness and experimentation are essential features." (p25)

Ryan et al (2010) present a review of a series of projects concerning multimodal texts in primary and secondary classrooms including IWBs, podcasts, moviemaking, and animation and presentation software – notably a focus on multimodal text production. Children found these approaches highly motivating, and developed independence and technical skills quickly. Teachers became facilitators with learners able to engage in self-directed learning to a greater degree, and able to improve their communication and collaborative skills. Planning was perceived to be more complex

(involving technology as well as the task). The authors conclude that teachers need to structure critical engagement, open-ended cross-curricular projects require complex planning, and that technical development speeds are challenging – teachers need to keep up.

Kervin and Mantei (2009) analyzing three case studies of technology supported literacy in primary schools argue that there needs to be a clear rationale and purpose when integrating technology with literacy instruction. The children worked independently but needed support from the teacher at various points. All three cases involved group work.

Wikan et al (2010) describe the role of digital multimodal text in group work in secondary schools in Norway. Nine self-selecting teachers engaged in action research during a two year project (2007-2009). Multimodal presentation and animation tools were employed and the teachers were provided with training. Group work is commonly used in Norway. The authors suggest that this approach led to increased discussion and learner interaction. However, they also report that some learners were not focussed enough on the task in hand (for example, aimlessly searching the internet). They conclude (albeit from a theoretical perspective rather than grounded in their evidence) that the co-construction of a digital text deepens learner's knowledge and understanding.

The CAPITAL project in England undertook a series of case studies. One of these in a secondary school (CAPITAL, 2009a) describes how a librarian used the school learning platform to create a virtual book club. All pupils at the school are automatically members and can contribute to discussions around books they have read. It has been challenging to keep the momentum up but regular competitions and engaging teachers has helped. In another case study from the same project (CAPITAL, 2009b) the embedding of creative digital media work (including animation and live action film making) at a primary school in England is presented. The aim was to support the development of literacy. The school has created a 'film making studio' in a resource store. Children find the work engaging, developing communication skills as well as critically evaluating their products without prompting.

Russell & McGuigan (2007) evaluated 'digital creativity activities' with 10 schools for learners with behavioral, emotional and social difficulties in the UK. Learners were more engaged, became more autonomous and were more willing to collaborate with their peers than they had been previously. The activities were embedded across the curriculum and included the creation and editing of music, animation, video, picture-strip format texts and podcasts.

Payton & Hague (2010) present case studies of UK primary and secondary classrooms in relation to digital literacy practices. In this project the participating teachers worked alongside the researchers to develop new ideas for using ICT in the classroom. All activities required learners to create an output for a real audience Teachers created appropriate scaffolds learners, developed critical thinking and evaluation skills, as well as improving communication and discussion skills. Teachers found it easier to create activities around collaboration, creativity and communication

than fostering social and cultural understanding. Teachers perceived that learners became more autonomous and that their roles changed to that of facilitator. Projects included animation and multimedia story creation, producing multimedia presentations to record knowledge, creating a digital prospectus including video footage, creating 3D objects using an online tool, and creating a newspaper.

Ching Yang (2009) describes an oral history project in which primary, junior and secondary aged-learners used technology to support historical inquiry through interviewing community elders. The learners created web-based resources drawing on the interviews and providing images and animations. The author argues that this approach helped students to develop their information literacy skills, critical thinking skills and problem-solving skills, as well as communication and teamwork skills. However, she cautions that students did not develop high levels of historical thinking as originally anticipated and that further development of the project structure is required to ensure that technology is used as a cognitive tool.

McMahon (2009) identified a link between technology rich learning environments and development of critical thinking skills in secondary education. Students with better computing skills scored more highly on higher order teaching skills tests.

Deaney et al (2009) report on one teachers' use of an interactive whiteboard to promote dialogue in classrooms. The whiteboard was used to enable the extensive use of textual annotation (including labels, links, thought bubbles, agree/disagree via marking with tick or cross) to facilitate public sharing, generation and recording of ideas, make inferences and crystallize causal reasoning, assessment of historical decision-making, encourage pupils to respond to peer contributions, engage pupils and 'give proposers a stake' in the discussion.

1.2 Blurring Boundaries

The capacity of digital technologies to build connections across different settings, and to allow students to access resources and collate their own work, is beginning to have an impact on the way in which classroom activities are organized. A number of indicative projects that suggest that some traditional spatial and temporal boundaries are being blurred are included below in three key areas: first, the development of remote/virtual classroom practices; second, the emergence of the learning platform as a resource for teachers and students; and third, the developing use of social software practices to support teaching and learning.

1.2.1 Remote and Virtual Classrooms

Teachers in 5 rural schools in Australia sought to provide a wider range of curriculum options for their students by connecting their classrooms via Interactive whiteboards and video conferencing screens (Murcia and Sheffield, 2010). This allowed teaching of subjects where specialists weren't present in each individual school. The teacher used the whiteboard to bring focus to the lesson with remote students. Students in

other schools could see each other. The teacher voice played a critical role in ensuring the success of the lessons.

Cavanaugh, Barbour & Clark (2009) present a review of literature relating to virtual schooling (online distance education) in the USA. They note that the pedagogical practices do not necessarily change and that the structure of such online environments can actually result in very didactic approaches. The authors argue that more research is needed in relation to asynchronous pedagogies and the provision of learning communities in school sector distance education programmes.

Virtual schools are prevalent in the US (Bacsich et al, 2010). They offer a mix of live technologically-mediated instruction with asynchronous support and learning resources. Learners are able to follow the curriculum at their own pace. A wide range of pedagogies are employed including cross-curricular project-based learning.

The U.S. Department of Education (2009) presents a review of online learning in the school sector expressing their surprise at the dearth of empirical research in this area. Only a limited number of studies from the school sector were included in their meta-analysis, the remainder coming from tertiary and adult learning sectors. They conclude that students studying wholly or partly through online learning perform better than students following traditional face-to-face courses, and that blended learning models were the most effective. Online learning can be enhanced when learners are given greater autonomy and control, and when learners are prompted to engage in reflection.

Heck, Houwing and de Beurs (2009) report on an e-class within a learning platform at secondary level used in a blended learning approach. Students were studying discrete dynamic models in mathematics. The online provision included digitized resources, animations, simulation software and online tutorials together with a chat room where they could get advice from peers and teachers. Homework was set and submitted online. About 300 students participated in the study. The resources were designed by one of the participating teachers and a study guide was provided on a weekly basis, enabling the teacher to adjust the workload as necessary and to tailor the activities for the forthcoming week to meet the needs of the students. The evaluation focuses on student perceptions. They appreciated the learning resources, and the facility to chat to each other and teachers. They also liked the flexibility of the approach and the level of autonomy. Teachers perceived that it had been beneficial but expressed some concerns around workload particularly in relation to communication with students (e.g. email). The authors conclude that the blended approach ensures that students still have social contact with their peers.

In the CAPITAL project in England one case study (CAPITAL, 2009c) describes a virtual school developed by a local authority in England, initially to support geographically-dispersed disaffected primary-aged learners but later also used to provide support for gifted and talented students for example. The technology supported online real-time lessons via videoconferencing followed by online activities through a learning platform. Learners work together online contributing to a shared online whiteboard and able to speak and text each other. Learners can choose

whether to communicate publicly with everyone or privately with the teacher. An external evaluation suggests that this approach boost motivation and confidence for disaffected learners. In another case study from the same project (CAPITAL, 2009d) describes the use of videoconferencing by a secondary school mathematics teacher to provide mathematics lessons for groups of primary aged pupils in local schools. As the intention was enrichment the tasks were more open-ended and the learners were encouraged to ask questions. The learners were not monitored and generally behaved appropriately, usually engaging in constructive discussion rather than argument when disagreements arose.

1.2.2 Learning Platforms

In the CAPITAL project in England one case study (CAPITAL, 2009e) describes a learning platform to support pupils outside formal education with banked and live interactive lessons, learning resources, and online communication tools. Based on the 'notschool' approach, learners negotiate individual curriculums according to personal interests and are supported by a personal tutor together with face-to-face encounters such as drop-in sessions and home visits.

A UK primary school considered to be 'at the forefront of ICT use with younger learners' (Fronter, undated, p.1) provide a good example of learning platform use (Aubrey-Smith, undated; EUN, 2009a; Fronter, undated). Learners have their own e-portfolio and make use of discussion forums as well as being able to access a range of curriculum resources, podcasts and games. They are able to progress at their own pace, working individually and in groups, and access the platform outside school. Teachers perceive that it has improved collaboration in teaching and learning across the school.

Jewitt et al (2010) evaluated current learning platform practices in the UK through 12 case studies of schools identified as making good progress integrating this technology in teaching and learning. They suggest that as well as supporting parental engagement and learning at home, the learning platform in these schools offered opportunities for independent and personalised learning, interaction and collaborative learning. In relation to assessment learning platforms facilitated self and peer-assessment as well as more traditional assessment forms. Finally in relation to pedagogy they note that learning platforms in these schools enhanced the development of digital literacy.

Wastiau (2010) reviewed the use of learning platforms across Denmark, the UK, and Spain (Catalonia and Andalucia). They report that implementation is slower than expected and usage relates to management and organisation primarily, except in Denmark where almost all schools have a learning platform, pupils are active users through project-based learning approaches and communication with parents is widespread.

Granić, Mifsud & Ćukušić (2009) describe the EC FP6 funded UNITE project in which a learning platform designed to support collaboration and facilitate mobile access was developed. It was trialed in 14 secondary schools from 10 European countries.

The outcome of the validation suggests that the platform supported autonomous and collaborative learning. Some students captured data using their mobile devices and uploaded it to the platform. Teachers noted that it was also easy to personalize learning for individuals. The authors conclude that although the ICT resources supported collaborative learning the "crucial element remains the teachers and their pedagogical approaches, hence the need for a well-developed pedagogical framework" (p.1070).

1.2.3 Social Software

A strong overview of current social software and learning practice in the UK is offered by Crook et al (2008) who report on a study of web 2.0 use in secondary schools in the UK. The authors report that it was challenging to identify schools which had embraced the participatory approaches to learning that web 2.0 technologies can support but a number of individual teachers were identified. Social networking use in schools was very rare. Blogs were used by some teachers but sometimes simply to provide information rather than engage learners in online discussion and debate. "Some teachers used blogs with students, setting open-ended tasks with structured support provided through the blog, with the goal of encouraging enquiry and empowerment" (p6). "Wikis were used [by a small number of teachers] with students for peer assessment, development of behaviour guidelines, and sharing knowledge and research. However, some teachers found that wikis were unsuitable as document repositories and were unable to cope with the conversational demand generated, and moved from wikis to linked discussion forums" (p6). Discussion forums were more commonly used, often within the closed site of the school learning platform, to support debate and discussion, peer-assessment and knowledge sharing. However 41% of teachers surveyed reported that they had never used web 2.0 tools to support collaborative learning. A small number of teachers perceived that publication of content by learners was an important aspect of Web 2.0 use. "Publication was felt to enhance a learner's sense of ownership, engagement and awareness of audience, lending weight to peer assessment and to learning informally or outside the classroom" (p7). Luckin et al (2009) in an analysis of informal uses of social software by the young people in this study argue that there was little evidence of sophisticated uses such as collaborative knowledge production. They conclude that it is necessary for "the development of a pedagogic model which provides the in-school learning community with a conceptual model of the learning potentials of these technologies and the kinds of connections these can engender across and between spaces for learning" (p102).

Tarasiuk (2010) presents a case study of her own practice as a secondary English teacher as she developed a better understanding of her students' digital cultures and tried to draw on this to inform her practices. She describes how she adopted publicly accessible wikis as a means of supporting collaboration between students around vocabulary, summaries and characterization in novels. Students she notes were more engaged, and made more thoughtful contributions. Eventually students created their own entries in Wikipedia. Students also created movie trailers about books. The author notes how she became a facilitator and a learner, discussion became more spontaneous and the learners appreciated the authenticity of the tasks.

Seet & Quek (2010) describe a study of a small group of secondary school students (n=68) who used of a computer mediated communication tool for supporting project work between groups of 4-5 students together with support from students at in international partner school. The approach undertaken was blended with the online tool used to support local and international communication as and when required. The tool offered chat, forums, document storage and a website feature. However, student autonomy was limited by timetabling constraints and task structures. The teachers in this study acted as a facilitator and supported students to become more independent learners. The authors conclude that equipping teachers with skills to facilitate such activities is essential. Students perceived that they needed more support with online communication and collaborative skills.

Open source applications were used in Italy to facilitate the creation of a class (aggregated) blog to support reflection, peer-support and communication between students, technicians and teachers (Lin & Zini, 2008). It was used to supplement classroom activities enabling the students to draw on personal interests beyond the school walls and teachers to get an insight into youth digital media practices.

Garcia, Pacheco & Garcia (2010) describe the use of web 2.0 tools to support a constructivist approach to supporting instruction in a range of subjects in Mexican primary school classrooms. The platform developed supported communication, self-assessed activities, and collaboration between learners. The visions was to facilitate "project-oriented teaching and learning in an internet-supported, collaborative knowledge space, where information resources, inquiry and discussion" (p.20). Learners accessed the platform for 2 hours a week in the classroom and 4 hours a week outside the classroom to pilot the platform in mathematics instruction. Teacher perceptions are not reported here but learners perceived that the platform supported group collaborative work well and was helpful as well as motivating. The authors conclude that the platform supports teachers to shift their pedagogies from traditional didactic approaches to teacher-led, student-centred approaches.

Woo & Wang (2009) describe an exploratory study of blogging to support critical thinking in history education in secondary schools in Singapore. After a week of instruction by the class teacher students were set open-ended research tasks and asked to produce a blog on what they found within a week. They were then asked to comment on at least one other student's blog. This activity was repeated three times over a period of 6 weeks. The authors argue that students' critical thinking skills are supported through blogging but that it is topic-dependent as well as being related to the amount of information readily available. They conclude that students need better information literacy skills to improve critical thinking skills further.

Crook et al (2010) present a case study of a music teacher in a UK secondary school who used a range of technologies to support an innovative approach to providing learners with an experience of performance. Blogs and video were used to support reflection and the learning platform was used to 'broadcast' the performance and provide feedback. Netbooks were used as the main recording and production device.

Grant (2006) presents a short-term, small-scale case study of a secondary teacher using a wiki to support group project work in history. However individual learners or pairs took ownership of particular topics in relation to the overall aim and produced pages of material independently rather than co-constructing knowledge. In fact, only one student attempted to edit text produced by a peer – which was revoked. Grant notes that this approach went against other practices in the classroom, acting as a barrier to collaborative approaches. In terms of developing technical skills however she comments that learners did collaborate and support each other.

Hastie, Casie & Tarter (2010) describe the use of a wiki to support physical education instruction. Learners were divided into two teams and asked to develop a new game (similar to football or hockey) using the wiki as a tool to support collaboration and the shared construction of a text. In addition a PE expert from outside the school also had access as well as the teacher and school librarian. Learning was extended beyond the classroom, the learners and the teachers were engaged, the teacher was able to monitor activity at any time and communicate in-between lessons, learners benefitted from accessing games developed by other groups, and the outcome was considered to be of higher quality than it would have been without the technology.

Abbott et al (2009) conducted a small-scale study of the potential relationship between deep learning and the use of technology for learners aged 14-19. The methodology included the support of classroom teachers engaging in action research. They employed learning platforms and web 2.0 technologies to develop new practices to facilitate deep learning – although many of the studies reported related to accessing resources via the learning platform rather than interacting with peers etc. These practices included inquiry-based learning, project-based learning and the use of learning platforms to support self-directed and independent learning. The teachers involved noted that ICT on its own does not necessarily lead to greater levels of deep learning but that some pedagogical approaches such as project-based learning and the development of metacognitive skills were necessary.

The EUN STEPS project on the impact of ICT in primary schools presents a brief case study of a primary school in England (EUN, 2009a) which used the social software features of the learning platform (blogs, social networking) to support peer review processes as well as provide an insight into some pupils' informal learning and personal interests. In addition, the authenticity of publishing content for peers, teachers and parents to see was believed to have improved the quality of learners' work and raised self-esteem. In a case study of a Swedish school twinned with a school in Ireland (EUN, 2009b) pupils and teachers at both schools used a blog to share knowledge of local myths and legends. A collaborative report was produced by learners from both schools using a wiki, and a film was produced by the Swedish learners with voice-overs from the Irish learners. The examples of good practice reported in the Irish study (EUN, 2009c) also include the use of blogs, wikis and podcasting to support collaborative and authentic activities as well as promote student-centred approaches.

1.3 Learner Agency, Personalisation and Mobility

One of the most important developments in education over the last decade and one which is likely to continue over the coming decades, is the attempt to place 'learning' and 'the learner' at the heart of educational practice.

In this area, the potential of personal and mobile technologies has long been considered to be important. In our review, there are a wide range of innovative classroom practices designed to harness the potential of personal and mobile devices to support learner agency. These are described below. Across all of these studies, however, it becomes clear that the success of these new resources in really guaranteeing changed pedagogic relationships is dependent upon thoughtful reflection by practitioners on student and teacher identity, and upon attempts to change underpinning educational structures. The attempt to 'bolt on' student agency in classrooms, while organizing all other elements of the institution and of teacher-student relationships around traditional hierarchies, is unlikely to be successful.

1.3.1 Tablet PCs and Laptops

Pennuel (2006) presents a review of literature on one-to-one access in the classroom. The author notes that in most studies teachers used the technology to support existing teaching practices rather than changing them. Where student-centred approaches were adopted they involved project work and the creation of digital resources such as movies. The most commonly reported outcome was an improvement in student acquisition of technical skills.

Li et al (2010) report on a case study of tablet PC use in a primary school in Hong Kong. Students were given the devices as 'learning companions'. Students could access the internet and school intranet, as well as make 'handwritten' notes using handwriting recognition software, seen to be particularly useful for inputting Chinese characters. The tablet PCs were also linked together in order to co-construct written texts. All textbooks were provided electronically and assignments and assessment were managed online. Teacher pedagogies included inquiry based learning, collaborative and group learning. There was a shift to self-regulated learning. Students were motivated and developed high levels of ICT competence.

Li (2010) also reports on a comparative study of one-to-one access to tablet PCs in a primary school. Four classes – 2 with individual tablet PCs and 2 without – were studied. Students were shadowed for a day, and then lessons relating to project-based learning and independent study were observed at a later date. There was no requirement for teachers to consider their pedagogy. Instead the tablet PCs were seen as 'learning companions' which held all learning resources and could be used to support learning as and when students decided to use it. Most observed lessons were whole class or directed instruction together with class activities. Students used their tablet PCs for note taking, annotating e-texts and completing exercises. Independent study and project-based learning however enabled greater student autonomy when students worked collaboratively, used mind maps, and engaged in self-initiated peer-supported learning activities.

Klieger, Ben-Hur & Bar-Yossef (2010) describe the introduction in science education of teacher and student laptops in Israel, noting that it led to a shift from teacher-centred to student-centred practices (although the actual use of the laptops is not made explicit in this paper). A series of case studies were conducted some three years after the program of laptop provision had been delivered. The program included professional development support with a focus on science education and ICT pedagogy. Changes in practices were reported as an increase in online learning which led to the development of higher order thinking skills in learners, an increase in self-directed learning, an increase in the use of forums on the school website. There were some technical issues and concerns around classroom management (controlling access to the internet).

Drayton et al (2010) describe three case studies of 1:1 laptop initiatives in relation to pedagogies in science. They comment that teachers use a range of science software to promote student engagement, reflection and student-centred approaches although less than a third of participating teachers felt this software contributed to improving collaboration between students. Teacher-centred approaches dominated however, with teachers using the technologies in ways which supported their existing practices. The authors conclude that more should be done to change school cultures through the provision of appropriate professional development.

Balanskat & Garoia (2010) reviewed laptop and netbook initiatives across Europe identifying 33 initiatives from 18 countries. In terms of pedagogy, across all initiatives, the key pedagogical aspiration is noted as 'personalising learning'. Some initiatives are more focused on pedagogical change, such as a shift to student-centred learning, than others which focus on addressing digital divide issues and the development of teacher and student ICT skills. Only 8 of the initiatives have or are being evaluated; information on pedagogical practices in this report is limited.

Vuorikari, Garoia & Balanskat (2010) present a pre-evaluation report of a European project to explore the use of netbooks. This project is still at an early stage and has yet to collect data on how the netbooks are being used but almost half the participating teachers intend to use them to support collaborative activities (including online collaborative homework).Teachers also perceived that the use of netbooks could have a positive impact on student engagement and facilitate more opportunities for personalised learning.

1.3.2 Mobile Phones

De Marcos et al (2010) describe the use of a mobile application for use on any student-owned mobile phone to support self-assessment in secondary schools as a supplement to the teacher's usual pedagogical approach. Students accessed a multiple choice quiz which teachers had designed. Teachers were able to monitor students' progress. There were some technical problems running the application on some of the student-owned mobile phones. Costs of internet access (required to perform the task) were also noted as a barrier. This initiative only had a statistically significant impact on attainment for younger learners (aged 14-15 years). Students found the experience positive.

Hartnell-Young and Heym (2008) investigated how mobile phones could be integrated in teaching and learning, working with 5 UK secondary schools. Teachers considered ways of using the technology in their classrooms and devised/adapted activities to include the use of the phones. Phones with cameras and videos were used to capture evidence of activities. Some students used the calculator feature of the phone and the stopwatch to time events. The phones were used to connect to the school network and also transfer documents between devices. In some cases images and video data were uploaded to learners' portfolios. Learners also downloaded and listened to podcasts. One teacher sent regular reminders to students via text messages.

Moura & Carvalho (2009) report on a similar study of mobile phone use in Portuguese and French schools to access resources, produce text and support language learning through SMS exchanges. Scenarios were developed to support teacher's pedagogical practices around personal reflection, enquiry-based learning and collaboration. Students made notes, undertook activities, listened to podcasts and collaboratively produced a text.

Taibi et al (2009) describe how they developed an environment to support mobile learning and piloted it with 29 teachers from 6 secondary schools with only 12 smart phones. Teachers from across the 6 schools collaborated to produce learning activities, using a concept mapping tool to support this process. When the students tried the activity which involved travelling off site the teachers were able to monitor their progress using various tools (including a location tool) and also to communicate with the learners via chat and instant messaging. Students worked collaboratively in groups. The students had to tag geographical locations and collect data such as photographs, which they considered relevant to the task they had been set, as well as construct a collaborative text (wiki). The authors were particularly interested in the impact of this environment on motivation (both for teachers and students). However they note that teachers' roles changed and that they were able to remotely support and manage a knowledge-construction, group activity.

Greenhill with Pykett & Rudd (2007) present a case study of a mobile phone and web application designed to embed physics learning through games creation and play. It was trialed in secondary schools; the authors conclude that its use was authentic and engaging, and consolidated learning, not only about science concepts but also about science design processes and digital literacy. Moreover it was considered most effective when presented with a dialogic pedagogy (teacher as facilitator of discussion, peer-interaction and peer-learning) rather than a didactic pedagogy.

1.3.3 Handheld Devices

Kim et al (2010) describe a study of mobile devices in a rural and urban primary school in Mexico. The devices were pre-loaded with story books designed to support the teaching of reading (Spanish 1st grade). As well as reading the words and listening to the story being read aloud, students could record their own narrations of the story. Students were able to listen to stories again if they chose to do so or to move on to an unread story. The devices were used to supplement regular

classroom instruction. Unfortunately the devices were not taken home due to teacher concerns about high levels of drop-out and migration (which proved to be the case). The learners in the rural school benefitted to a greater extent than their counterparts in the urban school.

Eduinnova is described as a pedagogical development which uses networked handheld devices to support collaborative learning (Nussbaum et al, 2010). The mobility enables learners to move around the classroom into groups to work together and also to interact face-to-face as well as via technology. This enables a more student-centred approach and has been used with over 700 teachers in Chile over the course of the last 10 years. The software provides online assessment tool for the teacher to use which shows graphically which groups are having difficulties with the task and what could be done to support them. Teachers using the devices claimed that their pedagogies shifted away from a purely expository style taking on the role of a facilitator. Students were perceived to take an active role in the process. The outcomes for learners included improved communication skills. The software has been trialed in the UK (Galloway, 2007) where it has been used to support discussion and collaboration in primary schools.

The Eduinnova software was adapted by Roschelle and colleagues (2010) to support the teaching of fractions in mathematics in USA primary schools through 3 activities described as 'exchange' (multiple representations of fractions), 'ordering' (putting individually assigned fractions in ascending order) and 'aiming between' (where learners propose and evaluate fractions which could occur between two points on a number line). In this study, which focused on the learning outcomes rather than the role of the teacher, teachers and learners were given training in collaborative approaches. The teachers received real-time feedback on each group's progress. Students were observed to develop communication skills such as questioning, explaining and discussing which enabled them to solve the problems set as a group with less support from the teacher. Students in the control group were observed to put their hand up more often to request support from the teacher. Furthermore there was a positive impact on learning outcomes when compared to a control group.

PDAs were used in one UK school in a Media Studies class to capture video data, access the internet and the learning platform, and as a voting device (Lynch et al, 2010). Teachers involved felt that learners were more engaged and that communication and interaction between peers had been enhanced.

Hartnell-Young (2009) reports on a case study of PDA use in a primary school in the UK with one teacher and a class of learners aged 10-11 years. The teacher worked with an e-learning consultant to establish how best to use the technology to support her pedagogy. Greater levels of learner autonomy and collaboration in the classroom developed. Although the PDAs were used throughout the curriculum, the focus in this paper is on the development of digital literacies. For example, learners used the PDAs to create multimodal texts using video, text and animation. The teacher perceived that boys' writing was improved as a result of participating in the project.

McFarlane, Triggs & Yee (2008) investigated the use of 1:1 personal mobile devices in 2 primary and 3 secondary schools in England. Teachers perceived a positive impact on attainment. Some use was very 'traditional' for example primary children used the devices independently to engage with drill and practice applications in mathematics. Teachers initially incorporated the devices in ways which supported their existing practices – largely teacher-controlled. A secondary pupil described how he used the device with a portable keyboard to support his learning throughout the day – for example taking notes, writing essays, and taking photographs. There was a slight shift towards more student-centred, open-ended activities as the teachers became more comfortable with the technologies but the authors note that innovation was constrained by the demands of the curriculum and concerns about high-stakes testing. Some teachers experimented with new forms of assessment – for example, capturing and recording the screen to provide as evidence of activity.

Learning2Go in the UK was a study of 1:1 computer provision in primary and secondary schools from 2004 to date. Initial studies focused on PDAs (Perry, 2005) but more recent work has broadened the scope to look at a range of technologies including netbooks (Perry, 2009; 2010). In 2008 (Perry, 2009) one secondary school provided handhelds to all pupils aged 11-12 and all pupils aged 14-15. As with many large-scale innovations such as this, uptake varied according to individual teacher enthusiasm. Some experimented with multimedia text production including animation, video, photographs and multimedia presentations. For example, in Geography and Science students used an application to capture data in the field. At another school where an A-level group (aged 16-17) was provided with the devices students shared their work via the interactive whiteboard, and created e-portfolios using the data capturing features of the handhelds. A further secondary school (Perry, 2010a) provided all 11-12 year olds with netbooks and also re-designed the curriculum, shifting to a cross-curricular thematic approach and supporting learning through the adopting of the RSA Opening Minds curriculum. Teachers had not yet begun to rethink their pedagogy differently but planned to develop more collaborative approaches in the future. In a primary school in the same study students aged 10-11 used smartphones (telephony-disabled) to document project work using different applications to create sketches, animations, photographs and video.

Loveless et al (2007) report a small-scale study of the use of mediascapes (location-sensitive multimedia texts) in educational settings including primary and secondary schools in the UK. The mediascapes were used across the curriculum and teachers perceived them to be engaging. Learners accessed these resources using PDAs which they carried with them as they travelled through a location, and which brought up text, sounds and images (GPS triggered) in relation to particular spots. The project enabled exploration of "locally embedded personal geographies and shifting identities among young people" (p.4).

One CAPITAL case study (CAPITAL, 2009f) describes a project which used mobile technologies (including personally owned devices) in a further education setting. The main aim was to develop the infrastructure so that a wide range of devices could be used on the college network. The college invested in a range of technologies which

lecturers could use. There was an increase in the use of video and audio in learning activities. And learners could record learning activities using their preferred device.

Bunce & Reid (2009) conducted a small-scale study of the use of hand-held devices (learner response devices, mobile phones, netbooks, and games consoles) to support the development of enquiry skills in a primary school, middle school and high school in England. The report focuses on the challenges faced when trialing a range of devices and software, and some solutions/workarounds. Examples of use included using the chat room facility of the games console to download a grammatically incorrect sentence created by a teacher in Modern Foreign Languages and upload it to the chat room to share with the other learners. In another example the teacher provided the start of the story and learners collaboratively worked on developing it further by uploading sentences to the chat room. Challenges included the need to develop rules of use, and that only 16 devices could connect to a chat room at the time of the study. However, teachers organized the activity so that pairs used the same device and this was perceived to enhance communication and collaboration. The use of the technologies in different ways, with the support of frameworks developed within the project, was perceived to have contributed to learners' development of enquiry skills including: communication, collaboration, questioning, reflection and self-management of learning.

1.3.4 Self Organised Learning

Sugata Mitra's work (Mitra, 2010) around technology-supported, collaborative problem-solving provides an interesting and yet simple example of how an extreme form of student-centred learning (no or limited support from a classroom teacher) can lead to interesting outcomes. The work started through the 'hole-in-the-wall' projects in India but has recently been continued through a project in UK primary schools where teams of learners with access to the internet are asked to solve GCSE questions (the formal assessments given to learners aged 16). Mitra describes this as a 'self-organized learning environment' with teachers adopting the role of mediators – setting the question and then leaving the learners to it. Mitra comments that 'teachers need to be trained to design simple questions that will evoke curiosity and interest while gently nudging a group towards the curriculum'. Tobin (2010) reports that one of the participating primary school teachers now introduces all new science topics using this approach. There have, however, been critiques of this approach which have argued that the withdrawal of the teacher can lead to existing inequalities playing out in which boys and children with existing educational and social capital tend to do better (Arora, 2009). There have been few robust studies of the long-term impact of such environments.

1.4 Innovation in Classroom-Based Assessment

One of the key trends identified as important for transformed classroom practice in Crook et al (2009) is the potential for digital technologies to be used to support rich feedback and to enable new forms of assessment. Evaluation and assessment are notoriously under-reported in classroom studies of innovative practice, although a

number of projects focusing on innovative teaching and learning necessarily engage with this issue. Our review, however, identified a number of projects where innovative practice around assessment is highly visible, these tended to cluster around the use of digital technologies to offer more opportunity for learners to participate in peer and formative assessment, and the emerging field of tagging and the semantic web as a means of reflecting upon practice:

1.4.1 Self, Continuous and Peer Assessment Practices

Kimbell et al (2009) describe the e-scape tools – handheld devices providing access to a web-based portfolio and web-based assessment system, designed to link to awarding body assessment systems. The tools were piloted in phase 3 in design and technology, science and geography and involved 19 secondary schools. Teachers design activities which are sent in units to learners devices and each individual learner's work is retrieved after a set amount of time for each unit. In a further development of the system (Patterson, 2010) teachers provide prompts and formative feedback (eg target setting) using both text and audio. Learners in both secondary and primary schools used the handheld device to record their 'design story' through the multimedia capabilities of the device (video, audio, image capture). The learners engaged in self and peer evaluation. All feedback whether learner or teacher initiated was recorded in the e-portfolio. One learner did note that using the technology to provide feedback to peers seemed to take longer than it may do if provided verbally – however, using the technology did provide a record of this.

Weir & Connor (2009) report on a trial of the use of digital video to support teaching, learning and assessment in physical education. The use of video clips to support formative and summative assessment was examined. Students also produce e-portfolios. Teachers felt that students' technical skills improved the most, with 12 of the 31 participating teachers claiming that it was most beneficial in enabling students to identify their strengths and weaknesses. However the teachers and the learners felt that it was very time-consuming.

Clark-Wilson (2010) described a similar study working with 7 teachers in England, Scotland, The Netherlands and Sweden, focusing on the development of new formative assessment practices. The teachers decided how to integrate the graphing calculators into their pedagogies. Some teachers also used the devices in conjunction with IWBs. The teachers reported on 25 lessons with the screen capture facility reported to be the most useful feature. Pedagogical practices were identified as: "develop new and support existing formative assessment practices; enable the development of innovative mathematical tasks; support the use of the handheld technology for both individual and whole-class work; support teachers' lesson planning to include desired pedagogical approaches, lesson organization and classroom management strategies." (ibid, p753). These practices were used to support teacher interventions, classroom discourse, peer and self-assessment, mathematical generalizations.

1.4.2 Learner Response Devices, Feedback and Innovation in Assessment

Learner response devices have been enthusiastically taken up in many university settings and are increasingly being used in schools. We could have reported on these devices in the section on personal and mobile devices. Our reading of the current innovative practice in this area, however, is that their use is qualitatively different. It tends not to be aimed at building learner responsibility and autonomy, but might more usefully be considered part of the ongoing development of more effective feedback mechanisms to teachers and as part of the developing panoply of tools for in-classroom assessment.

The literature on the use of learner response systems (also referred to as clickers, classroom response systems, audience response systems, voting systems) is as yet fairly limited and tends to relate to their increasingly common use in HE settings prompted by the opportunity afforded for introducing a more varied pedagogy in the context of lectures delivered to very large classes (Kay and Lesage, 2009).

However, Moss and Crowley (2010) working in a substantial science outreach project involving 5000 learners in the 15-19 age ranges see the devices as offering a highly flexible and transferable approach to engaging learners of all ages in the use of interactive technology. The devices are generally considered easy to use by both teachers and students, thus enabling more interactive teaching (Draper & Brown, 2004; Siau et al, 2006) and they have been found to have the potential to support learning when underpinned by appropriate pedagogies (Fies & Marshall, 2006).

An analysis of 56 studies undertaken by MacArthur and Jones (2008) has identified clear learning gains from the use of these devices under certain conditions. A number of the affordances, including the primary advantage which they identify, the option of being able to submit either identified or anonymous responses thus providing formative assessment and function supporting student collaboration appear relevant to all phases of education. Their analysis suggested that the devices were instrumental in supporting collaborative learning and constructivist pedagogical approaches

Furthermore, learners themselves perceive they are more involved and making a contribution rather than being passive receivers (Trees & Jackson, 2007; Walsh, 2009). Evidence from a comparative study of students using no formative assessment, paper questionnaires and voting systems suggests that the use of learner response systems does impact positively on attainment (Mayer et al, 2009). Their use in the classroom can increase attendance and retention (Caldwell, 2007; Stowell & Nelson, 2007; Moss & Crowley, 2010)

The use of learner response systems is underpinned by beliefs that active learning and student engagement is worthwhile (Simpson & Oliver, 2007). This is now being interpreted in a more sophisticated and holistic way, looking beyond the assumption that using handsets equates to meaningful interaction (ibid, 2007).

Other studies suggest that the devices have helped to alleviate boredom in classes, increasing motivation and engagement (Hoekstra, 2008; Trees & Jackson, 2007; Draper & Brown, 2004; Boyle & Nicol, 2003; Walsh, 2009). For example, they provide opportunities to discuss material, break up the lecture, help students stay focussed and generate 'noise' that helps to alleviate the boredom (Hoekstra, 2008). The system also enabled students to see how theory could be applied and to test their understandings. Moreover, the audience can be given ownership which can be powerfully motivating (Wilson, 2006; Caldwell, 2007).

Anonymity can positively affect confidence levels (Caldwell, 2007, Walsh, 2009; Draper & Brown, 2004) and students are more likely to respond honestly (Stowell and Nelson, 2007). Bannister et al (2010) comment that while some learners reticent to respond verbally for fear of embarrassment clearly value anonymity from their peers there are advantages in the teacher being able to identify individual's errors rather than seeing only an aggregate result. It may also be beneficial sometimes for learners to see others' contributions (Draper and Brown, 2004) and seeing that others had similar responses/opinions can build self-confidence (Caldwell, 2007).

From a teacher's perspective in relation to the management of learning, feedback from learner response systems can be an indicator of how well the teacher is getting the message across (Draper and Brown, 2004; Walsh 2009). With just-in-time information such as this, teachers can then alter pace of session, try a different approach or backtrack as appropriate.

The introduction of these interactive devices can also prompt teachers to reconsider their overall pedagogies. For example, in History lessons, learner response systems can prompt teachers to reconsider their use of questioning and its nature and purpose (Walsh, 2009).

The use of learner response systems increases opportunities for formative feedback (Roschelle et al, 2004; Simpson & Oliver, 2007). Staff can assess all members of the teaching group rather than the individual who is chosen (or has volunteered) to answer the question, keeping a permanent and individual record of each student's contribution (Caldwell, 2007). Whilst clearly able to support assessment, learner response systems also have the potential to support discussion (Boyle and Nicol, 2003; Simpson and Oliver, 2007; Hoekstra, 2008), foster peer interaction (Hoekstra, 2008), tackle misconceptions (Caldwell, 2007) and can challenge learners to justify their responses (Boyle and Nicol, 2003). They can enable staff to test students' application of theory in a concrete way (Hoekstra, 2008; Trees and Jackson, 2007).

Students value the feedback provided (Trees and Jackson, 2007) and like to compare individual answers with whole class responses (Caldwell, 2007; Draper and Brown, 2004).

However, there are also some issues which need to be considered. The use of learner response systems in the classroom can be time-consuming (Boyle and Nicol, 2003; Caldwell, 2007; Draper and Brown, 2004) and a distraction (Draper and Brown, 2004). Sometimes use of learner response systems detracts from learning objectives

rather than enhancing them (Draper and Brown, 2004). Students do not appreciate overuse (Caldwell, 2007) or uses that are not perceived to be purposeful (Caldwell, 2007; Draper and Brown, 2007).

Some students do not feel comfortable working collaboratively in discussion groups with learner response systems (Hoekstra, 2008). However, this could be due to not having done the required preparation, preferring not to have to listen to their peers' potentially incorrect reasoning, or simply personal preference.

Cutrim-Schmid (2007) and Moss and Crowley (2010) provide a number of imaginative examples from modern language and science teaching respectively of the use of quizzes involving a range of question types which enable both teachers and students to identify a baseline knowledge of the topic and to monitor progression as knowledge and understanding evolve.

Much of the research published to date was conducted prior to the introduction of devices such as ActivExpression, which have greater functionality (for example text responses) than the early voting systems and which are now widely available. Chambers (2009) reports on the use of such devices for the planning and teaching of history lessons in a secondary school. The findings supported those of Walsh (2009) regarding the positive benefits of the devices for increasing learner engagement and the devices were popular with learners across the secondary age range. Opportunities to support a more student centred pedagogy were identified by virtue of their support for collaborative learning with pupils comparing and contrasting their individual responses and sessions where students determined their own routes of enquiry.

Chambers' findings are consistent with those of Cutrim-Schmid (2008) who observed increasing levels of interactivity and an increase in participation among learners previously comparatively reticent to contribute to discussions. The need to broaden the range of questions beyond those where there was a right answer was identified and the emergence of advanced historical thinking which can be developed through debating more open questions and issues proved more difficult to assess.

Bannister et al (2010) report on a large scale evaluation of similar devices involving data from 100 questionnaires over 130 lesson observations involving 70 teachers, 80+ interviews with teachers learners and local authority advisers gathered over three phases of visits. Their findings were consistent with the body of research reported above e.g. Simpson and Oliver, 2007; Hoekstra, 2008 Chambers 2009, Walsh, 2009 in terms of the use of the devices to support constructivist pedagogies, collaborative learning, more active participation from somewhat reluctant learners and the value of instant feedback for formative assessment purposes. The scale of the project and the research design enabled the project team to address the issue identified by Chambers (2009) regarding the limitation of responses based on questions requiring a correct answer by working with teachers to design other types of response. They also identified a need for teachers to recognise that accurate responses are not always evidence of complete understanding and the need for careful consideration of the learner's ability to read and interpret the question.

Conducting the research over three phases of visits served to highlight how teachers' use of the devices became progressively more sophisticated with experience. They identified five phases in the teachers' development of their expertise and draw attention to the need, where sets of devices are limited, for teachers to be given sufficient access to enable them fully to develop their expertise.

Early findings on the use of a new generation of learner response devices which incorporate additional "self-pacing" software for enhancing the formative assessment process have been reported by Haldane and Smith (2010) working with secondary school students in biology classes. The software enables questions to be planned and leveled in advance of the session by the teacher with pupils being required to answer correctly a certain number of questions at a particular level before being able to progress.

The data generated can be easily followed and interpreted live by the teacher throughout the lesson and individual and class records of progress pasted into Excel for more detailed analysis and to inform the planning of targeted differentiated provision. The teacher is able to identify and respond to difficulties encountered by individuals or those common to a number of learners, to address them as they arise, and to set differentiated homework accordingly at the end of the session. The devices themselves, the improved quality of feedback, the rapid intervention within the session in response to difficulties arising and the differentiated homework all proved popular with students who also perceived that they stayed more engaged with lessons during which the devices were used.

1.5 Games

Wastiau et al (2009) reporting on the Games in Schools present a review of game based learning in schools in 8 European countries, taking a broad view of what counted as games play as identified examples were limited in number. Focusing on six case studies they suggest that games have the potential to support motivation, improve skills (for example social skills) – but not necessarily subject knowledge, and provide stimulus for multi-media production and the development of literacy skills. In the concluding report on the EU funded IMAGINE project, Blamire (2010) noted that the use of games in school settings is still at an early adopter stage in most European countries with more advanced uses in Scotland, Denmark and Catalonia. Blamire argues that teachers need support if they are to begin to integrate games based learning into their pedagogies but also noted there is still much resistance from teachers. The two studies from European Schoolnet echo earlier findings from Sandford et al (2006) who reviewed the use of commercial-off-the-shelf games in formal education. This report argued that there were important barriers to the use of games in education including technical, cultural and logistical issues. They argued that when students had greater autonomy over games play they were more engaged and that teachers need a good understanding of the curriculum in order to ensure that games play supports learning objectives.

Papastergiou (2009) presents a review of literature on games and learning in physical and health education. The focus on this review was on the potential of games in these disciplines rather than the impact on classroom pedagogies specifically. The empirical evidence in relation to effectiveness was limited but participants of the studies reviewed were positive about the potential benefits including: motivation and engagement, knowledge acquisition.

Williamson (2009) considers desk-based research, a survey of practicing teachers and interviews with 10 teachers already making use of games in the classroom. A third of respondents in the survey reported using commercial games in the classroom. Often teachers made the games fit their existing educational objectives. Games have been used to support literacy and communication development, as well as developing learner's design skills. Teachers perceived that games support greater learner autonomy and increased social interaction as well as the development of media literacy skills.

Ulicsak with Wright (2010) reviewed the literature on serious games to support learning with the aim of providing guidance for teachers to evaluate and select appropriate games to support learning objectives. The authors argue that, based on current and previous research, games are part of young people's digital cultures; teachers now recognize the educational potential of games and are becoming more willing to experiment with them in the classroom; games can support constructivist learning approaches (i.e. different pedagogies); they can be motivational; they should be used alongside a range of approaches; games technologies are continually developing and this will facilitate greater levels of interaction in the future. However, they caution that games do not suit all learners as they often demand significant investment of time to achieve mastery through experimentation and repeated failure at tasks. And some games require teachers to think creatively about how to use them to achieve learning objectives and meet the demands of the curriculum, which in turn demands time from the teachers.

While games use is still at an early adoption stage, because of the interest in games in student informal learning cultures and a significant interest in games and learning in academic education research, there is a wealth of innovative practice in this area. Indicative examples of the range of games-based learning activities are presented below. It is noteworthy, however, that there are still no widespread, taken-for granted, games-based learning activities across Europe or elsewhere. Innovation in this area may therefore need to consider, early on, what would make for a sustainable long term development rather than a one-off experimental project.

1.5.1 Location Based Gaming

The shift of gaming onto mobile platforms combined with the development of GPS functionality in mobile platforms is leading to a growth in location-based gaming and augmented reality gaming.

Wijers, Jonker & Drijvers (2010) present a study of location based games for handhelds to support mathematics and also geography education in secondary

schools, developing a geometry game (MobileMath). Students were introduced to the game then spent about 1 hour playing in teams on the school field using mobile phones with GPS facilities. Students created geometrical shapes, using online maps and placing vertices on the school field by entering geographical location details on the phone. If correctly placed the online facility shows the shape created on the map. Teams score points according the area of the shape. Shapes cannot overlap adding to the challenge. Shapes can also be 'deconstructed' by opposing teams. Students found this motivating and used different strategies to construct the shapes. They perceived that they learned more about geometrical shapes and also developed collaborative skills. There were technical issues in relation to the GPS readings.

The emapps.com project involved mobile technologies, GPS systems and games designed to be used beyond the school walls (Brophy, 2008). The focus of this report is the impact on children but the author also touches on pedagogical practices. The games, produced by teachers (together with children in some of the schools), involved collaboration and the co-construction of knowledge, and were described as being intellectually challenging for the children involved. Teachers were positive about the use of mobile learning, perceiving it to be very motivating. There were some technical issues, particularly in relation to the use of GPS in urban areas and teachers were concerned about safety issues (learners were provided with devices which they took home). The author concludes that there was a change in the relationship between teacher and learner – it became less formal leading to different kinds of interactions. Emapps.com used game templates but it was still time-consuming for teachers to prepare the activities.

Matthews (2010), a secondary teacher, developed a new approach to supporting community studies education developing a project with three activities: place-based inquiry learning, learner authored games and finally the creation of an augmented reality game for mobile devices. The intention was to develop students' understanding of design processes through an authentic task within a culture of participation. Learners worked both independently and in groups. This innovative teacher concludes that developing such new approaches is not an easy task. However he felt that the project was successful facilitating collaboration, offering an authentic experience, engaging students and developing their digital literacy skills.

Squire (2010) evaluated the use of an augmented reality game in seven secondary classrooms in the US in 2007. The cross-curricular science mystery game was designed to be played over 2 weeks by groups of students, with one day collecting data in the field using a PDA with GPS. Video and data (readily available public documents) were shared with the learners as they approached geographic hotspots. Teachers provided support in interpreting the data acquired. In the classroom, learners role-played investigators (doctors, chemists, environmentalists) researching the cause of sickness of students who spent a day at a local beach. The author concludes that integrating game-based pedagogies together with problem-based approaches is a powerful catalyst for learning in the classroom.

Squire and Klopfer (2007) report on 4 case studies of secondary environmental science students participating in an augmented reality game which was designed to

be flexible such that teachers could integrate it in different ways. The game was designed to be played in a 2-3 hour window. In their observations the teachers in this study did not develop sophisticated mentoring and facilitation skills yet the game was perceived to have 'helped students understand the socially situated nature of scientific practice' (p.406). They surmised that this was partly because the game offered a degree of scaffolding

The Netherlands case study presented in the final report of the Games in Schools project (Kearney, 2009) describe a location-based game, developed in 2005, in which students had to travel around Amsterdam and learn about medieval sites in the city. One class of secondary school students piloted the game in 2005 and a further larger-scale pilot with 10 classes was undertaken in 2007. Students playing the game achieved higher schools on knowledge tests than those undertaking traditional instruction. Teachers felt that the students participating in the game had developed collaborative skills. As a result of these pilots a games-authoring tool was developed for students to create their own location-based games using one of three templates. The underlying pedagogy was to promote constructivist and collaborative learning. The tool was piloted from 2007-08 and, as the findings were promising, they were then made available for all secondary schools in The Netherlands to purchase.

1.5.2 Virtual Worlds and Simulations

Wrzesien & Alcaniz Raya (2010) investigated the use of virtual worlds for teaching natural science and ecology (in groups of 4 with a virtual tutor), comparing its use with a traditional approach (a whole class with a teacher) in primary school. There was no difference in outcome between the two groups but the learners using the virtual world were reported to be engaged and motivated, although possibly distracted by the 3D visual effects and novel interaction via paddles.

Ulicsak with Wright (2010) provide a case study of a business simulation game used to support Business Studies courses for 14-16 year olds in the UK. Students play the game over a period of 5 weeks towards the end of their course. It enables them to consider all aspects of business, holistically, through exploring the impact of decision making. Students here play in pairs and so are able to discuss decisions and reflect on the outcomes. The teacher adopts the role of facilitator.

Schwarz, Mayer and Sharma (2007) reporting on the use of computer simulations to support science pedagogy with pre-service elementary teacher trainees suggest that their experience helped them to develop their understanding of technology, science pedagogy, and epistemology. However, the trainees felt that use of software in the classroom should be fun and provide science information within a structured learning task. The authors conclude that trainees understand science pedagogies in very traditional ways – as teaching and learning science information rather than developing models and building theories from evidence. They also noted a lack of quality software at the time of the study for supporting the teaching and learning of elementary science.

Ketelhut et al (2010) describe a project which investigated inquiry-based approaches to science instruction through a virtual world environment. Over 2000 students collaborated in teams to solve problems around disease and bacteria through interacting with each other via avatars and accessing digital artefacts. In addition, learners could also interact with computer-based 'agents' which acted as mentors. The study was designed to support teachers to change their practices and included a professional development programme to achieve this. The focus of this paper is on students rather than teachers' experiences but the authors conclude that the environment was effective in enabling teachers to incorporate inquiry-based learning in their classrooms.

Thomas, Barab & Tuzun (2009) describe three case studies of the use of Quest Atlantis in primary classrooms in the USA. Teachers chose this virtual world because they could see an alignment with their learning objectives yet at the same time appreciated the flexibility of the environment and it support for social interaction. Learners try to solve missions (quests) which may or may not be assigned by teachers.

1.5.3 Incorporating Games into Practice

Miller & Robertson (2010) report on the use of 'brain training' games in primary schools in Scotland. Set up as an experimental study they argue that regular use improves learners' mental computation skills and self-esteem. However, arguably the use of games here was as a supplement to classroom practices and did not have any impact on the participating teachers' pedagogies.

Groff, Howells & Cranmer (2010) provide an evaluation of Learning and Teaching Scotland's Consolarium project which is designed to promote the use of console games in the classroom. The use of games is perceived to be engaging but require careful planning. Participating teachers were prepared to change their classroom practices in order to incorporate games based learning effectively. Teachers felt that the benefits included "teamwork and skills for life, including problem-solving, communication, collaboration and negotiation" (p.39). They also perceived that they became more of a facilitator in the classroom than they had been prior to using console games. Games including Nintendogs, Guitar Hero, Endless Ocean , Gardening Mama and Cooking Mama, were used to support cross-curricular and literacy projects.

Partington (2010), as a classroom teacher, describes the use of games authoring to develop media literacy skills in a UK secondary school with 12-13 year olds. He provides insights as a classroom teacher into the process of developing and refining a 'course' delivered through 2 lessons a week over 9 weeks, drawing on the digital cultures of his pupils. It involved playing commercial games, producing posters representing learner's personal experiences with games outside school, working in teams to create games for each other, peer assessment and reflection on what had been learned.

Baren dregt & Bekker (2010) reported on a study of educational computer games to support English language learning in The Netherlands, comparing learners' use in school and at home. The internet-based game was presented as a game world with quests and mini activities in order to 'find' 91 English words to fill a dictionary. The game was positioned by its developers as an 'informal learning activity' but clearly recognised by learners as relating to formal education and hence not many of them chose to play it in their own time at home.

Vos, van der Meijden & Denessen (2011) compared primary school students who created their own 'drag and drop' games with those who used existing games to support the same learning objective (to learn a Dutch proverb). Students who created their own games were more motivated and exhibited deeper strategies developing problem solving, critical analysis and thinking skills. However this study did not provide evidence of impact on learning outcomes and the authors acknowledge that the existing games may not have been challenging enough.

Charsky & Resler (2010) explored the use of concept maps as a conceptual tool to be used alongside the use of a commercial game in history in order to enhance the educational value of the games playing. However, learners in the control group were more motivated and engaged than those with an expert generated concept map and those required to produce their own concept map.

Watson, Mong & Harris (2010) reported on a study of an education game designed to teach about World War 2. The use of the game resulted in an active student-centred approach with learners more engaged and motivated rather than a teacher-centred passive approach. The teacher had incorporated the game into the classroom pedagogy over a number of years and had adopted strategies to maximise the effectiveness of its use. Shifts included moving from large groups to pairs, encouraging face-to-face interaction around gaming strategies rather than restricting this to the online game environment, and the framing activities around the game including linking the outcomes to formal assessment. During game play the teacher interacted with the students, not only in relation to technical issues, but also to scaffold learning opportunities.

Phillips (2010) describes the use of handheld games consoles in a secondary school which was supported through the creation of a new post – a learning technologist (also a trained teacher) – who worked with teaching staff to turn ideas into purposeful activities. PSPs were used in different subject areas as devices to capture, analyse and review audio and video, creating multimedia texts/portfolios to support project work or self-assessment of performance. Teachers felt that the technology supported new approaches in the classroom, and had an impact on both motivation and attainment.

PART 2: COUNTRY SUMMARIES

iTEC Knowledge Map: Austria

Key Groups

The Ministry of Education, part of the Federal Authority in Austria, is the main educational body. During 2000 – 2008 it undertook an initiative of consolidating the implementation of new technology in education. This took a number of forms, including:

- eFit (2000-2006), a funding mechanism from the Ministry of Education which helped to launch innovative ideas and projects concerning ICT in education. Efit helped to consolidate and fund the implementation of new media across the education sector and spawned two companion projects (eContent and eLearning Cluster – see below);
- eContent, the development of teaching/learning software and e-learning materials (further details below);
- eLearning Cluster initiative developed pilot schools in each of the Austrian provinces which collaborated together in clusters to implement practical models of eLearning (further details below);
- Future Learning Programme (2007-2010), an initiative that supported new forms of teaching and learning using ICT in education, especially forms that moved aware from traditional teacher centred classrooms towards a more individual learning pathway approach. This included the development of the 'Edumoodle' programme which provided all schools with access to a free VLE;
- IWB development, which has spread across some schools (a survey in 2007/08 found that 21% of state schools were equipped with IWB).

Several of these initiatives are worthy of further comment. Firstly, eLearning Cluster Austria is a network of clustered schools hat work together to offer their students and teachers certified qualifications in IT and e-learning skills and knowledge. Secondly, the eLSA eLearning Project has funded a number of middle schools (students aged between 10 – 15) and provided a high level of up-to-date ICT infrastructure. This has a very positive impact on teachers 'new media competence. Thirdly, the Virtual School Austria, run in collaboration with the European Schoolnet, has been an important portal of ICT educational projects. It has become the centre for interdisciplinary ICT projects across Austria, leading to further e-content development and an exemplar of good practice for other educators.

Finally, the Future Learning Programme has fostered a new concept of ICT linked to Web 2.0 technologies. The use of IWB has accompanied this programme, but these are mainly focused in secondary education and adoption is slow. The Future Learning Programme targets young people aged between 6 – 19, adult learners, teachers and other target groups (e.g. isolated children and children in hospitals). The various strands of activity include:

- Digital content and ICT services;
- Social software and Web 2.0 within the school setting;
- New equipment including laptops, mobile phones for learning, PDAs, iPods;
- Teacher training including e-learning didactic course, online academies;
- Equipment guidelines and initiatives for schools;
- Developing networks within other groups outside the immediate educational context (e.g. the Ars Electronica Centre in Linz).

The overall computer per pupil ratio in Austrian schools is 16:100 and 59% of schools have broadband (STEPS, 2009).

The Current Curriculum Context for ICT

ICT is taught in a cross-curricular way and should be part of all curriculum subjects. Most schools do not have specific ICT projects but integrate ICT as part of a route of ongoing educational activities. Typical applications of ICT include the use of information search tools, word processing, audio, video and administrative tools.

There has been a lack of engagement at a policy level relating to other ICT functionality within education. For example, computer gaming, the use of IWB, mind-mapping and other social software is generally underdeveloped in Austrian schools although things are developing slowly, especially within the secondary phase of education. The secondary school curriculum specifies professional as well as social competencies, such as self- management, self-directed learning, and ability to collaborate and to take responsibility. ICT is taught as a separate subject (Network Technologies), although it is not compulsory and therefore not offered by all schools (OECD, 2009, p24).

Computer Science is a compulsory subject in the fifth year of all schools. It is taught in two lessons each week. More generally, ICT supports teaching and learning in each curriculum subject at each phase. The initiatives outlined above all feature a clear subject component that the use of ICT as a tool for teaching and learning can support.

ICT Usage in the School

Research shows that computers are used by 88% of teachers in Austrian primary schools. Of these teachers, 59% of them use computers in class for presentation or demonstration; 97% of them have pupils working with computers during their classes.

Almost all (99%) Austrian primary schools have access to computers within the school and are connected to the Internet.

Primary school teachers in Austrian are broadly supportive about the use of ICT when compared to other European countries. However, they are amongst the most

skeptical about the impact that ICT can have on a child's learning. This should not be mistaken for utter skepticism. Rather, research points to these teachers having a balanced attitude profile (STEPS, 2009, p4). Austrian teachers 'somewhat agree' rather than 'strongly agree' about the motivational effects of ICT on pupils.

The vast majority of Austrian primary school teachers feel confident about their use of ICT (87%). Around 11% can be classified as novice ICT users.

In terms of barriers to the further use of ICT within this part of the Austrian educational sector, the following issues have been identified by some teachers:

- Dissatisfaction with the internet connection speed (29%);
- A lack of computers (31%) and associated maintenance and support of the ICT infrastructure within the school (62%);
- Difficulty in finding adequate learning materials for teaching (19%);
- Lack of quality learning materials (20%).

Digital Learning Resources

The development of digital learning resources has been helped by specific Government funded projects such as the eContent Initiative. Within this, teaching and learning software, alongside other eLearning materials, have been developed and distributed through networks under the control of provincial (federal) groups, independent subject-focused groups and individual schools. There seems to have been a significant collaboration between teachers, developers and publishers in this initiative. It is hoped that half the classes in Austrian schools will be provided with eLearning materials in all subjects by the end of 2010.

The Ministry of Education's education portal (www.bildung.at and http://bildungspool.bildung.at) provides a 'one-stop-shop- for all matters related to using ICT in education. This is set to undergo further development over the next few years to become an 'eContent clearing house' that will offer a broad range of quality web-based educational content for teachers and students.

The 'Education Highway' is another important portal with more than 36 various subjects (http://www.eduhi.at/index.php?changeurlto=gegenstaende), an informatics specific portal (www.informatikserver.at) with advisors on open source solutions, and a platform to teach government related issues (www.edugov.gv.at).

The national development of the Edumoodle programme has shown that VLEs are in great demand in Austrian schools. The free Edumoodle VLE has been taken up by many schools (with ILIAS and dotLRN being popular in two other Länder); 1200 further school locations are currently being developed.

Other Issues

The establishment of an eLearning strategy group in 2007 has considered new forms of teacher education which include eCoaching and EPICT. The 2009/10 European Schoolnet report discusses the launch of a pilot programme that may lead to the implementation of the European Pedagogical ICT License (EPICT) across Austria.

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iTEC Knowledge Map: Belgium

Key Groups

The Flemish Ministry of Education and Training is responsible for funding schools, developing educational attainment targets, checking that these targets are reached and developing/running specific projects according to contemporary policy or societal requirements.

The four Educational School Networks (ESN) act as the representative association for each individual school's governing body. They are responsible for pedagogical and organizational issues such as curriculum development, timetabling, school support, etc. Each network, along with each school, is largely autonomous.

In recent years, the central authorities have stressed three goals in relation to ICT in schools:

- Providing infrastructure;
- Delivering training;
- Supporting schools.

The Current Curriculum Context for ICT

The ICT curriculum provides the general framework ICT in Flemish schools. However, in line with the autonomy outlined above, each ESN, or individual school, can decide for themselves how these competencies are taught and, fundamentally, what the principles of a digital 'pedagogy' might be.

Generally, ICT competencies are taught through the daily classroom activities. A set of cross-curricular 'final' and 'developmental' ICT objectives were implemented across all schools in September 2007. These objectives were seen as challenging. Therefore, the Flemish Government has developed a five-point implementation policy to help support the education system, as a whole, in their use of ICT. The five points are to:

- Strengthen the policy-making capacities of educational establishments at institutional level;
- Promote the professionalism of educational staff;
- Provide a high-quality infrastructure;
- Develop a suitable teaching aid policy;
- Research and ICT monitoring.

Within the curriculum itself, ICT is a separate subject in secondary education but not in primary education. The ICT-related cross-curricular final objectives and developmental objectives (referred to above) are designed to be employed in primary education and/or the first level of secondary education. This cross-curricular

dimension is important. The aim is not to create a separate 'subject' at primary level. Rather, ICT is seen as providing opportunities within all subjects and fields of study. The individual class teacher is responsible for examining each pupil in light of these objectives.

In secondary education these skills are included in the cross-curricular themes:

- Learning to learn;
- Social skills;
- Citizenship;
- Health education;
- Environmental education;
- Expressive-creative education;
- Technical/technological education.

Changes to the cross-curricular part of the core curriculum, with a particular focus on key competencies, will be introduced in 2010. Schools decide themselves how to achieve the cross-curricular objectives; there are no guidelines or models from the Ministry. Similarly, there is no assessment of these skills, although the inspectorate ensures that sufficient efforts are made by the school in order to fulfill the cross-curricular objectives during school audits (OECD, 2010, p24).

At the second level of secondary education, ICT becomes a more specific set of components and does, in the traditional sense, become an individual subject.

ICT Usage in the School

There are 2,505 primary schools in Belgium that pupils attend between the ages of 6 to 12. As we have seen above, digital competence is a cross-curricular competence in two out of the three language communities (Flemish and German speaking); in the French speaking community it is integrated within the subject 'education and the media' and taught through specific pieces of software. In primary schools some 21 century skills are included in the core curriculum either as concrete objectives or as broader goals or underlying principles.

Primary school teachers in Belgium have good or very good ICT user skills and only 9% can be classified as novice ICT users. The computer/pupil ration is 7.7/100 and 69.3% of schools have a broadband connection.

Recent research (STEPS, 2009) has reported that 67% of teachers use computers regularly within their classrooms. Of these, 70% of teachers make use of the computer themselves (e.g. to demonstrate or present something) whilst 93% of this group regularly allow pupils to use computers for particular sequences of learning within the classroom.

Teachers in Belgium access learning materials from school networks in line with the European average, but make more use of offline material (85%) than teachers in other countries.

Whilst nearly all of the primary schools in Belgium surveyed within the STEPS (2009) research used computers at some point for teaching and learning activities, they were generally ranked towards the middle in terms of specific ICT usage and equipment items. For example, 61% of schools have a website, 58% offer email to teachers and only 16% offered email to their pupils.

Like teachers in Austria, Iceland, France and Luxembourg, teachers in primary schools across Belgium are generally support of ICT but amongst the most skeptical about its benefits, in particular in respect of the motivational effects for pupils that ICT can bring in the classroom.

Teachers in this sector have identified a range of barriers that affect the use of ICT (STEPS, 2009, p4). These include:

- Dissatisfaction with the internet connection speed (25%);
- Requiring better technical maintenance and support of ICT within school (77%);
- Teachers lacking sufficient computer skills (59%);
- Difficulty in finding adequate learning materials for teaching (45%).

The MICTIVO study (2010) confirms these barriers. It demonstrated that the computer within schools are more often used to present and search for information than for other curriculum tasks. 20% of pupils said that they used the computer only several times a year. Only 28% students (primary school) and 48% (secondary school) mentioned that they used the computer regularly in a week. Whilst 3% used the computer daily in the classroom, 15% of the pupils use the computer for their homework at home. The infrastructure at home seems better than that within the school.

Tondeur's study (Tondeur et al, 2008) tested the determinants of educational computer use in 68 primary schools across Belgium. In particular, the research focused on teacher and school characteristics that are associated with different types of computer use by primary school teachers. Besides the importance of school characteristics, the results reveal differential effects of particular characteristics on particular types of computer use. Cultural school characteristics for instance, such as the schools' openness to change and the availability of an ICT school policy plan, are positively related to the use of computers as a learning tool and to the adoption of ICT in view of basic computer skills. In contrast, no cultural school characteristic seems to be associated with the use of computers as an information tool. In a comparable way, the research explored how teacher characteristics are associated with particular types of computer use, e.g. the gender. In general, male teachers reported integrating computers more often. In this study, it appears that gender differences only exist in relation to the adoption of computers as an information tool.

The results demonstrated that a multi-dimensional approach provides more insight into the characteristics affecting computer use.

The focus on media and non-computer ICT (the use of iPods, cameras, voice recorders, etc) has got more attention recently. While the infrastructure in the MICTIVO (2010) is seen as old and not up to date, some schools since 2010 have begun to provide each of their students with their own netbook.

Digital Learning Resources

The Ministry of Education has not engaged specifically in software development, but has invested heavily in providing a 'program matrix' which presents an overview of commercial software linked to curriculum attainment targets and a central database of secondary school software.

Digital Learning Resources are developed through a Government policy on the development of educational software. The first stage hands over responsibility to educational publishers to develop materials that 'flesh out' the curricula. At a second stage, the Government may take action to develop resources in areas where there is a lack of content (e.g. in recent years this has included special needs education). The policy also encourages teachers, other artistic and heritage organizations, commercial and open-source developers to contribute to the production of high quality educational resources.

One of the key projects in recent years has been the development of an educational portal which acts as a central point for educational information and support in the use of ICT. It includes examples of good practice and is organized thematically. The portal allows individual teachers, alongside other publishers, to share their own digital resources. The portal can be found at: www.klascement.net. This year, new portals have been developed including: www.knooppunt.be and www.bingels.be.

Smartschool is the most widely used VLE. IT is a local, commercial tool. Some Catholic schools make use of EloV. Open source products such as Moodle are used less frequently.

Other Issues

Valcke's study (Valcke et al 2007) explored the approach to ICT teacher training in Flanders. It focussed on two main questions:

- What is the validity of the content and format of the teacher training?
- To what extent is the ICT teacher training linked to the policies of schools?

In-depth interviews were organized with respondents of primary, secondary, and adult education schools. The results indicated that ICT school policies are not well developed and revealed a partial match between policies, needs, and the actual in-service training. Innovative applications of ICT were not promoted.

In response to these findings, the Klascement portal makes use of Web 2.0 technologies. This has also been a specific theme in in-service training for teachers since 2007. It has resulted in a significant amount of user-generated content, along with the rating and commenting on existing content by the users themselves. The free blog service 'Classy' has also been offered to schools, teachers and students.

Teacher education in Belgium currently comprises of a set of basic competences which subsume the use of ICT. There are not specific ICT competencies at this stage of training. The EduBIT project focuses on the role of the ICT coordinator. Their research showed that the ICT infrastructure of a school and the technical competencies of the ICT coordinator is are two major determinants of the successful adoption of ICT practice within the school.

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iTEC Knowledge Map: Estonia

Key Groups

There are three main groups responsible for ICT in schools in Estonia. These are:

- The Ministry of Education;
- Universities;
- The Tiger Leap Foundation.

Simply speaking, the Ministry of Education is responsible for strategy, the legal framework, ICT infrastructure and initiating research. The universities are responsible for developing the initial teacher training curriculum and providing Master's level frameworks for continuing professional development.

Practical implementation of the Ministry of Education's plans for ICT is delegated to the Tiger Leap Foundation. This foundation has a broad range of responsibilities. These include:

- Creating a repository of virtual learning resources;
- Supporting schools in web-based projects;
- Developing innovative learning environments;
- Supporting new and in-service teachers in their use of ICT;
- Developing conference opportunities and running campaigns (e.g. on internet safety);
- Supporting the development of educational resources.

The Tiger Leap programme was launched by the Estonian Government in 1997. Its principle aim is to improve the quality of Estonian school education through the use of ICT. Two previous phases of the programme have been completed (in 1997-2000 and 2001-2005. The focus of the 2006-2009 development plan was on eLearning and the development of various eLearning-related content services. It aimed to increase the quality of the curriculum and its effectiveness through the use of ICT and by introducing eLearning as a part of daily classroom activities.

In 2008 the Ministry of Education launched the 'Laptops for Teachers' programme. This saw 4,000 teachers receive a laptop (out of 15,000). A smaller scale 'Laptops for Students' programme took place in five schools (with one class in each school receiving laptops to be used during one school year).

At the present time, there is no school-related ICT policy work taking place. However, the Tiger Leap Foundation has a plan for work across 2010-2013. This will cover the following key areas:

- ICT in science education;
- Robotics;
- Virtual schools, including a learning resource repository, VLE, web-based tools for creating content, teachers' virtual networks)
- Internet safety;
- In-service teacher education programme in ICT methodologies and Web 2.0.

The Current Curriculum Context for ICT

There have been major reforms of the curriculum in Estonia over the last few years. This year (2010) saw the launch of a new curriculum across all schools. It gives greater flexibility in choice of subjects, with fewer compulsory subjects. Although ICT is seen as separate subject within this curriculum, it is also conceptualized as a tool which spans across curriculum subjects. The balance between ICT as a core subject in its own right, and the cross-curricular use of ICT, has been something that Estonian educational policy has considered on many occasions (Plomp et al 2009, p285). It tends to err on the side of a specific curriculum subject rather than cross-curricular usage. A report by the European Commission in 2006 saw this as a trend in new member states (European Commission, 2006).

Specifically, the new K-12 curriculum divides students' ICT competencies into four main levels. For example, a Level 1 student would be able to 'prepare and store user generated/self-created content in a computer; a Level 3 student would be able to 'collect and systematize data and perform simple statistical analysis'. At Level 4 (high school) the ICT competencies are developed through group-work scenarios based within research or development projects, where possible in collaboration with local technology firms or research centres. Part of the rationale for this is to develop a positive student attitude towards technological innovation and related career possibilities.

It is important to note that individual schools have a considerable degree of autonomy in respect of these matters, including the type of ICT infrastructure that they provide and the type of curriculum they offer.

Reiska's study (Reiska, 2009) has investigated this in more detail. In particular, it aimed to discover and describe the differences in schools' approaches to teaching and learning integrated themes, especially ICT. Through questionnaires to 67 schools (with pupils aged between 9 and 15), and detailed qualitative research within six of these, Reiska reported the following key findings:

- ICT is generally regarded as a separate subject and individual subject lessons that use ICT are rare;
- Subject teachers do not assess ICT skills. These are taught and assessed in ICT lessons by ICT teachers;
- There is some evidence that ICT promotes new teaching methods, but only in cases wehre ICT is fully and successfully integrated into subject lessons;
- Students feel that their ICT Skills are mainly developed outside of the school;

- Students' motivation is high, and they want to learn more ICT than most schools in this sector (upper primary/lower secondary) are willing to teach;
- ICT integration into subjects is the key way to transforming teaching practices;
- School managers are not encouraging the integration of ICT into the curriculum;
- Many teachers believe that old methods are better and provide good results (Estonia holds the top 10 places in the international PISA test in various subjects);
- Students are ahead of their schools when it comes to ICT skills and willingness to use ICT;
- There is a growing gap between the ICT experiences that schools offer and the demands of the work place.

ICT Usage in the School

The STEPS (2009) report has analyzed in some detail the use of ICT within Estonian primary schools. Here, 61% of teachers make regular use of computers in their classes, with 85% of teachers using them for presentational purposes or for demonstrations of various types, and 89% of them regularly allowing pupils to use them within their learning.

Estonian primary school teachers access learning materials from school networks broadly in line with teachers from other surveyed countries, however they make significantly less use of offline materials. Estonian teachers are amongst the most frequent users of self-research materials from the Internet.

Almost all Estonian primary schools use computers for learning and have internet access. Estonia was ranked highest across Europe (96%) for schools connected to the Internet via a broadband connection.

In terms of the impact of ICT on students' learning, Estonian primary school teachers were amongst the most optimistic, with the vast majority (91%) agreeing with the statement that 'pupils are more motivated and attentive when computers and the internet are used in class'; and 84% of teachers disagreed with the statement that 'using computers in class does not have significant learning benefits for pupils'.

In terms of their individual skill with ICT, 79% of Estonian primary level teachers have good or very good ICT skills. Only 13% were classified as being novice ICT users.

Estonian primary school teachers expressed the lowest levels of concerns related to potential barriers to ICT use in their schools (STEPS, 2009, p4). Whilst 68% would prefer better technical maintenance and support, 80% were satisfied with the speed of the internet connection and 70% agreed that their school was well-equipped with computers.

Finally in this section, Uibu & Kikas (2008) conducted a qualitative study to explore the role and impact of ICT on the instructional process within primary schools in

Estonia. According to their results, some of the teachers' roles were similar whether they were delivering a traditional as opposed to a computer-aided lesson. Other roles were easier to perform with ICT and some new roles had emerged once ICT had been embedded within the school. For example,

> A*ll the interviewed teachers confirmed that introducing ICT into their teaching had not brought about any essential changes in their roles, but admitted that the proportions of their role related activities and tasks had changed (Uibu & Kikas, 2008, p18)*

But there were implications for the preparation of teaching materials noted by Uibu and Kikas:

> *Nearly all the teachers emphasized that an enormous amount of new material had brought about the necessity to fulfill new tasks—to assess the authenticity of the materials and aptness to the students' age. (ibid, p.19)*

In conclusion, they state that:

> *The teachers who regularly used ICT in their work did not think that the very nature of the teachers' role had changed, however, they brought out that ICT had made some of their tasks easier, while at the same time increasing their workload. At least partly, their conceptions of teaching were in accordance with the traditional teacher-centred education. Similarly, Blom and her colleagues (2001) noted that the use of ICT offers new options to make lessons more varied and effective, but this is not enough to change the nature of learning. (ibid, p20)*

Digital Learning Resources

The Tiger Leap Foundation promotes various open source initiatives. The recent Schoolnet report indicates that in 2009 there were over 3,000 groups of study materials created and shared by teachers or groups of teachers. There were no initiatives in place to produce materials with commercial publishers. The Tiger Leap Foundation provides funding for some of this type of learning resource development. There is also a private firm, Miksike, which produces materials for the primary education sector. Many of these resources are freely available to Estonian teachers, with much of the training delivered by the Tiger Leap Foundation through Web 2.0 media such as wikis, Twitter and Moodle.

There is a range of learning platforms in use across Estonia. These include WebCT and Moodle, alongside university developed platforms such as IVA and VIKO. Educational administration for all schools is held within an online education database called EHIS. Students grades are stored and managed in the national central digital class register – e-Kool.

Other Issues

As ICT is not a compulsory subject within the curriculum, there is no official assessment scheme. Individual assessment frameworks are generated by individual teachers. There is work being done by the National Examinations and Qualifications Centre to create an ICT-based examination for the country.

There is also no official system for monitoring or inspecting the progress of individual schools in relation to their adoption and use of ICT.

In terms of teachers and their level of ICT competent, the Estonian Government has a set of standards for teachers. However, there are no assessment accreditation schemes fo teachers' ICT competencies and no official demand for integrating ICT in initial teacher education (universities are free to choose to integrate it or not). As seems to be the case in the majority of ICT school-related work in Estonia, the Tiger Leap Foundation has a significant network of trainers providing opportunities for teachers to develop their skills through courses, campaigns and competitions.

Conclusion

Ongoing developments in Estonia seem to be prioritizing the development of ICT across the educational sector. The Estonian Development Fund was established by the Parliament of Estonia in order to consider the economic development and Estonia and how it could invest further in technological innovations. The 'ICT Foresight' project was one of three undertaken by this fund. The EST_IT@2018 report contained three main recommendations. The third of these contained a reference to the development of a roadmap for ICT development and implementation in six key areas, including education. It seems likely that there will be significant developments in the use of ICT in education within Estonia in the years between today and 2018.

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iTEC Knowledge Map: Finland

Key Groups

The Finnish education system comprises of one year of pre-primary education followed by nine years of basic education (comprehensive school). The National Board of Education is responsible for education across Finland. As part of this role, they implement a national ICT strategy within all primary and secondary schools. All schools are required to construct their own ICT strategies in light of this national framework. Each municipality has autonomy in assessment their schools' requirements for ICT.

Generally, local education authorities and the schools themselves draw up their own curricula for basic education within the framework of the national core curriculum. The schools can develop their own profiles within these curricula arrangements (e.g. focusing on languages, mathematics, music and other areas). Teachers in Finland are nearly all qualified to Masters level.

The Current Curriculum Context for ICT

Over the last ten years there have been a number of initiatives that have affected the development of ICT in Finnish schools. One of these, OPE.FI, was launched in 2004. It aimed to improve the ICT skills of in-service teachers and other teaching personnel. There were three main stages. Stage one helped all teachers achieve mastery in basic ICT skills such as word processing, internet browsing and email. Stage 2 provided skills in using ICT for educational purposes. These included the use of generic tools, pedagogical applications and digital materials within each subject area. It also taught teachers how to produce their own digital learning materials. The final stage developed these approaches through specialized knowledge related to content-specific and professional applications, further production of digital learning materials, institutional management systems and the development of broader education support networks to cascade knowledge and skills.

In 2004 the Finnish Government adopted a resolution to provide broadband access to all schools by 2007. It provided financial assistance for the setting up of high-performance telecommunications in all schools and colleges.

ICT is not taught as a separate subject within the Finnish curriculum. But it does form an important part of, and should be embedded within, every subject that is taught.

The Finnish national core curriculum has the following cross-curricular themes:

- Personal growth;
- Cultural identity and internationalism;
- Media skills and communication;
- Citizenship and entrepreneurship;
- Environmental responsibility;

- Safety and traffic;
- Technology and the individual.

Other skills and competencies are defined in the learning objectives and core content of education of the different subjects. The Finnish National Board of Education has published a guidebook for teachers on cross-curricular themes. Schools and teachers decide for themselves, however, how competencies are taught. There are currently no assessment regulations or guidelines on these 21st century skills and competencies.

The computer per pupil ratio across Finland is 14.3/100 and, as reported in the European Schoolnet STEPS report (2009), 76% of students currently have a broadband connection. Larger schools have dedicated computer laboratories but there are still very few interactive whiteboards. There are no schools with no ICT.

ICT Usage in the School

Access to computers in Finnish schools is very high. This is matched by an equally high degree of access to computers within the home environment. As an example, an OECD report in 2005 (OECD, 2005) found that over three-quarters of students said that they used computers at home on several occasions throughout the week. The same report found that 15 year old students were using computers more frequent at home than they were at school. In both cases, recent years have seen a large increase in computer usage both within the school and home environment across Finland.

Within the primary schools in Finland, 88% of teachers make regular use of computers in their teaching. Of these, 93% of them have pupils working with computers during class time on a range of activities. Finnish teachers are amongst the most frequent users of self-researched teaching materials from the internet. Primary schools excel at ICT usage. 82% of schools have their own website, 93% offer email to teachers and 26% to so to pupils (European Schoolnet, 2009, p2).

Interestingly, whilst primary school teachers tend to be supportive of ICT, they are the most impact-skeptical (ranking 20th out of 27 other European countries). When asked whether 'pupils are more motivated and attentive when computers and the internet are used in class', 23% disagreed or strongly disagreed with the statement.

The majority of Finnish primary school teachers (64%) expressed dissatisfaction with the level of technical maintenance and support within their schools and also identified a lack of computers as being problematic (43% agreeing that there were too few computers in their schools). Nearly 50% of teachers found it hard to find adequate learning materials and around 20% considering existing materials to be of poor quality.

Finally, the belief that using ICT has positive impacts on the motivation of pupils or learning benefits is correlated with the level of computer skills of the responding

teaching. This is true in nearly every European country. In Finland, the teachers with very good ICT user skills show only somewhat higher levels of impact optimism.

The Impact of ICT on Teaching and Learning in Finland

- Kaisto's study from 2007 explored and assessed the impact of educational use of ICT in schools across Finland. This mixed methods study surveyed 6,000 pupils through questionnaires and drew data from 33 interviews with teachers (from 12 schools). The study found that:
- Teachers realized the possibilities of ICT but most of them lacked the pedagogical vision to integrate ICT effectively within their teaching;
- All teachers had basic ICT skills. But the technical infrastructure between schools varied considerably and, therefore, the opportunities to develop these skills also varied in practice;
- The vast majority of teachers used ICT to help with their planning but few used it in their teaching;
- Pupils disliked, and were not motivated by, highly structured, ready-made learning tasks. They preferred open, enquiry-based tasks but these were seldom evidenced in the research;
- Those pupils with a positive attitude towards ICT had a more positive attitude about their school and themselves in general. They were able to use their knowledge in more critical and creative ways.

Pedersen's study (Pedersen et al, 2006) indicated similar findings. Here, whilst the positive impact of ICT on students' learning outcomes was noticed, a broader criticism of Nordic schools failing to realize the full potential of ICT was also noted. As others have discussed (Plomp, 2009, p308), trends like these 'raise questions on how to support and encourage schools to become more diversified ICT users, in order to help students become competent members of the Finnish knowledge society'.

Ryymin's study (Rymnin et al, 2008) examined the network structure of a teacher community in relation to their use of ICT. Their participants were 33 teachers in a upper comprehensive school in suburban Helsinki. Through social network analysis, participants were asked to assess their networking relationships in respect of five particular dimensions. The results indicated that whilst there were few central actors in the community who dominated the exchange of technical or pedagogical knowledge, there were two 'hybrid' actors who were central to the exchanges. These teachers' networks were characterized by their own external networks which helped them develop and maintain a high level of ICT competence. The study concludes with the categorization of networks into four principle types:

- The Counsellor, who offers advice actively without seeking information in return;
- The Collaborator, who works collaboratively in web-based learning using several different media;

- The Inquirer, an active seeker of ICT-related information by capitalising on their social relationships;
- The Weakly Social, who prefers media rather than face-to-face encounters in their search for information.

Finnish schools have adapted well to the fast pace of change in ICT development and usage. Like educational systems across the European Union, they will have to continue to flexible to meet the challenges associated with ongoing changes in society and the diverse perspectives of different ICT users. Developing pedagogically innovative and quality practices is a challenge for all participants within the iTEC project. There is much that can be learnt from Finland's educational system in this respect.

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iTEC Knowledge Map: France

Key Groups & Programmes

France's Ministry of National Education has oversight of all aspects of the French educational system. It is responsible for providing a National Curriculum. However, this power is devolved in many significant ways through 30 educational units called *académies.* These regulate and establish national educational policy. This decentralization of power is a long-standing feature of the French educational system. It has resulted in schools and teachers having a great deal of freedom in choosing their pedagogical approaches in accordance with the national curriculum.

The Department of Information and Communication Technology in Education (DGESCO-A3) is responsible for coordinating ICT development in education. The department's mission covers the following main areas:

- Encouraging teaching practices using ICT;
- Developing school equipment;
- Creating networks;
- Teacher training (both initial teacher education and continuing professional development);
- Supporting the production and distribution of multimedia resources;
- The product and services industry.

The *académies* (the regional structures of the Ministry of Education) are responsible for implementing national directives and polices. This includes the development of ICT. The overall ICT policy in France covers a number of key areas relevant to the iTEC programme. These include:

- Proposing and implementing measures for increasing the use of the internet and ICT;
- Providing training for families, children and others in the use of ICT;
- Preparing and implementing guidelines for the development of ICT for educational purposes in schools and higher education;
- Monitoring the use of ICT in these contexts;
- Supporting the production of digital resources;
- Establishing partnerships and agreements with regional authorities and companies.

The DGESCO-A3 is part of the Ministry of Education. It is currently running a number of programmes that have bearing on the iTEC programme. The 'Infrastructure and Services' programme aims to provide the educational community with the infrastructures and services necessary to support the development of good practice with ICT.

There is a particular focus within this programme, as well as in the 'ICT Uses in Education' programme (see below) on how teachers and students can benefit from the use of ICT in their work.

The 'Digital Resources for Teaching and Learning in Schools and in Higher Education' programme supports the production and distribution of high quality digital educational content for pupils and teachers.

The 'ICT Uses in Education' programme focusses on how ICT is adapted to particular school subjects at the various educational levels. It encourages various groups to produce and share the educational uses of ICT and digital learning resources.

Examples of specific projects developed in the context of these programmes are:

- The '1000 visioconférences pour l'école' (2008 ongoing) project is a plan to support and develop foreign language learning in primary schools. It has equipped 1000 primary schools with video-conferencing in order enable primary pupils to get in touch with native speaking peers in other countries;
- PRIMTICE (2004 – ongoing) is a directory of several hundred teaching scenarios involving the use of ICT. The PRIMTICE portal opened in 2009 and identifies, presents and advertises digital resources and pedagogical usage scenarios for primary educators;
- EDUBASES (2002 – ongoing) is a collection of directories of several hundred teaching scenarios involving the use of ICT. It covers all disciplines and school grades from secondary school. EDUbases are collections of resources created by teachers for teachers.

Finally, the 'ICT Training and Support' programme has systematized the training and support of staff working within the educational sector as they develop their skills with ICT (this includes teaching and non-teaching staff). It also has supported the adoption of the IT and Internet Proficiency Certificate within schools. This programme is currently conducted by the French Ministry of Higher Education and Research.

The Current Curriculum Context for ICT

France has a National Curriculum in place that defines the subjects to be studied at primary and lower secondary levels. Within this framework, there is flexibility for individual teachers to adopt their own pedagogical approaches. ICT itself is not taught as a specific subject. It is embedded within all the other subjects that are taught at these levels.

The ICT skills that pupils develop during their education are first assessed at the end of primary school. Then, at the end of their lower secondary education, the “Brevet Informatique et Internet (B2i)” (national certificate of ICT standards) recognizes the level of achievement of the pupils. Failure to validate enough B2i items may prevent the candidates from passing their Diplôme National du Brevet (French GCSEs). ICT skills are also assessed at the end of their upper-secondary schooling and at the

beginning of higher education. Moreover, since 2009, all new teachers must pass a certificate, the "Certificat Informatique et internet appliqué aux métiers de l'éducation (C2i level 2)", attesting that they possess the professional skills which will allow them to use ICT in an educational setting. In addition to this, all students have to take the ASSR Road Safety Certificate (a highway code test at the ages of 14 and 16) using a specially designed piece of computer software.

Each year, there is a national survey of the use of ICT across primary and secondary schools. This aims to provide indicators related to the equipment, infrastructure, human resources and digital services that are currently in place to support the use of ICT across the curriculum.

ICT Usage in the School

France has 55,329 primary schools for pupils aged between 6 and 11. The STEPS (2009) research reports that the pupil to computer ratio across these schools is 12.5 to 1, with computers mainly being located in computer classrooms. In some larger schools computers are also located within other classrooms. Just over two thirds (69.3%) of primary schools have a broadband Internet connection whilst 5% of primary schools have interactive whiteboards.

Within this sector, 66% of teachers use computers in their classroom. The focus here is more on the use of computers by pupils than teachers, with 83% of the pupils of these teachers using computers regularly as part of their classroom experience.

French teachers within the primary sector are much more likely to use offline learning materials (85%) rather than access materials from a school network or the internet (38%). Self-research materials are used even less often.

Like teachers in other countries such as Austria and Belgium, French primary school teachers are somewhat skeptical about the impact and benefits of using ICT in comparison with their colleagues across the EU. 76% of French teachers were classified as having good to very good ICT user skills; 17% were classified as complete ICT beginners.

Within the STEPS research (European Schoolnet, 2009, p5), French teachers were the most outspoken in identifying the barriers to using ICT in classrooms. These barriers included:

- Dissatisfaction with the internet access speed within the school (28%);
- Lack of computers within the school (50%);
- Better maintenances and support for ICT infrastructure within the school (78%);
- Lack of computer skills amongst the staff of the school (48%);
- Difficulty in accessing adequate learning materials (43%).

According to a report from the Higher Council of Education (2010), five major projects of ICT use in secondary schools have taken place in the recent years. Four of them concern the equipment of 6th-9th graders and their teachers with portable computers connected to the Internet. Named 'Ordina 13', 'Ordi 35', 'Ordi 19', and 'Un collégien, un portable', these projects have been conducted at the local or regional level, sometimes with financial support from the national government. In one of these projects (Un collégien, un portable), 75% of the students obtained the national certificate of ICT standards after they were equipped, and 57% of the teachers declared using the computer in one out of two courses they teach. However, not all schools were equipped at the same rhythm and some teachers estimate that they did not receive sufficient training in using the computers in class.

The second major project concerns the use of digital textbooks and virtual learning environments by sixth graders. More than 8,000 students from 21 regional educational authorities were included in this project, which was conducted at the national level in partnership with publishers and computer software companies.

Wider Issues in the Use of ICT in School Teaching

Research conducted by Pragma (Société Pragma, 2006) on behalf of the Ministry of Education examined the practices and perceptions of ICT by teachers and pupils in primary and lower-secondary schools (105 primary and 92 lower secondary). The study found that:

- Teachers have a positive perception of ICT;
- ICT helps teachers organise their work;
- ICT is pedagogically underused, and some teachers do not have a clear vision as to how it can support the learning process and are unaware of its potential;
- There is, therefore, a wide gap between the perceived positive role of ICT and its actual use in practice;
- Interactive whiteboards and video projectors have helped to integrate ICT into daily classroom activities without causing disruption;
- There is limited use of ICT for assessment in primary schools;
- ICT is seen as having a positive role in regard to pupil behaviour, attendance and concentration;
- ICT helps peer learning and social interaction and also increases autonomy in the learning process;
- ICT is underused in monitoring learner and also in helping to diagnose and identify individual learners' issues.

Digital Learning Resources

Commercial resources are generally produced through licensed arrangements with particular publishers. The Ministry of Education plays a role in ensuring quality. There is a commissioning process that certifies appropriate products as having RIP status (i.e. they have educational value in the view of the Ministry of Education).

Additionally, the Ministry of Education provides advice about open-source products through a website called SIALLE. This website presents technical and legal analyses of certain pieces of open-source software by experts. It then allows users to download software, use and test it before giving it a mark for pedagogical/technical aspects and content. Products that obtain good marks are integrated within a brodaer information system that the Ministry of Education supplies to schools alongside a tutorials about how to use them.

PRIMTICE is a collection of pedagogical scenarios created by teachers at the primary school level. These resources are validated by the Inspectorate before they are included on the database. Research published in 2009 (Macedo-Rouet, 2009) considered the ways in which teachers use 'learning scenarios' that had been shared within a database of this type. Most teachers found that the scenarios were useful to give them ideas for a course, but also as a model to learn how to write a scenario. Those who found the scenarios “not useful” thought that searching for adequate scenarios is time consuming and they do not identify any need to use such materials. The study concluded by setting several objectives for future investigations to improve the usability and effectiveness of learning scenarios.

Recently, there has been a focus on some Web 2.0 technologies such as blogs, RSS, etc. These have often been driven forward by particular schools or groups of schools and have been encouraged by the local education authorities.

Since the beginning of 2009 all the *académies* have had a VLE project. About 2/3 of the *académies* have now deployed these VLE and are working in partnerships with their various groups of schools to help continue to fund, maintain and support these environments.

Other Issues

The ICT training of teachers through their initial teacher education and continuing professional development has been facilitated through a balance of distance learning and on-site training. The 'C2i level 2' certificate is the benchmark for teachers in validating their professional skills in this area (level 1 is mandatory before entry into initial teacher training institutes). ICT is a compulsory element of all initial teacher education.

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iTEC Knowledge Map: Hungary

Key Groups

The main responsibility for public education in Hungary lies with the Ministry of Education and Culture. Their responsibilities are assisted by a number of other institutes, councils and offices, including the National Office of Research and Technology. At the regional level, education is under the control of politically autonomous elected bodies, with schools having a responsibility for developing their own ICT infrastructures and their compliance with the different educational programmes that are legislated.

The Hungarian education system comprises of three main stages. Basic schooling is provided by the primary schools and lasts eight years (from the age of 6 – 14). Following this, students can choose from three types of secondary schools: the secondary grammar school, vocational secondary school or the short vocational training school.

The Ministry of Education has a strategic role and focuses on policy development and general administration. Regional administration has an important role in delivering national policy. County councils set up their own educational strategy plans for their particular regions and ensure proper funding of the educational institutions therein.

Current policy developments that affect the use of ICT within Hungarian education are centred on the Second National Development Plan (2007-2013). Within this plan, the 21st Century School Flagship Program (CSFP) has aimed to disseminate and draw on the findings of ICT-related trial programs in order to accomplish the following aims:

- Renovate and modernize school buildings so they can accommodate up-to-date ICT infrastructures;
- Provide training and support services necessary to implement and integrate ICT in school teaching and learning programmes;
- Train teachers and produce digital resources;
- Ensure financial and consultancy support for schools to allow them to integrate students with various learning difficulties.

As will have become apparent, this program is primarily about providing an appropriate infrastructure in each of Hungary's educational institutions. A sub-set of the CSFP is the Intelligent School of the 21st Century program. This program extends the influence of the CSFP by focusing on a range of further issues to do with the effective use of ICT in education. Amongst a range of aims, these include:

- Supporting a competence-based educational methodology;
- Supporting teachers' pedagogical work;

- Establishing community communication networks and providing digital teaching and learning resources.

The program has trained 40,000 teachers to integrate ICT skills within their teaching. This has included the use of a range of digital content, electronic lesson administration, online help and support.

The Intelligent School of the 21st Century program is deemed the most important ICT-related initiative of the Second National Development Plan. It is a phased approach, with phases 2 and 3 spanning into the iTEC project. The program is due to end in 2013.

The Current Curriculum Context for ICT

Hungary has a National Core Curriculum (NCC) which sets national goals for education, the main subjects to be taught and the key educational objectives within these. The NCC sets the framework and local authorities have to set in place curricula in accordance with these principles.

Informatics is a compulsory subject in public education across Hungary. This includes ICT knowledge, digital literacy and a range of other themes (including using different pieces of ICT for particular aims).

The NCC implemented in 2007 includes digital competence as a key competence. It is defined as follows:

> *Digital competence comprises the confident, critical use of Information Society Technology (IST) in work, communication and leisure time. This is based on the following skills and activities: recognition, research, evaluation, storage, preparation, introduction and editing of information, and communication and networking through the internet.*

At the present time, there is no national system for the assessment of this digital competence. However, work is being done to construct and implement an ICT qualification framework over the next few years.

ICT Usage in the School

Within the primary school, 37% of teachers use computers for presentational purposes, with 33% incorporating computers within tasks that their pupils undertake. This places Hungary at 25th place in terms of European rankings.

Hungarian teachers also access less learning materials from schools networks than their European counterparts (42% compared with 64%) and rely less on offline materials. The recent STEPs report stated that Hungarian teachers use particularly little material from established online sources (European Schoolnet 2009, p2). Similarly, although nearly all Hungarian primary schools have access to the Internet

via a broadband connection, there is relatively little use of this in comparison with other European countries (44% of schools have a website; 35% offer email to teachers and 20% to their pupils).

Primary teachers in Hungary, when compared to the rest of European countries, are very optimistic about the impact of ICT on their teaching and learning. 57% of teachers agreed strongly that 'pupils are more motivated and attentive when computers and the internet are used in class'. This ranked Hungary at 15th position (out of 27) when compared to other European countries. 67% of primary school teachers were assessed as having good or very good ICT skills with only 16% of teachers being classified as ICT novice users (European Schoolnet, 2009, p4).

Whilst Hungary is somewhat below average in regard to the level of school ICT equipment, there teachers are neither too optimistic nor too pessimistic in their identification of potential barriers to the use of ICT in their teaching. 80% of teachers stated that their school was well equipped with computers, and 87% said that the internet connection was sufficiently fast. However, 83% of teachers expressed the view that better technical support and maintenance was desirable and nearly 50% of teachers found it hard to find adequate learning materials online.

The Network of Multi-grade Education (NEMED) project, part of the EU Socrates Programme, aimed to improve the pedagogy in multi-grade classes using ICT schools. Working with children aged between 6 and 10, the project trained teachers to use a mentored innovation model to adopt ICT more fully in their classrooms. The study found that ICT improved pupils' motivation and attendance, reducing the gap between pupils with poorer educational conditions and the national average by making them motivated to go to school. There were also reported successes in raising the skills levels of pupils in poor, disadvantaged areas to the same starting point as those pupils who had more privileged backgrounds (European Schoolnet, 2009, p6).

ICT in Hungary Romani (Gypsy) schools

Hungarian teachers optimistic tone related to the positive impact of ICT in teaching and learning in the primary school was also identified in an interesting study exploring the impact of ICT on the educational skills and abilities of a group of young people aged between 13 – 15 in a difficult educational situation. The study created ICT-enriched, constructivist learning environments in ten schools. Teaching programmes for Hungarian Romani children were developed and delivered in these spaces. The study found that ICT-integrated teaching methods generated significant developments in these students' performance, even those starting from a lower level (report in European Schoolnet, 2009, p6).

Digital Learning Resources

The Ministry of Education has aimed to promote the use of digital content. They have increased the proportion of digital learning resources created by the private

companies, alongside some centrally developed resources. Digital IWB resources are available for almost every school subject via the Sulinet Digital Knowledgebase.

Sulinet provides internet access to the whole Hungarian public education system. It also provides a range of online content and advice, including:

- Approximately 10,000 digital learning objects;
- 3,000 animations;
- 600 activities;
- Two complete sets of interactive curricula;
- Over 10,000 images;
- 510 movies;
- Specialist e-books.

In addition to this content management system, teachers are encouraged to create their own digital content with the help of IWB software. In some local networks of schools, 'digital exercise-banks' have been created where teachers can integrate their own digital content with that created by other teachers. However, there does not seem to be a way in which teachers can share their work more widely at the present time.

A usability study conducted by Hunya (2005) suggested six ways in which teachers could be helped to access, select and use resources within Sulinet. These included:

- A general introduction to the aims and pedagogical requirements of the resource;
- The resource's technical requirements and previous knowledge needed to access it;
- Keywords or tags that describe the content of the resource;
- Task sheets for students or teachers, additional resources, and related links;
- Ideas on and activities for teachers and students, tips on classroom management, and guidance on forming learning groups based on competence assessment;
- Methods of evaluating student learning.

There are a number of companies and book publishers who offer a variety of digital content to educators.

In respect of VLEs, Moodle has been taken up by a few high schools.

Other Issues

According to the Educatio Nonprofit Plc., (an institution of the Ministry of Education and Culture responsible for ICT developments within education), all teachers should have a basic knowledge of ICT and associated pedagogical issues. However, ICT in initial teacher education is not compulsory at the present time; nor is in-service teacher education related to ICT either. The strongly centralized developments in

teacher training have had the tendency to homogenize the target group and led to an absence of innovation in this area (European Schoolnet, 2009, p7). This is worrying. Plomp (2009, p367) states that:

> *The key to successfully disseminating the outcomes of innovative projects and sound use of ICT in teaching and learning seems to rest with teacher education. … Accordingly, between 2000 and 2006, the Hungarian government provided large-scale, national in-service courses for teachers. In the near future, ICT-based educational reforms will hopefully reach university level.*

As universities are responsible for all initial teacher education in Hungary (as well as providing ongoing continuing professional development), this seems like a vital area of work for the continuing developing of ICT usage in all Hungarian schools.

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iTEC Knowledge Map: Israel

Key Groups

Israel's education system is a complex one. It contains multiple streams at primary and secondary levels and also includes military conscription. Significant population growth and economic expansion have brought a massive increase in demand for all levels of education. There are also significant gaps between Arab-Israelis and the rest of the population. The Ultra-orthodox community's independent education system presents specific concerns and challenges (Hemmings, 2010, p2).

Education is compulsory and free for all children aged between 3 and 16. The education system itself reflects the country's cultural and ethnic diversity. There are four main streams in primary and secondary education comprises four main streams. There are three streams for the Hebrew-speaking community and one for the vast majority of Arabic speakers. The Hebrew-speaking streams comprise State, State-religious and Ultra-orthodox schools. All streams are supervised and fully funded by the state, except the Ultra-orthodox stream, which is independent and receives partial state funding. Private mainstream schooling occupies a relatively small share of the market (Hemmings, 2010, p6).

In terms of policy making, primary and secondary education is fundamentally split between the supervised and unsupervised sectors. In the supervised sector (i.e. this includes the State, State-religious and Arab streams), the Ministry of Education has considerable powers to influence and monitor the type and quality of learning. For the Ultra-orthodox stream government, policy makers are not without influence but, by definition, do not have the conventional means of implementing reform (Hemmings, 2010, p13).

Primary and lower-secondary schooling is directly administered by central government whilst most upper-secondary schooling is under the authority of local government. These supervised, fully state-funded schools provide the vast majority of mainstream education (Hemmings, 2010, p14).

The Current Curriculum Context for ICT

During the 1990s the Ministry of Education began a systematic process of implementation in respect of ICT within all Israeli schools. This approach has continued to the present day. It is represented by the following three phases.

Phase 1 (1993 – 1998): The National Computerization Program

- This phase involved the following key activities:
- Supplying infrastructure to all Israeli schools;
- Supporting ICT-related skills and knowledge acquisition;
- Fostering ICT implementation in different disciplines;
- Intensifying pre- and in-service teacher training in ICT implementation;

- Encouraging and supporting other national programmes and initiatives.

During this phase around 45,000 computers were allocated to around 1,350 schools; during 1999 – 2001 an additional 30,000 computers were allocated to an additional 1,150 schools. Most of this hardware was funded through public sources.

Phase 2 (2000 – 2005): The Second ICT in Education Program

This second phase constituted the education system's response to the challenges posed by rapid advances in ICT and the implications of these advances on the processes of teaching and learning (as well as other aspects of life generally). Melamed (2000) reports that the pedagogical goals and recommendations here covered seven main areas:

- Knowledge and skills: the requirement that students master a wide range of ICT-related skills and have a broad knowledge of various technologies;
- Independent learning: the ICT-enriched environment should support self-directed and constructivist learning; educators need to act as mediator and schools accommodate changing pedagogical goals and values;
- Values and moral issues: students should exercise good self-judgement and make ethical decisions involving ICT appropriately;
- A sense of belonging and social commitment: accessing ICT in schools should reduce the digital gap and collaborative projects between schools should strengthen students' sense of belong and commitment to their community;
- Teacher training: the program needed to bring about changes in teachers' roles;
- Pedagogical support: ICT instructors supported the work of each school during the first two to three years of ICT implementation within that school;
- Experimentation, research and control: some schools experimented with ICT and served as indicators for other schools, particularly in terms of making visible the advantages and disadvantages of ICT-related pedagogy.

During this stage, another evaluation was completed that focused on schools' use of computers and other peripherals. This led to an upgrading of the ICT infrastructure in schools.

Phase 3 (2006 onwards): The Third ICT in Education Program

This third phase is the education system's response to the ongoing needs posed by 'constant ICT-facilitated educational change, such as ubiquitous learning, sharing, collaboration and joint ownership of knowledge' (Plomp, 2009, p410).

The work in this phase is characterized by two main sets of issues. The first of these are logistical issues. These include issues such as the use of one-to-one devices and the associated pedagogical practices that might accompany these devices within communication networks within and outside schools. Secondly, pedagogical issues centre on issues that develop models for the promotion of wider use of ICT within

every area of the curriculum and the facilitation of pre- and in-service teacher training.

ICT Usage in the School

Research done in 2007 by the Ministry of Education gave the following ratios for computer/student: 1/18 in primary schools and 1/14 in secondary schools. Obviously, these have lowered considerably in recent years.

As Plomp comments (Plomp, 2009, p416), schools to vary markedly in their use of more innovative pedagogical approaches with ICT. Common pieces of word-processing software and graphical packages are frequently used in schools, along with students in lower secondary schools making use of the Internet for communication and research purposes.

The availability of other subject-specific educational software varies according to school level. Primary and lower-secondary level schooling tends to make greater use of these than high schools.

More recent developments in ICT usage in Israeli schools (evidenced in data from SITES-M2) has included a growing number of students participating in online learning (including virtual courses being delivered by two schools that have focused on distance learning). Other institutions, such as educational institutes, not for profit organizations and commercial agencies are establishing their own virtual communities (e.g. the Center for Educational Technology) which are delivering educational content in various subject areas.

Other Issues

The issue of teachers' professional development with ICT has been examined in recent studies. Klieger's study (Klieger et al, 2010) explored the implementation of laptop computers in the work of science teachers at junior high schools. It found that science-based disciplinary training in the use of ICT was most relevant and successful. The laptop computers themselves were considered to contribute 'significantly' to the teachers' professional and personal development and did facilitate a shift from teacher-centred to student-centred teaching.

Their recommendations for the implementation of future models of professional development emphasize this link to disciplinary communities, the location of such training and the importance of mentoring:

> *Special focus should be placed on meeting the needs of the disciplinary communities. Building a disciplinary teachers' community, and providing support for the professional community contributes more than anything else to the PD of teachers and provides solutions to their immediate needs.*

The in-service training sessions must take place in the teachers' natural teaching setting, where they experience the changes and feel less threatened i.e. their schools. In addition to holding training sessions in the schools, virtual sessions and guidance must take place in order to save the teachers time and allow them to work and ask for counsel at the time which best suits them. Furthermore, this allows the teachers to get instruction using different tools.

Co-mentoring by a disciplinary instructor is recommended along with an instructor who is an expert on ICT. In other words, pedagogy should be the key word that guides along the ICT and correctly integrates the digital tools. It is also recommended to integrate cooperative platforms: building an environment enabling co-learning, where every participant is able to equally contribute to everyone's general knowledge. (Klieger et al, 2010, p197)

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iTEC Knowledge Map: Italy

Key Groups

Formal schooling in Italy has two main phases: primary and lower secondary (students aged 6 -14) and upper secondary and vocational education (students aged 14-16 (compulsory), with some vocational courses being offered to students up to the age of 25).

The Ministry of Education, University and Research (MIUR) is the principle administrative body, although in recent years many of its powers have been decentralized. Schools now have a considerable degree of autonomy in how they organize tuition and conduct the teaching and learning processes. The National Curriculum also allows for individual schools to adapt their approach in light of their specific context. Overall responsibility for school education lies with the Ministry of Public Education. This is represented at the local level by regional and provincial education officers.

Central governmental bodies such as these support schools in their use of ICT in teaching and learning. A widespread reform in 2003 across all schools reformed the provision and use of ICT. It supplied schools with multimedia equipment, connected schools to the Internet, set up networks and services and undertook a revision of teachers were trained with ICT. These developments have continued into more recent years. The Ministry of Education has undertaken a number of recent projects. These projects include the Digital School which has focused on two main areas.

Firstly, a large implementation of interactive whiteboard technologies has been undertaken. This saw 16,000 interactive whiteboards supplied to lower secondary schools in 2009, with an additional 8000 boards going to primary and upper secondary schools by the end of 2011. The National Agency for the Support of School Autonomy devised and implemented an in-service teacher training for the proficient use of these interactive whiteboards and this trained 75,000 teachers.

The Cl@ssi 2.0 project has experimented with a range of innovative learning environments at the lower secondary school level. This investigation into the impact of ICT and the new learning environment on students' performance and skills will continue for a further two years.

The School Family project has provided new services to assist the communication between schools and families, including online reports, digital registers, surveys of students' attendance and access to online student files. The project began in December 2009 and has spanned the work of 4,180 schools.

In the field of teacher training, eLearning initiatives have been developed for the training of school staff. The ForTic Program saw the development of a web portal that offered teachers and others technological training through a blended learning approach. The program ran from 2005 – 2008 with the following three key aims:

- To improve teaching and learning processes in specific ICT subjects and through general ICT-related skills;
- To empower students in gaining practical understanding of different ICT tools, styles of learning, communication and dissemination of information;
- To enhance teachers' professional capabilities by training them in the use and application of ICT as part of their administrative role and within their pedagogical approaches.

ForTic also examined and implemented different models for the provision and location of ICT resources within schools. A range of solutions were implemented, including:

- Setting up multimedia laboratories for all students within a specific class;
- Including a few workstations within a classroom to encourage blended learning and group work;
- Providing ICT service centres within schools.

The Current Curriculum Context for ICT

There are national guidelines and curriculum guidelines for the introduction and support of ICT within education in Italy. The Guidelines for the Curriculum are the reference framework for the curriculum which individual schools, being largely autonomous, have to implement. Within these guidelines there are various competences. For example, the goals for primary schools are the pupils can use ICT and multimedia to develop their work in various subject areas, etc. At the lower secondary school, pupils are required to use ICT and multimedia to support their work, make and validate hypotheses, make self evaluations, etc. Teachers are responsible for the assessment of students' knowledge, skills and competences in these respects.

ICT Usage in the School

ICT is not taught as a separate subject within Italian schools (with the exception of some of the vocational secondary schools which fall outside the remit of the iTEC project). Individual subjects have responded differently to the adoption of ICT skills and competences within them. For example, within the mathematics curricula there is a considerable focus on ICT-based concepts and methods.

Nesler's study (Nesler, 2004) investigated the advantages of using ICT in the curriculum as well as its pedagogical limitations using a range of qualitative methods (including action research). Working with 1000 teachers and 3000 pupils in primary schools across Italy, the study found that:

- ICT improves pupils' performance provided that software is used appropriately and coherently with the curriculum objectives;

- ICT can offer meaningful opportunities for communication and cooperation;
- ICT impact is affected by five key factors including the relationship between learning and internet cooperation, the availability of multimedia software for learning, school networks, and professional development for teachers and opportunities for multimedia education online.

Falcunelli's study (Falcunelli, 2006) worked with a smaller sample of around 260 pupils and 22 teachers (again in primary schools). Through a three phased programme of research, the study found that better results are with ICT are achieved when:

- More classes, and particularly pupils of different ages, are involved working together in ICT projects;
- Teachers work together and share their experiences of using ICT;
- ICT activities have been undertaken by within and outside the school;
- A well-defined and specific time has been provided in the weekly schedule for using ICT.

The computer to pupil ratio within Italian primary schools is 1:14. Computers are located in ICT laboratories. Schools have a great deal of freedom in how they meet the demands and objectives of the national curriculum for ICT. At primary school, this is centred on the concept of digital literacy and there is a growing demand for specific educational quality software and more teaching training and support.

At the present time, 72% of Italian primary school teachers make use of computers in their classrooms. For these teachers, more use of the computers is made by the pupils (66%) rather than solely by the teacher (59%). There is a good integration of computers and the internet into traditional subjects or basic skills (e.g. reading and writing), teaching foreign languages and most other subjects in the curriculum (with around 80% of head teachers expression agreement of the use of ICT in each of these areas). However, teachers make much greater use of offline materials (85%) rather than online materials.

Italian primary schools adopt a lower midfield position with regard to ICT usage and equipment when compared to other European countries. Whilst 63% of schools have access to the internet via a broadband connection, only 65% of schools have a website and only 7% of schools offer email to their pupils (European Schoolnet, 2009, p2).

Italian teachers within primary schools are amongst the most optimistic about the impact that ICT can make on the teaching and learning process. 90% of then agreed or strongly agreed with the statement that 'pupils are more motivated and attentive when computers and the internet are used in class' (European Schoolnet, 2009, p3). This places them at 6th (out of 27 countries) in terms of their optimism. Interestingly, Italian teachers are also the most vociferous in terms of their identification of potential barriers to the use of ICT in their schools, expressing dissatisfaction with both the internet connection speed and the level of equipment in their schools, alongside

expressing their desire for between standards of technical maintenance and support (European Schoolnet, 2009, p4).

Digital Learning Resources

PuntoEdu is the principle environment within which multimedia educational content has been developed. This currently contains over 3,000 learning objects which have been developed for teachers' online training by the teachers themselves.

In addition to this, there are other user-generated databases of curriculum materials. These include Dia (a digital database of 25,000 images dealing with every subject in the curriculum), Gold (a database of 'best practices') and Musiknet (a virtual museum of music).

In terms of learning platforms, the PuntoEdu platform is the most widely used platform in Italy. The majority of teachers' training is done on this platform. Over time, teachers' interest in this platform has grown and evaluations of its use have improved. Several aspects are being improved.

Since 2000, common technical issues with the platform have been replaced by issues concerned with pedagogy. This is probably because the change in attitudes towards social networks and their increasing prevalence, have ensured that teachers are happier operating and finding materials within PuntoEdu. The challenge then, of course, is what to do with them, and the environment itself, within their pedagogy.

Other Issues

There are not ICT competence targets for teachers, nor is there a defined framework for the assessment of any ICT competence.

ICT does form part of initial teacher education at high education level, but it is not compulsory. As we have discussed, the PuntoEdu online training environment is the most commonly used source of training in using ICT for in-post teachers.

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iTEC Knowledge Map: Lithuania

Key Groups

The educational system in Lithuania is managed on several levels. The Ministry of Education and Science (MoES) is the national, central government group, but below this there are regional (county) governmental bodies, municipal (local) governmental bodies and, of course, the governing bodies of individual schools.

As part of the work of the MoES, the Centre of Information Technologies of Education (CITE) has been formed. CITE is responsible for the national policy formation and the implementation of main governmental programmes for the introduction of ICT within education. At the level of the individual state, there are other national educational networks and services being established. But, increasingly, power is being devolved outwards to the individual municipalities and schools. So, the purchase of new hardware and software, the training of teachers to use these, and the production of educational software and content are all increasingly the responsibility of individual municipalities and schools rather than delivered through a county or nationwide framework.

That said, the central Government programme is still important. At the moment, a Strategy and Programme for the Introduction of ICT into Lithuanian General and Vocational Education is in place, covering the time period from 2008 – 2012. The vision of this strategy is to create new and flexible student and teacher learning environments and personalised learning possibilities. It covers a number of goals, including:

- Digital learning content;
- The provision of appropriate hardware and software for all schools;
- Competence in the use of these technologies for all;
- The development of school management strategies within new electronic spaces.

The Current Curriculum Context for ICT

Lithuania has a National Curriculum in place which is organized around individual subjects, each with their own objectives, didactic principles and themes.

Information Technology is taught as a discrete subject within this framework. Although the National Curriculum is open to the idea of information technologies being integrated within other subjects or used as a means to encourage cross-curricular learning, there is almost nothing concretely prescribed within the other subjects about how technology might be used.

Students are expected to develop their ICT knowledge, skills and attitudes according to two main standards. These are the General Information Technology Standard and the Students General Computer Literacy Standard.

Both standards relate closely to the European Computer Driving License model. They have certain key areas of study and learning objectives (e.g. to use ICT possibilities to search for, process and present information). The standard of a student's ICT literacy is assessed by formal examination.

ICT Usage in the School

Recent research into the use of computers in Lithuanian primary schools has shown that 59% of teachers make regularly use of computers in their teaching. This ranks Lithuania at 24th position in relation to other European countries. Of this 59%, 94% use computers for demonstration or presentational purposes; 79% develop activities which involve the pupils using computers in the classroom environment. 83% of head teachers reported that ICT is integrated in the teaching of most subjects within their primary school (European Schoolnet, 2009, p2).

In terms of the internet, the European Schoolnet STEPS survey showed that nearly all primary schools have access to the internet, but only 32% have a broadband connection. This places Lithuanian primary schools in the lower rankings (23rd) when compared with other European countries (European Schoolnet, 2009, p2).

Most Lithuanian primary school teachers are well skilled in their own use of ICT, with 67% having good or very good skills. However, 9% of teachers are assessed has having no or very few ICT skills, and 25% were classified as novice users (European Schoolnet, 2009, p4).

The provision of ICT equipment, particularly computers, in the primary school is a major concern for teachers in Lithuania. There is also a high demand for increased maintenance and support of the ICT equipment (90% expressed concerns in the European Schoolnet STEPS survey in 2009, see p4). However, despite these problems these teachers remain positive about the potential impact that ICT can make on teaching and learning (being more positive than the average response to these questions in the STEPS survey; European Schoolnet, 2009, p3). This belief is correlated with the level of computer skills of the teacher. In Lithuania, increased levels of impact optimism were observed from teachers with very good ICT skills themselves; those with fewer skills were less optimistic.

Digital Learning Resources

The European Schoolnet report identifies that there is still a big lack of quality educational software and content across Lithuania. For example, the Institute of Mathematics and Informatics study (2006) surveyed the e-learning contexts and services for primary and special needs education across Lithuania. It analysed policy documents, computer teachings aids provisions for schools, e-content and e-services across 250 schools and 60 municipalities. The study found that:

- A lack of suitable interactive learning objects that matched the curriculum requirements;

- A positive correlation between the impact of well implemented learning objects and virtual learning environments on students' knowledge, skills and competences and their motivation;
- The requirement for a further increase in the number of computers in classrooms for purely educational purposes.

More recent research into the use of digital learning resources within primary schools has shown that teachers access a range of online and offline materials broadly in line with the average primary school teacher in the EU (obtained from a survey across all European countries; European Schoolnet, 2009, p2). There has obviously been an improvement in resource and provision since the Institute of Mathematics and Informatics study in 2006.

Other recent initiatives have tried to make up some of the identified shortfall (e.g. the Digital Teaching Aids Methodical and Technological Evaluation Criteria were approved by CITE in 2008). These criteria have set a benchmark for the design and functionality of digital learning resources.

Once a specific resource has been officially recognised through CITE's procurement and assessment process, there are several CITE repositories within an educational portal where it can be stored and then accessed by schools. These include:

- Textbook search services;
- Centralised meta-data repositories;
- Collections of materials produced by teachers as a result of their engagement in national and international projects;
- Subject-focussed collections of educational content;
- Distance learning courses for talented children or those with SEN.

The development of new educational digital resources are being encouraged through public tenders for CITE funding, funding from the European Social fund for specific purchase or creation of e-content at a national level, and the production of methodological materials by teachers through their involvement in project such as the CITE/Microsoft Corporation 'Virtual Classroom Tour' project. This project is part of a larger 'Partners in Learning' project through which teachers create lesson plans and ideas using Microsoft PowerPoint.

In terms of VLEs, in 2006 a version of Moodle was adopted by CITE and proposed as the most suitable VLE for use across the Lithuanian general educational system, as well as in vocational training institutions and for teacher in-service training.

Other Issues

There are national requirements for the integration of ICT into all pre-service initial teacher education programmes in Lithuania. However, as these programmes are delivered by autonomous institutions such as teacher training universities and colleges, the level of ICT integration is variable. (European Schoolnet, 2009, p1).

Lithuania has a set of ICT competence targets that teachers are expected to reach. There is a national ICT training programme to help teachers develop their skills in this area. These are assessed at three levels through the production of an e-portfolio of evidence. To help support teachers in this process, teachers can use a specially prepared distance learning course to assist the production and collection of the required evidence of their knowledge and skills.

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iTEC Knowledge Map: Norway

Key Groups

The Ministry of Education and Research has the overall responsibility for administering the educational system in Norway. Within this, the Directorate for Education and Training is responsible for the development of primary and secondary education. In 2010, a Norwegian Centre for ICT was established.

A new National Curriculum, called Knowledge Promotion, was established in 2006 to help all pupils develop fundamental skills that will enable them to participate actively in the knowledge society. Within this curriculum, digital literacy is defined as a basic skill and, therefore, is a legal directive. It is the most important ICT policy framework for schools.

Knowledge Promotion defines goals generally and specifically for each subject and each key stage within primary and secondary education. Although this is a central Government directive, there is room for individual choice and adaptation at the level of individual schools regarding the pedagogy and approach they wish to take to deliver this curriculum framework.

The Current Curriculum Context for ICT

Within the Norwegian National Curriculum for ICT is defined as 'the ability to make use of information and communication technologies' and is one of five basic skills. ICT should be integrated within all the learning activities of the school across all subjects. Targets for students' use of ICT related to the usage of various ICT tools, broader issues associated with assessing information using these tools, and other management skills. As ICT is an important element in most subjects, ICT-related skills are assessed through traditional school subjects. There is no separate test or examination of ICT skills across the whole country, although a small number of local initiatives have explored this option.

Norway's latest curriculum reform (the Knowledge Promotion, 2006) defines the following basic skills of learning:

- The ability to express oneself orally;
- The ability to read;
- The ability to do arithmetic;
- The ability to express oneself in writing;
- The ability to make use of ICT.

This applies to all levels of primary and secondary education.

As a result of the implementation of this piece of curriculum reform, the following results have been noted:

- New subject syllabuses in all subjects, clearly indicating what students and apprentices are expect to learn;
- New distributions of teaching hours per subject;
- New structures governing available choices within education programmes;
- Freedom at the local level with respect to work methods, teaching materials, and organization of classroom instruction. (Plomp, 2009, p556)

Although national definitions of skills and competencies do not exist, several 21st century competencies are mentioned in the core curriculum or subject curricula documents. Teaching and assessment guidelines for a selection of subject curricula are in the process of being developed. In addition there are national tests in the basic skills of reading, mathematical literacy and reading in English (OECD, 2010, p26).

In terms of assessment of quality within this system, the Norwegian approach emphasizes the role of local responsibility to ensure high quality. So, based on the British self-review framework for the use of ICT in schools, an online tool has been provided for schools so that they can evaluate their achievements in this area.

Alongside these pieces of curriculum reform, there has been recent Programme for Digital Competence which has covered primary and secondary education and training, higher education and adult learning. The programme's priority areas have been related to ICT infrastructure, competence development, research and development, digital teaching resources, curricula and working methods. The programmed had the following key objectives to meet by 2008:

- Access to high quality ICT infrastructure and services;
- Digital competence at the heart of all levels of education and training (focusing on how all learners could be able to use ICT in a secure, confident and creative manner in order to develop the skills and knowledge needed to participate in society);
- To establish the Norwegian education system as one of the best in world in regard to the development and use of ICT in teaching and learning;
- To use ICT as an integrated tool for innovation and quality development in Norwegian education.

The evaluation of this programme by the University of Oslo highlighted that, despite improvement to ICT infrastructure across the various contexts, the use of ICT in schools particularly did not reflect the increased possibilities that this infrastructure could provide. Moreover, it was noted that there was a lack of a holistic understanding as to how digital competences could be nurtured and developed which often led to educational strategies and policies being too specific and narrow in their focus.

Additionally, there have been longitudinal studies of the use of ICT in basic education across Norway. One of these (Arnseth, 2007) provides interesting data drawn from web-based questionnaires completed by teachers, pupils and school leaders from 499 schools. The study found:

- An increase in teachers' time spent using computers at all grade levels between 2005 and 2007;
- An increase in the use of e-portfolios for marking and assessing student work;
- An increase in the amount of time that pupils spend using computers in classroom work;
- Digital learning resources not being widely used in primary and lower-secondary schools;
- Pupils using multimedia resources more at home than at school;
- Significant variations in digital literacy skills amongst pupils within the same grade;
- Positive use of learning management systems in all schools.

These improvements noted in 2007 have continued to be built upon as we will see below.

ICT Usage in the School

The National Network for IT-Research and Competence in Education (ITU) undertakes an annual survey of the use of ICT across the Norwegian education system. There most recent report (ITU 2009) provides a helpful overview of the current issues facing the Norwegian education system as they increasingly adopt ICT and develop approaches to digital literacy within their schools. Key findings from the 2009 survey included:

- Primary schools still lag far behind upper-secondary schools in their use of ICT in daily school work;
- There are major variations in use amongst student groups, schools and when compared to grade levels;
- Teachers in upper-secondary schools use ICT a lot more than teachers in the 7^{th} and 9^{th} grade;
- Computers are best integrated and used most frequently in the teaching of the Norwegian language;
- Digital divides have been noted between students in respect of their computer utilisation and digital literacy;
- A positive correlation has been noted between ICT usage in subjects like Norwegian, English and Mathematics and the fact that the school has a person employed full-time as an ICT coordinator;
- Teachers report a relatively limited us of digital learning resources.

Despite primary schools lagging behind upper-secondary schools in their use of ICT, Norway ranks as one of the highest uses of ICT in the primary school when compared to other European countries, with 90% of teachers making regular use of computers in their daily work (European Schoolnet 2009, p.2). Unlike many other countries, the major focus here is on pupils using computers within the classroom, with 97% of this 90% of teachers stating that pupils work regularly with computers in classrooms. In terms of the spread of use across subjects, Norway ranked as 3rd with regard to ICT use in traditional subjects such as numeracy and literacy; 81% of head teachers reported that ICT was embedded across the whole curriculum which is broadly in line with the European average.

Almost all Norwegian primary school have internet access through a broadband connection. Therefore, it is not surprising that teachers make good use of online teaching materials and rely less on offline materials.

In terms of primary school teachers' perceptions of the benefits of ICT in teaching and learning, Norwegian teachers are nearly all optimistic, with 93% expressing agreement with the statement that 'pupils are more motivated and attentive when computers and the internet are used in class'. A minority of teachers (15%) agreed with the statement that 'using computers in class does not have significant learning benefits for pupils' (European Schoolnet, 2009, p4).

The overwhelming majority of primary school teachers (90%) have good or very good ICT skills themselves. Only 2% are classified as having no ICT skills.

Despite these very positive developments within the primary education sector, Norwegian teachers are quite outspoken about the barriers or obstacles that they face to using ICT in their classrooms. Approximately half of them find it hard to find adequate learning materials for teaching and consider existing teaching materials on the internet to be of poor quality. However, they did express satisfaction with the number of computers and the infrastructure to provide technical maintenance and support. This has led to the following conclusion in the STEPS survey of 2009:

> *It should be clear that the demands with regard to availability of high quality learning material and higher levels of ICT proficiency of teachers increase with the overall level of sophistication of ICT deployment in teaching. The wide range of barriers expressed by Norwegian teachers here seems to point to a situation where the supply of learning materials and skills is not keeping up with the technical infrastructure. (European Schoolnet, 2009, p4)*

Digital Learning Resources

The Ministry of Education provides funds to the local authorities across the country to enable them to choose and purchase digital learning resources and content. The Ministry also funds the development of specific learning resources in those cases where the market is too small to sustain a commercial approach.

As the use of digital tools is one of five basic skills within Knowledge Promotion (the Norwegian National Curriculum), the provision of a range of digital learning resources is essential in all schools. Therefore, as part of the Knowledge Promotion reform, a three year plan for funding the upgrade of learning resources was put in place.

At the upper-secondary level, the majority of county authorities (18/19) have formed a digital learning portal called the National Digital Learning Arena (NDLA). This has facilitated both the purchase of commercial resources and also encouraged the development of resources by teachers and others. These 'user-generated' resources are moderated by universities and colleges. Within the NDLA, all content is freely available to all.

In addition to the NDLA, there are two other national education portals for primary and secondary education. These portals collect, index and make available digital content for schools free of charge.

There are also some other commercial developments in this area.

Almost all schools in the Norwegian education system make use of a learning platform of some sort. The most widely used by far are Fronter and It's Learning.

At the current time, there are no national initiatives addressing the use of Web 2.0 technologies within education.

Other Issues

As ICT is integrated within the subjects of the Knowledge Promotion curriculum, there are no specific targets set for ICT competence for teachers. However, there are targets set for ICT competence related to how ICT is used within each subject.

Similarly, with initial teacher education ICT is not taught as a separate subject. It is integrated within the subjects. There is a concern that ICT is not sufficiently integrated at this level and work is being undertaken to revise the curriculum framework for initial teacher education to strengthen this element. The STEPS survey (European Schoolnet, 2009, p2) indicates that there have been recent improvements in this area.

Conclusion

The use of ICT across the Norwegian education system seems well integrated within the subject boundaries developed through the Knowledge Promotion curriculum. Research done by Ottestad (2010) has compared the approach in Norway with other Nordic countries (Finland and Denmark). Since 2006, all three countries have developed significant policies in this area and implemented large investment programmes to promote digital literacy and readiness (for teachers and students) facing the information age. Ottestad (2010) notes some interesting differences in teachers' pedagogy and approach to ICT across the three countries, but concludes

that most ICT-using teachers in all countries surveyed make use of ICT in confined periods of time and not on a daily basis. This is contrary to the various policy statements and goals of the various countries and is a reminder of the complex nature of these reforms and the difficulties in ensuring that they impact fully on the work of individual schools and the teachers therein.

As Plomp (2009, 566) notes, in Norway the issue is not one of lack of technical resources:

> *Rather, the most important issue confronting ICT within education in Norway is a pedagogical one: how should we use this technology as a didactical tool in education? … Further research is needed to address not only the issue of whether ICT is being used in the various school subjects but also how (in what kind of learning activities) it is being used.*

This is clearly a question to which iTEC can respond most positively.

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iTEC Knowledge Map: Portugal

Key Groups

The Portuguese education system is managed by the Ministry for Education. The centralized Ministry of Education works alongside regional agents and services who are responsible for the direct administration of state schools at all teaching levels.

Since 2007 the Ministry has implemented a national strategy to modernize every school in respect of the ICT infrastructure and resources. This plan, called the Technological Plan for Education (PTE), is based around three key areas: technology, content and training.

The PTE is the current programme to modernize every schools' use of ICT across Portugal. The main goals of this plan are:

- To turn classes into interactive spaces of sharing knowledge without barriers or obstacles;
- To certify teachers, students, and other school staff, with ICT competences;
- To prepare students for the information society.

Since 2007, much has been achieved through this plan, including:

- Every state school has been connected to the Internet by broadband;
- There has been a large additional number of computers and other equipment such as interactive whiteboards provided to all schools;
- The ratio of school students per computer has dropped each year;
- There has been an increase in the number of students enrolling for the first time in university ICT courses.

In July 2008 the Government launched the Magellan programme through which every child can apply for a laptop for free or at a very low price (with, or without, an internet connection). The Portuguese Government has also placed a high priority on new pedagogical materials, internet safety services and resources, including those for special needs pupils.

The Current Curriculum Context for ICT

The curriculum framework is centralized and coordinated by the Ministry for Education. It is based on the development of a set of competencies. ICT is one of these competencies. But it also crosses over into every other subject and competence area. Consequently, in education up to the 8th grade, ICT permeates through each subject area; in the 9th grade ICT exists as a specific subject. Here, the aim is to give ICT competences to every student. Students are assessed during the school year. There is no national examination in ICT.

There are interesting examples of how ICT has been integrated within different subject areas. For example, Ramos' study (Ramos, 2005) into the use of ICT within schools for language learning combined lesson observations with interviews with teachers and students. It found that:

- ICT in the classroom stimulates students' curiosity and interest;
- Students demonstrated a strong engagement with their tasks;
- The interaction of students with their peers, teachers and ICT have a positive impact on their ability to communicate effectively.

ICT Usage in the School

As a result of the Technological Plan for Education, the resources within Portuguese schools have increased dramatically. Figures released in 2010(Pedro 2010, p.5) reveal that the ratio of students per computer is now 2/1 (in 2008/09 this was 5/1), the vast majority of schools (94% have access to a high-speed broadband connection) with a smaller number of schools (35%) having access to a wireless connection within their classrooms.

In recent surveys done by the European Schoolnet (2009), 70% of teachers in this phase use computers regularly within their classroom teaching. Of this 70%, 59% of teachers use the computer for demonstration or presentational purposes; 49% get their pupils using computers to complete various curriculum tasks or activities. The average ratio of pupils/computer is 15/1. Although many teachers use the internet to access teaching materials (49%), this is well below the European average of 64%. (European Schoolnet, 2009, p2).

Many primary schools (70%) have a broadband connection to the internet but, by and large, they fall behind the European average in respect to ICT usage and equipment items (e.g. 56% of primary schools have a website, 29% offer email to teachers and only 10% to pupils). 65% of teachers have good and very good ICT skills and many teachers are optimistic about the benefits of ICT use in teaching and learning.

Ponte's study (2006) suveyed over 604 primary school teachers across Portugal and attempts to describe the impact of a national project (Internet@EB1) on the development of more sophisticated and significant use of ICT within the primary school. Using a mixed-methodology, the evaluation found that:

- The project significantly contributed to teachers' use of ICT in their teaching;
- Teachers' competence to promote ICT integration in the classroom and their students' competences improved through the project;
- The development of school websites helped strengthen local partnerships and collaborations.

Ponte's 2007 report (Ponte et al, 2007) focused further on the development of primary school teachers competences with ICT. The main aim was to promote the use of ICT in the primary school and foster learning in all curricular subjects and

develop cross-curricular approaches. Again, the project received a positive evaluation.

Digital Learning Resources

As part of the PTE, a repository of digital content for teachers has been developed called the Schools' Portal (www.portaldasescolas.pt). This includes digital learning resources designed to support each area of the curriculum, including lessons plans and other activities, cross-curricular content such as scanned newspaper and magazine pages from 1910 to today, as well as professionally produced video clips.

The portal aims to be a reference for other educational web portals and it is intended to provide the following services:

- Digital educational resources (DER's) repository;
- Online communication and collaboration tools;
- Dissemination of international/national educational initiatives and local ongoing projects with support of educational partnerships;
- E-portfolio system;
- E-learning tools and services.

It is possible for teachers to contribute their own resources to the Schools' Portal. Submitted resources are validated by the Ministry of Education before being released.

Pedro's report (2010, p10) states that at the present time only the digital educational resource repository of this portal has been fully implemented. The total amount of shared resources has exceeded the 1300 educational resources that were planned although the distribution of these shared resources is not balanced across curricula areas or phases of schooling.

There are several initiatives in Portugal to promote the use of Web 2.0 technologies. Many of these were summarized in a handbook which described the uses of Web 2.0 technologies in education that was put together and made available online in 2008.

Almost every school in Portugal from the 5th to 12th grade makes use of a Moodle virtual learning platform (98.1% according to research done by Pedro et al (2008, p12). Within these schools, the usage made of the learning platform has been analyzed on a subject basis (Pedro et al, 2008, p16). This shows that ICT teachers are the most intensive users followed by mathematics and science teachers.

The most common usage of the learning platforms within Portuguese schools is for cooperative work between teachers, followed by the development of teaching and learning activities between teachers and students (Pedro et al, 2008, p22). There is also a significant administrative function that is facilitated through these learning platforms (both within the school, between schools and with other educational partners).

Other Issues

The training of teachers with ICT has been a focus of recent activity in Portugal. In 2009 legal guidelines concerning teaching training and the certification of ICT competencies were compiled. This document identifies the core ICT competencies that all teachers should exhibit. There are three levels of teachers' certification:

- Digital competences certification (level 1): teachers are expected to develop an instrumental and functional use of ICT tools in their professional context, this level is mainly linked to knowledge related to efficiently master tools and technical procedures;
- ICT pedagogical and professional competences certification (level 2): teachers' acquired knowledge and evidenced skills should make possible the effective use of ICT as a teaching resource, also understanding ICT importance in the practice of developing pedagogical and didactical strategies and in promoting real improvements in students learning processes,
- Advanced ICT in education competences certification (level 3): the teacher is able to develop innovative teaching practices using ICT, to reflexively evaluate his own professional experiences and practices and to incur in shared and collaborative activities with the educational community. (Pedro, 2010, p.12)

Initial teacher education is the responsibility of Higher Education Institutions in Portugal. They are responsible for delivering the training component related to the development of ICT competencies in teacher trainees according to the established principles of the programme (as defined by the PTE). Pre-service training of this sort assesses the competences of individual teachers through the use of general tools like word processors, email and internet browsers and some educational software.

Conclusion

The last few years have witnessed a considerable change in Portuguese schooling. The national statistics suggested that primary, middle and secondary schools have been properly equipped for the technologically-rich future that is expected. Pedro's report (2010) is very clear about what should happen next:

> *It's truly the most demanding moment for the required transformational process of what truly matters, the teaching and learning practices. Now that the lack of resources and the inadequacy of infrastructures have slowly vanished, the 'ICT-competence' factor will tend to appear as a determinant element of the process.*

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iTEC Knowledge Map: Slovakia

Key Groups

The Ministry of Education is responsible for implementing educational policy in Slovakia. Slovakia has a diverse education system, with basic school grades going from grades 1 to 9. Primary schools cover grades 1 – 4 and lower secondary schools grades 5 – 9. Since a significant change in the law in 2008, a new education system was adopted which regulated the conditions, extent and content of education training, the length of compulsory schooling, and aspects relating to teachers' pay, terms and conditions. The governance and financial arrangements for schools are provided through national and regional bodies.

One of the key national policy frameworks for ICT is the Strategy for ICT in Education which runs from 2008 to 2011. The policy is mainly concerned with the development of students' and teachers' ICT skills. Schools receive equipment such as computers, data-projectors, and free internet access and teachers are trained to use these to develop a greater degree of innovation in their pedagogy.

Another important project, the 'Fluency in Information Technology: Application of ICT in Subjects' ran between 2006 and 2008. This was funded by the European Social Fund and aimed to train teachers in innovative pedagogical practices with ICT in subject lessons and cross-curricular projects. It involved 27,000 teachers at primary and secondary schools.

More recently, Elfa, a private company, is responsible for the national project called 'Modernization of Education at primary and secondary schools in Slovakia' on behalf of the Ministry of Education of the Slovak Republic. The project runs from 2009 – 2013 and aims to further the education and training of teachers, focusing on modernization of the educational process at all primary and secondary schools in Slovakia. Besides basic courses introducing the latest ICT and methodology of teaching to the teachers, there are also some specialized courses prepared for selected subjects. For primary schools these include: Slovak language, Mathematics, Science, Chemistry, Biology, Geography, History, Music, Arts and all subjects of the first level at primary schools. For secondary schools these include Slovak language, Mathematics, Science, Chemistry, Biology, Geography and History.

In the project, 4,683 teachers from primary schools and 2,132 teachers from secondary schools are involved and are participating in trainings through a specially designed virtual learning environment (www.modernizaciavzdelavania.sk). Online training is supported by teachers attended face-to-face training at various locations across the country.

ICT Usage in the School

Schools are autonomous and able to make their own decisions about the integration of ICT into the teaching process. The computer to pupil ratio across Slovakia is 1:14 and around 43% of schools have access to a broadband connection.

State educational programmes for primary and secondary education include specification of the following competencies:

- Communication;
- ICT competencies;
- Problem solving;
- Personal, social and civic competence;
- Ability to learn how to learn.

Most of these competencies are integrated in the teaching of several subjects, although ICT, media education and media literacy are taught as separate subjects (OECD, 2010, p27).

Dado's study (2006), commissioned by the Ministry of Education, sought to identify new pedagogical practices and define models using ICT and network platforms for teaching and learning. It started by analyzing the situation in Slovakia with other countries and regions, before measuring and comparing student achievements via experimental and control groups (e.g. in one school pupils used ICT and in another one they did not). The study found that:

- ICT raised students' motivation, attitudes and engagement in the learning process;
- Teaching with ICT had a positive impact on the digital competences of learners as well as their interpersonal, intercultural and social competence;
- Teachers were often not prepared with the necessary ICT skills to prepare materials, teach and assess students using the learning platform;
- Teachers considered that the use of ICT was time consuming.

Around 72% of primary school teachers make use of computers in their teaching. Of these, 68% use computers to support their own role whilst 98% of them get their pupils using computers regularly. The majority of Slovakian teachers are happy downloading materials from online sources (75%) and are amongst the most frequent users of self-researched teaching materials from the internet (European Schoolnet, 2009, p2).

Whilst the majority of Slovakian primary schools have computers and other pieces of ICT, only 31% of them have access to the internet via a broadband connection. Despite this, these teachers are, broadly speaking, optimistic about the potential of ICT (ranking 12th out of 27 when compared to other European countries; European Schoolnet 2009, p.4). 84% of primary school teachers are classified as having good or very good ICT skills within only 12% having no or very little ICT user skills. The recent European Schoolnet STEPS report (2009) provides evidence for Slovakia's poor ICT infrastructure (when compared to other European countries) and

hypothesizes that the 'demands with regard to availability of high quality learning materials and higher levels of ICT proficiency of teachers will increase with the overall level of sophistication of ICT deployment in teaching' (p4).

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iTEC Knowledge Map: Turkey

Key Groups

The Ministry of National Education provides leadership, supervision and administration to the formal state education system in Turkey. It is responsible for the preparation of the curriculum, maintaining coordination between educational institutions and the construction of school buildings. The Ministry of Education also appoints Provincial Directors of Education who have regional authority and accountability.

The Current Curriculum Context for ICT

Compulsory schooling in Turkey begins in the primary school for children aged 6 and continues until the age of 14. The curriculum is determined by the Ministry of National Education and comprises of compulsory courses (e.g. mathematics, sciences, history, etc) and elective courses. Computer education is an elective courses (alongside other subjects such as drama, tourism, local handicrafts, etc).

The establishment of a comprehensive information technology infrastructure within schools is the responsibility of the Ministry of National Education. In the last ten years a number of national plans have been implemented, including the 'Basic Education Project IT Policy Report' (2004), the 'Information Society Strategy' (2006-2010) and the 'Information Society Action Plan' (2006-2010).

The 'Information Society Strategy' (State Planning Council 2006) outlines the following key actions for ICT within schools:

- IT infrastructure in schools
  - Installation and updating of IT labs with multimedia libraries in all designated schools;
  - IT labs open to the public during non-student use.
- Public Internet Access Points (PIAPs)
  - Free access to all citizens without a home internet connection;
  - Digital literacy courses twice a day, including special needs groups;
  - On-site tutor assistance.
- Computer and internet campaigns
- Computer and broadband connection packages for special needs groups at affordable rates.
- Basic ICT education in schools
  - Scope of ICT courses in secondary education curriculum to be improved and rolled out;
  - Digital literacy taught within dedicated certificate programmes;
  - Students informed on benefits of using ICT in daily life and guided on its effective use.
- Basic level ICT courses for adults

    - ICT training programmes at PIAPs, with priority given to disadvantaged and marginalized groups;
    - ICT training certification;
    - Certification programme identified by both the public and private sectors to achieve standards in ICT training.
- ICT-supported formal education
    - Updated secondary education ICT curricula to sustain and complement ICT education in primary education;
    - ICT-supported basic and auxiliary courses in the education system and access to education curricula on the Internet.
- ICT-supported informal education
    - eLearning courses designed to contribute to the personal and vocational development of all citizens, regardless of special needs;
    - Special focus on training programmes for disadvantaged and marginalized groups to assist in the inclusion of ICT.

By December 2009, just over 28,000 Information Technology Labs had been established throughout the country in schools with at least 8 classes and 150 students. Another 17,261 schools that did not meet this capacity requirement were provided with one PC per 15 students, digital projectors, scanners and printers with the aim to reduce the digital divide. Digital literacy courses have now become part of both the primary and secondary education curricula.

According to recent reports, 96.3% of Turkish primary schools have access to internet-connected computers through ADSL or satellite connections (European Commission 2010).

Digital Learning Resources

Textbooks are set by the Board of Education and teachers are not given the freedom to select alternative resources. Although teachers can choose the way to teach, the selected approaches within these textbooks do force them to stick to certain pedagogical styles in accordance with the approaches utilized within the provided textbooks.

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