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Part II

Executive Summary

The European Schoolnet Validation Network (EUN ValNet) is an accompanying measure in the School of Tomorrow action line to facilitate building knowledge about innovation in schools and help create the conditions for schools of tomorrow. The project has set up an integrated infrastructure for validating and demonstrating products and services arising from IST projects relevant to the schools sector (and national research programmes and the ICT industry). Its core activity has been to validate five Schools of Tomorrow projects using a framework methodology in selected schools across Europe, to cluster and animate projects and to consolidate and disseminate results.

Whilst many of the School of Tomorrow projects have evaluated the products and services that have been generated, this has tended to focus on functionality and usability testing, and has often only involved a limited number of schools located near to the institutions participating in the projects. Within ValNet, five educational ministries, acting as partners in the project, agreed to lead the validations and engage the support of three other countries/regions. The validations undertaken have involved at least:

- 16 European countries
- 200 schools
- 565 teachers
- 5649 students
- 153 members of the community, academics, teacher trainers or experts

The intention was not to replace internal project evaluations with an external independent validation, but to provide a supplementary and complementary service. The validations have been structured by a validation framework D2.1 (MENON, 2002) focusing on five core dimensions:

- Pedagogical
- Organisational
- Economic
- Technical
- Cultural

In addition, two preliminary studies (D1.1, Wood, Scrimshaw and Lewin, 2004), THINK, undertaken to identify key issues facing policy makers and to develop future scenarios for the public education service, and NOW, presenting a consolidated analysis of four contextual studies of innovative practice, have made a major contribution to the validation procedures followed in WP3. The four THINK scenarios have been used to analyse the educational contexts of the countries, regions and schools participating in the validation and also where the School of Tomorrow projects fit in relation to future scenarios. In addition, issues arising from both studies contributed to the framing of the focus of the validations.

The five School of Tomorrow projects that were selected were:

- 5D
- ITALES
- ITCOLE
- Lab of Tomorrow
This work was carried out in the broader context of continual technological developments opening up new potentialities for schools of the future. In particular, EUN are particularly interested the changing nature of learning in technology rich societies. Therefore the validations were underpinned by the future scenarios presented in the THINK study and also the concept of ambient schooling which we will now explain.

**Future visions/scenarios and support for ambient schooling**

The school of the future should support **ambient learning**. That is, learning that takes place any time and any where, facilitated through technology, but rooted in schooling as an institution of society. Thus is it not simply concerned with ubiquitous learning but also provides support emanating from school organisations such as provision of learning resources, and access to teachers, experts, mentors and co-students through networked learning communities. This shift in the way that education is delivered and supported will demand new models of learning, new mobile technological tools, and innovative ICT resources to facilitate communication, interaction and management of learning resources. ValNet will seek to investigate to what extent School of Tomorrow projects can facilitate ambient learning and what can be learned from the outcomes in relation to the development of new models of learning. The challenges are:

- How to use resources effectively
- To identify new ways of knowledge building
- How collaborative learning in a virtual world can be supported

ValNet has led to the national widespread adoption of one product resulting from one School of Tomorrow Project. Hungary and Portugal intend to adopt Fle3 (a product of ITCOLE) on a large scale. The concepts behind a second School of Tomorrow project have also been implemented nationally. While the country concerned has not implemented any products as such they have collaborated closely with the School of Tomorrow Project team, who have provided training and support on an informal basis. The Flemish Community in Belgium are introducing 5D into all schools. These two projects are described in detail below but have common features:

- underpinned by tightly defined pedagogical theories,
- involving collaborative problem solving approaches,
- provide tools that incur minimum costs (although additional demands on teachers time),
- easy to implement.

We believe that both approaches can be used effectively to support ambient learning, with appropriate levels of support and training (both of teachers and pupils). However, this will be easier to achieve in educational contexts where the curriculum is flexible, timetabling (particularly in secondary schools) ensures that extended periods of time can be devoted to projects, there is a greater focus on learner autonomy and student-centred approaches, and schools are open to greater involvement of the local community.

The remaining three projects were not perceived by teachers to offer anything different or new although the underlying principles were believed to be sound and have potential benefits for teachers and learners. The Lab of Tomorrow tools whilst still being in development at the time of the validation were perceived to have potential to support specific areas of the science curriculum, and were underpinned by a strong pedagogical theory. ITALES, again whilst still in development, was perceived positively, particularly the ITALCO tool which enables teachers to author their own resources without demanding high levels of technical skills, and also to access resources created by
others. Seed was challenging to implement fully in the short time-scales demanded within the validation process. It was almost impossible to develop learning communities involving technical experts as well as pedagogical experts. Nevertheless, schools participating in the validation interpreted the project very flexibly and developed a number of interesting initiatives, but largely building upon existing learning communities rather than creating new ones.

With all three projects there are issues relating to change and comparability (which could equally be applied to the first two projects described above). The underlying concepts of the tools fit well with the THINK 2 scenario but it has not been possible explore the extent to which school staff or the school as an entity wanted to change and innovate, apart from individual teachers participating in this project. Thus we cannot say enough about whole schools and therefore it has not been possible to comment on whether or not the tools, potentially interesting and conceptually flexible as they are, will be able to stimulate sustained innovation and change in the whole school culture. It should not be expected that tools of this sort, not specifically the School of Tomorrow projects, can be used to alter a school culture in any very perceptible way unless a much more powerful support and developmental environment is provided. Moreover, such tools could be used inadvertently within educational systems that are more closely associated with THINK scenario 1. Thus, rather than acting as a catalyst for change, ICT tools might be used to fit into a different setting from that for which they were originally devised. Finally, the participants perceived that these tools and approaches were not superior in comparison with other available educational innovations although they were positive about its future potential and its conceptual value. School of Tomorrow projects were conceived at least four years ago and whilst at the time were ground breaking there now exist a wide-range of similar commercially available products, some of which are already being used by teachers. This relates particularly to ITALES, Lab of Tomorrow and tools created as part of the Seed project (Cool Modes, eSlate).

The key lessons learnt are:

- **Uniqueness and value-added.** School of Tomorrow projects were conceived at least four years ago and whilst at the time were ground breaking there now exist a wide-range of similar commercially available products, some of which are already being used by teachers. Future consideration of project proposals should ensure that project teams present a case as to why the tools and services they intend to produce will be different (and perhaps offer greater value) than those available commercially.

- **Demands on teachers’ time.** In all projects involved in the validation, teachers’ time was the most significant cost. In many cases, teachers were offered a limited amount of financial support as an incentive to participate but were not fully compensated for the amount of time required. The evidence suggests that funding is necessary in order to enable such projects to thrive in schools, and needs to be more substantial particularly to facilitate scaling up. It is not advisable to rely on the goodwill of individuals for sustained periods of time.

- **Alignment with national, regional and school cultures.** The implementation of School of Tomorrow projects (and by implication, any educational innovation) is most effective when tools and/or underpinning pedagogical theories relate closely to regional and national priorities. Educational policies and cultural differences in pedagogical approaches remain powerful forces. Curriculum and timetabling constraints were barriers that had to be overcome.

- **Flexibility versus complexity. Perceived educational potential versus risk.** Teachers prefer tools that are intuitive and flexible but not too complex, providing opportunities to create teaching resources that meet their particular needs and are purposeful. However, at the
same time their prime aim is to educate their students and therefore they are not prepared to take unnecessary risks. Teachers need to be able to see the educational potential of a product and to be aware of the possible benefits and added-value for their students.

- **Actual use versus intended use.** Teachers can use products in unintended ways and often make them fit current practices rather limiting the kinds of pedagogical changes that take place. In some cases unintended uses result from lack of understanding of the capabilities of the tools and services, and different interpretations of the underlying pedagogies. Training and workshops should not simply focus on the technical operation of educational products but also the underlying pedagogical models and intended uses.

- **Importance of shared experience, learning from colleagues and external support.** Collaboration and mutual support for teachers was perceived to be beneficial. Meeting face-to-face however appears to be an important element of developing strong working relationships, particularly initially. Teachers greatly valued external support of the validation team.

- **Importance of underlying pedagogical models.** The School of Tomorrow projects that were underpinned by specific pedagogical models appeared to be easier to implement and were received more positively by teaching staff.

- **Importance of student-centred learning and collaboration.** Students who participated in ValNet activities greatly enjoyed opportunities to publish for a real audience, and to collaborate with students of the same and different ages, both locally, nationally and internationally. Student-centred learning approaches were also perceived to have a positive affect on student motivation.

- **Cross-cultural challenges.** All five School of Tomorrow projects proved to usable in different countries and have the potential to support multi-lingual and international/inter-regional learning activities. Partner schools all wish to form communities that work across regions and national boundaries but they also find security in starting with local links that they can easily sustain by traditional means and face-to-face meetings. The differences in national and regional education systems, particularly curricula and term dates, were greater barriers to international collaboration than language.

**Key recommendations to the European Commission**

- The evaluation of project proposals should ensure that intended innovative tools and resources are value-added both in relation to existing practices and teaching aids, but also in relation to existing commercially available ICT products and resources. Short feasibility studies would enable sound judgements to be made.

- Future projects should have an early review point by a validation agency, particularly as innovative cutting edge ideas four or five years ago are no longer novel, and are likely to be competing with commercially produced resources. The screening process should use the ValNet framework and assessors should include potential end users, e.g. ENIS teachers. Projects could be championed by an education ministry. However, validation in partner countries is reliant upon face-to-face meetings and personal support. It therefore incurs costs and provision should be made to ensure that these are met.

- Future calls should make it compulsory for proposals to include information about the distribution and marketing of products upon completion. In addition the intellectual property rights must be clarified and tools/resources that are intended to be freely available should be placed in a public repository.
Key recommendations for consortia preparing future project proposals

- Commercial producers of innovative tools for education provide support for training, installation and maintenance. The marketing processes for such companies are often very well developed. The same principles need to be applied to products produced through commission-funded projects or those funded through other sources within academic institutions.
- Teachers involved in the five project validations would have valued the opportunity to share their experiences and achievements with the original project teams, but were unable to do so because of lack of funds and interest. Financial provision to allow for this in future project proposals and validations would be welcomed and motivate teachers to participate fully.
- A number of cultural barriers need to be overcome such as language, curriculum differences, term dates (when international collaboration is required), and the sceptical attitude of some teachers towards materials created by teachers in other countries. Project proposals that investigate such issues would be beneficial.
- The projects underpinned with sound pedagogical models have proven to be most successful through the validation. Support should be given to facilitate more exploration of pedagogical models.
- Schools do not have sufficient finances to investigate and experiment with tools and resources. Schools are not market environments. The best means of disseminating and promoting good tools/resources to schools should be identified. This should be identified in future proposals as should information regarding how hi-tech products can be introduced into schools and the potential impact.

Recommendations for policy makers

- National policy makers need to ensure that there is flexibility within the curriculum, and other inhibiting factors such as a reliance on ‘high-stakes’ testing or rigid structure of the school day, to support innovation and change; centrally controlled curricula will constrain ICT innovation in educational institutions.
- Successful innovation projects such as Fle3 and 5D should be promoted and supported at national levels both in relation to usage and research. Both these projects, for example, have not been expensive to implement and have achieved change through research and reflection. Fle3 facilitating computer supported collaborative learning with progressive inquiry methods has challenged students to hypothesise, investigate and evaluate. These students have been learning to learn, a major competence required to support life-long learning. 5D has enabled learners to interact with older and younger peers, as well as members of their local communities and experts in the field. Both projects have resulted in positive and welcomed changes in the roles of teachers and learners.
- The development of national ENIS networks should be supported and developed further to act as a cost-effective sounding board for innovation and new ideas.
- Involving schools in validation can stimulate a lot of thinking, reflection and innovation. Providing support such as additional funding and recognition for teachers would be valuable, and reap rewards. Providing training and support for teachers on ICT usage, evaluation and action research may also be beneficial.
- It may be beneficial to appoint a champion to address all cultural and organisational issues through consultation with potential actors, identifying barriers and means to overcome them. This would overcome the fallacy that innovation only works with certain people in certain situations and is not transferable or reproducible.
Recommendations for schools and teachers

- Support from leadership and senior management contributes to the success of ICT innovation. The success of any project depends upon how it is perceived by leadership and senior management. There needs to be clear guidance about what can be achieved and what contribution innovative tools and services could make. There needs to be an awareness of the commitment required. Teachers and other staff need to be provided with adequate training and technical support. Provision should be made for identifying problems and addressing them before they become major issues.

- ICT innovations should be embedded in well-formulated pedagogical policies on teaching and learning, underpinned by a clear vision on schooling. At the same time teachers should be empowered and trusted to experiment.

- Innovation and change is successful where it is perceived to be purposeful, flexible, collaborative, easy to manage (i.e. small, manageable steps), and develops a sense of ownership amongst those participating (for example, requiring teachers to adapt or create their own learning materials).

- Careful consideration should be given to the reorganisation of teacher workloads to ensure that sufficient time is allocated for the preparation of ICT resources and activities.

- Teachers not only need inducements to participate in research and development projects, they need to be reassured that their activity will complement local educational aims/objectives, and potentially have a positive impact on their students.

- Teachers should be made aware of how they can find and get support to use tools and resources that have been successfully validated.

The effectiveness of the ValNet validation service

The validation framework provided a sound starting point and made a valuable contribution. Without the five dimensions it would have been impossible to integrate the different validations. It helped to ensure that there was a balance between pedagogical considerations and other issues. The pragmatics of the O-E-T-C dimensions of an essentially pedagogical tool turned out to be more important than we had anticipated when considering the up-scaling of the tool.

The validation service overall proved to be effective. A number of improvements are suggested in the main report. Most importantly it would seem beneficial to run future validations in two stages; firstly, to identify the pedagogical soundness of innovative tools with a small number of tools and secondly, to focus on the remaining four dimensions (O-E-T-C) in a larger scale validation. The timing of the validation process would be most effective if the tools and resources were all but complete. The validation should be conducted over longer periods, particularly to establish impacts on learning. And finally, the goodwill of teachers should not be relied upon thus demanding greater funding and/or alternative reward systems such as accreditation.

Concluding thoughts

Learners should be supported at times that are convenient to them and anywhere that they choose. ICT through mobile technologies, online communication and resources, and blue skies developments offers these opportunities, providing the contexts in which ambient learning can take place, offering flexibility together with guidance and structure as required. The learner and the community must be central to the learning process; their needs and preferences should be prioritised rather than learning being governed by organisational systems such as curricula, assessment and timetabling. This is not
to say that in the future all learning will be facilitated in virtual spaces. There needs to be a balance between virtuality and physicality such that learners have real and concrete experiences to draw upon when constructing and reconstructing knowledge. Consultation is key: learners must be involved in designing curricula, assessment practices and learning spaces; teachers must be involved as pedagogical experts and work together with technical experts to build creative learning resources; the community must be involved both in defining local curricula and in valuable collaborations with learners. Ownership is crucial: students must be able to contribute to designing their learning pathways and be able to be autonomous; teachers need to be supported (both in relation to training and time) to contribute to resource development without demanding high levels of technical skills.

Some nations are making radical shifts (such as the Danish upper secondary schooling reforms that will be implemented in August 2005) towards these educational reforms whilst others are slowly moving in this positive direction. Perhaps ICT truly has acted as a catalyst to disrupt the time-served ‘traditional’ approaches to education. This message is not new and unique but is becoming increasingly important in order to serve the needs of our future citizens in the knowledge society. It will demand risk-taking and trust from all concerned, be they policy makers, school leaders, teachers, researchers, parents or other members of the community. The same may not apply to learners, particularly the younger generations; for them the implications of risk-taking may not be considered, whilst technological advances and educational reforms may be taken in their stride. They simply want to be heard, included and respected for their individual contributions to citizenship and society, and be able to have some influence regarding their (chosen) learning pathways.
Part III

The Consolidated Report

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1. Introduction

The European Schoolnet Validation Network (EUN ValNet) is an accompanying measure in the School of Tomorrow action line to facilitate building knowledge about innovation in schools and help create the conditions for schools of tomorrow. The project has set up an integrated infrastructure for validating and demonstrating products and services arising from IST projects relevant to the schools sector (and national research programmes and the ICT industry). Its core activity has been to validate five Schools of Tomorrow projects using a framework methodology in selected schools across Europe, to cluster and animate projects and to consolidate and disseminate results. The components of ValNet are:

- Ongoing clustering, analysis and discussions covering the schools of tomorrow projects in their wider technical and educational context
- A framework evaluation methodology (D2.1) based on this activity forming the foundation for a flexible validation service
- Validation studies of five IST projects using testbed schools belonging to the European Network of Innovative Schools (ENIS) under the supervision of national ministries (D3.1)
- A set of complementary reports:
  - A consolidated analysis of all the School of Tomorrow project results
  - Five validation reports (D3.2)
  - A contextual study of innovative practice, strategies and issues, within city and regional implementations (NOW, D1.1)
  - A study of emerging national tensions and issues, together with future scenarios (THINK, D1.1)
- A strong dissemination effort including EUN channels, web sites, workshops and networks
- Co-ordination, administration and management by the EUN office.

Whilst many of the School of Tomorrow projects have evaluated the products and services that have been generated, this has tended to focus on functionality and usability testing, and has often only involved a limited number of schools located near to the institutions participating in the projects. Within ValNet, five educational ministries, acting as partners in the project, agreed to lead the validations and engage the support of three other countries/regions. The validations undertaken have involved 16 European ministries in total (Table 1). The intention was not to replace internal project evaluations with an external independent validation, but to provide a supplementary and complementary service.

<table>
<thead>
<tr>
<th>Country</th>
<th>ITCOLE</th>
<th>ITALES</th>
<th>Lab of Tomorrow</th>
<th>5D</th>
<th>SEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td></td>
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<tr>
<td>Belgium (Flanders)</td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td>(Lead Ministry)</td>
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<tr>
<td>Denmark</td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
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<td>Hungary</td>
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<td>Iceland</td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td>(Lead Ministry)</td>
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<tr>
<td>Israel</td>
<td></td>
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<td>Y</td>
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</tbody>
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Table 1: ValNet validation projects and partners

<table>
<thead>
<tr>
<th>Country</th>
<th>Lead Ministry</th>
<th>National Validators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>Y (Lead Ministry)</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>N. Ireland</td>
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<tr>
<td>Norway</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>Y (Lead Ministry)</td>
<td></td>
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<tr>
<td>Slovenia</td>
<td>Y</td>
<td></td>
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<tr>
<td>Spain (Catalonia)</td>
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<tr>
<td>Sweden</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Y (Lead Ministry)</td>
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</table>

Each lead ministry appointed a lead validator to take responsibility for the validation of a project across schools in four countries, and to produce a validation report supported by national validators in the three additional countries, each of whom produced a national validation report. In some cases the role of coordinating the validation (selecting the schools, negotiating their participation, organising training events, etc) was undertaken by a separate person and in other cases the lead validators and national validators undertook the coordinators role in addition to the validation role.

This has allowed the five selected School of Tomorrow projects to be validated on a large scale, in real contexts, across a range of countries and regions. Furthermore, by involving policy makers, industry partners, researchers and practitioners, both in validation activities and dissemination, the innovation process can be facilitated through effective networks and thus accelerated. In addition, ValNet will demonstrate the viability of a truly flexible validation service that can contribute to knowledge building about ICT and innovation in schools. It facilitates a systematic and structured approach to finding out what really works through the collection of similar data in common formats, enabling comparisons to be made across projects.

The five School of Tomorrow projects that were selected were:
- 5D
- ITALES
- ITCOLE
- Lab of Tomorrow
- Seed

These projects are summarized below, together with the remaining six projects that form the IST School of Tomorrow action line. The five chosen projects were selected as projects that were believed to be on track to complete on time and progressing well. The projects also seemed to be appropriate for implementation in a wide range of schools.

Our broad definition of validation is:
- Identifying whether or not the selected tools and products created through the School of Tomorrow action line achieve the claimed aims and outcomes in real educational settings
  - On a large scale involving lots of schools and students
In different contexts including regions and nations

- Establishing whether or not such technologies make a difference
  - Do such technologies improve teaching and learning?
  - Do such technologies lead to changes in practice?

The challenges faced in implementing this definition are three-fold. Firstly, what is meant by the term ‘work’? In ValNet, we have interpreted this in a variety of ways: technical robustness, ease of use, and most importantly perceived value in classrooms by practitioners, students, educational policy makers and academics. Here, teachers who have used the technologies beyond the validation process and ministries that have supported wider dissemination are clear indicators of perceived value.

The second challenge is how ‘improvement’ in teaching and learning can be measured. Again, we have chosen to value personal perceptions, subjective opinions and illustrations as an important form of measurement rather than to rely upon complex quantitative procedures that in recent large-scale evaluations of the impact of ICT on attainment have proved to be challenging (see for example, ImpaCT2 in the UK, Harrison et al, 2003). Furthermore, as noted by many (e.g., OECD, 2001) traditional assessment practices do not necessarily capture the impact of learning experiences through ICT.

The third and final issue relates to the term ‘change’ – what constitutes change, how substantial should it be and should we recognize one-off experiments or only value long-term changes? In relation to the constraints of this validation and the necessarily short periods during which teachers and their students incorporated School of Tomorrow projects into teaching and learning activities, this challenge was more pronounced. Certainly, it is hard to comment on systemic change in such a short period. However, we believe that small changes in individual practices can be as important as school-wide systemic change. In addition, any experience, albeit small, with a new approach to teaching and learning could eventually lead to further and more substantial changes. The teacher who uses innovative technologies in the classroom for the first time may have their eyes opened to a wide range of possibilities for the future.

To operationalize the validation, the MENON Network EEIG, as a partner in ValNet, developed a validation framework (D2.3) designed for use across networks of schools to ensure standardised and comparable results, enabling synthesis of the main findings and the generation of future recommendations, applicable across Europe. It was designed to include quantitative and qualitative approaches, and a bank of templates and resources that could be customisable by individual validators such that the framework would be structured but flexible.

The purpose of validation framework is to determine whether claimed results are valid and to obtain qualitative and quantitative evidence of the positive impact of the innovation, product or service. The approach used to do this assists evaluations that are formative and summative, multidisciplinary and adaptable to different kinds of projects. The framework and its associated instruments essentially give a general structure for validation that could be used with projects with a wide variety of intended benefits through five dimensions: Pedagogical, Organisational, Economic, and Technological and Cultural/linguistic (referred to in the remainder of the report as POETiC for convenience). Table 2 below summarises the POETiC framework.
### Table 2: Innovation areas covered by the Validation Framework.

<table>
<thead>
<tr>
<th>Area</th>
<th>Brief definition</th>
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</thead>
<tbody>
<tr>
<td>Pedagogical</td>
<td>Teaching methods, learner grouping, teacher development, curriculum development, digital literacy</td>
</tr>
<tr>
<td>Organisational</td>
<td>Institutional development and innovation projects, change models, reducing bureaucracy and paperwork, virtual and actual integrated / ubiquitous learning environments, home-school links, timetabling, deployment of teaching and support staff</td>
</tr>
<tr>
<td>Technological</td>
<td>Communications, intranet, school on-line presence, mobile and wireless devices, effectiveness of broadband technologies</td>
</tr>
<tr>
<td>Cultural/Linguistic</td>
<td>Multi-lingual, cultural ‘localisation’, educational terminology, linguistic and cultural policy, transnational user groups, transnational linguistic approaches, transferable services products approaches and practices</td>
</tr>
<tr>
<td>Economic</td>
<td>Cost-effectiveness, impact measurement, return on investment, financial models, innovative services, e-commerce for education, funding models (e.g. leasing, outsourcing)</td>
</tr>
</tbody>
</table>

The objects the framework can be used to validate are:

- the project as a whole
- the working processes within it
- resources/products
- services provided
- and the results of the projects.

Each of these objects can be reviewed in terms of the POETiC dimensions of the innovation. Thus the objects and these innovation dimensions form a 2D matrix. A variety of exemplar validation tools were prepared, such as checklists, observation grids and support for structured group discussions, as part of the validation framework. These have essentially been used as templates to generate project specific validation tools. Thus, the framework has been used as a roadmap, together with the outcomes from THINK and NOW, to structure the five validation reports (D3.2).

The European Network of Innovative Schools (ENIS), established by European SchoolNet, is a network of a core of 310 of the most innovative schools in 12 countries and associated schools in other countries. ENIS schools are at the forefront of using ICT to improve teaching and learning. ENIS’ objectives are:

- to discuss and disseminate best practice
- to encourage collaborative projects between schools in the vanguard of ICT development
- to test and validate Commission- or commercially-funded projects, content and services
- and to encourage further innovation, including new organisational and pedagogical solutions and interaction with other less advanced schools.

National ministries are responsible for identifying ENIS schools from among the leading schools (in terms of ICT) in their country. Schools are often selected from existing, and active, national networks...
of innovative schools. Participating countries without official ENIS schools have nominated their most advanced schools.

The ENIS schools provide group of innovators and early adopters, forming a ‘test-bed’ of schools across Europe. Although not necessarily representative of all schools it may have been difficult to persuade teachers lacking technical skills, confidence and enthusiasm for ICT to participate in ICT projects which could be perceived as risk taking because the potential outcomes and/or benefits were not yet proven. The teachers who elected to participate were given support and training by the leading and/or national validator. They were also assured that the implementation of the project would be flexible such that it would support local curriculum aims. In addition, the impact of participating in a research project was intended to be minimal in terms of time and resources. The five projects involved school managers and administrators, teachers, students, parents and other members of the community. The data were collected largely through questionnaires and interviews; the lead validators were given autonomy to develop new tools or tailor existing validation tools to suit their needs. That is they were encouraged to adhere to the underlying philosophy of the validation framework developed by MENON, to use it flexibly and selectively. Data were collected at the beginning of the implementation where possible and on completion of the implementation. However, in some cases the limited length of the implementation period, September 2003 to January 2004, concerned teaching staff. They felt that it was difficult to make any real changes in such a short period and so planned implementations over a longer period. The validation exercise was thus conducted in some cases on projects that were still in progress.
2. Framing the validations through NOW and THINK (D1.1)

THINK (Wood, 2002) was undertaken to identify key issues facing policy makers and to develop future scenarios for the public education service. THINK draws on a series of in-depth interviews with key members of the education ministries and agencies from Denmark, France, Holland, Portugal, Sweden and the UK. NOW (Scrimshaw, 2002) presents a consolidated analysis of four contextual studies of innovative practice. The NOW Report is based upon studies of four European cities and regions with innovative strategies for developing and supporting the use of ICT in their schools. The studies cover Amsterdam (Lauret and Sligte, 2001), Barcelona (Castells and Dénia, 2001), Marseille (Puimatto, 2001) and Northern Ireland (Anderson et al., 2001), each study having been written by members of the team responsible for the strategy and its implementation. These studies were commissioned for the NOW report. The four were identified as they were known to be engaged in innovative ICT practices to support education within the community. In addition, they were intended to represent cities, regions, remote areas and geographically spread communities. The selection criteria placed emphasis on socially disadvantaged communities, use of advanced technologies as a solution, learning from their experiences, and the extent to which innovative ICT projects were prioritised.

Together THINK and NOW aim to:

- Promote understanding of existing practice in leading edge ICT schools and communities;
- create future scenarios for education made possible by ICT; and
- take stock of developments in technology and how they might impact upon public education.

In combination the two studies provide a way of viewing future possibilities that recognizes the importance of combining school, city, regional and national perspectives on policy and implementation.

The outcomes of the two reports have made a major contribution to the development of the validation procedures followed in WP3. Issues arising from both reports have been incorporated within the validation report outline, directing the validation led by each of the five participating ministries of education to collect appropriate data relating to issues of concern through the POETiC framework. In addition, the four THINK scenarios have been used to analyse the educational contexts of the countries, regions and schools participating in the validation and also where the School of Tomorrow projects fit in relation to future scenarios.

2.1 The THINK scenarios

The four THINK scenarios envisage the role of ICT within education systems taking the following forms:

Scenario 1: ICT strengthens the centralised regulation of schooling
Scenario 2: ICT supports the creation of schools as ‘learning organisations’
Scenario 3: ICT supports the emergence of schools as core nodes in their communities
Scenario 4: ICT fails to deliver: Technology melts down

All the scenarios share the assumption that schools should be held accountable for:

- Providing universally high levels of achievement in core skills
- Achieving greater levels of competence in ‘work place attitudes and skills’
• The development of school leavers with the attitudes, motivation and skills needed to equip them for a life of self-managed learning

The ways in which they set about meeting these demands, however, differ substantially.

The first scenario is based on the central tenet that ICT strengthens the centralised regulation of schooling. Policies are centralised, accountability is prioritised, there is limited flexibility in the delivery of national curricula and ICT is perceived to be a primary vehicle for supporting schools in the realisation of educational objectives. ICT is believed to have a supporting role in assessment and to facilitate delivery of curriculum content. Teachers will need to become ICT literate, develop new pedagogical approaches and raise standards. Due to the rigidity and individualised nature of national curricula provision of educational ICT products and services need to provided largely through the domestic market. Innovation in this scenario centres on achieving existing educational goals more effectively and efficiently through changes in pedagogical practices.

The second scenario encompasses the belief that ICT supports the creation of schools as learning organisations that participate in generating, evaluating and sharing knowledge about the learning process. Policies, whilst still driven centrally, support innovation and flexibility within schools. Citizenship and equipping learners with 21st century skills are of primary importance (as they are within the other three scenarios). It is perceived that investment in ICT will be a catalyst for change and stimulate educational innovation. It is acknowledged that current practices need to change to meet the needs of the learner and the society of tomorrow. Equity in schools is deemed to be of extreme importance. Whilst traditional means of assessment are still important, it is acknowledged that there is a need to develop new additional approaches and much of the responsibility for this is devolved to the schools themselves. ICT can help students to learn efficiently and effectively whilst providing autonomy and being motivational. It can be used to provide more authentic, dynamic, challenging and potentially interesting ways of gaining access to sources of information, models and simulations for the learner. ICT also provides access to experts in the field and up-to-date and relevant information via the Internet. Finally, it supports collaborative learning and communication between groups, both locally and remotely. There will be a greater demand on teachers to develop ICT pedagogy and integrate its use within their own practice. Parents, the community and public will need to place considerable levels of trust and support in the autonomy devolved to schools and the shift from central control. There will be a need for tools and resources that can be tailored to support individual needs as schools have differentiated requirements.

The third scenario is the most radical and relates to a decentralisation of curriculum and assessment methods. The primary objectives for schools are to facilitate autonomous learning and to develop ‘competent citizens.’ ICT is imperative in this scenario for networking to gather information and advice to inform local developments, for collaborations with the tertiary sector and to consult with the local community. Flexibility is key and learning becomes centred on in-depth realistic problem solving activities that take place over extended periods. Students, as well as teachers, have a degree of ownership and can make a contribution to the curriculum and assessment development. Learners are re-conceptualised as an asset and a local resource that can be recruited to undertake problem-based activities of concern and benefit to the community and beyond. Teachers need to reduce the formal curriculum to allow space for the investigative learning activities that will be conducted. ICT is central and all teachers are required to be competent and confident users as well as being able to embed ICT within pedagogical practice and develop collaborative working practices with colleagues.
and others. Consultation with parents and community members is vital. Their contribution to the development of local educational practices is greatly valued and utilised where possible.

The fourth scenario is that of ICT failing to deliver, leading to a technology meltdown. This may happen if:

- Policy formulation and its realisation is too slow, inhibiting the radical reform demanded by the integration of ICT within education systems
- There is no perceived or measurable impact of ICT on achievement
- The changes in teachers’ practice required for the effective use of ICT in the classroom take much longer than anticipated to bed in by policy makers and the public
- There is a widening of the gap between those that achieve their full potential and those that do not because formal support for learners who find it hardest to learn in the ICT rich school of tomorrow will be less robust than was the case in yesterday’s school
- The true cost of ICT implementation, support, maintenance and training for sustained use is far greater than anticipated and exceeds ‘society’s willingness to pay’

2.2 Other issues arising from the THINK study

In addition, the six countries that participated in the THINK project raised a number of specific issues. These were:

- Concern about the influence of major national players in the ICT resource market (such as the USA) upon national values
- The value of ICT in promoting European language use internationally
- Problems in creating and maintaining digital literacy for all
- The central importance of teacher development
- Complexities in creating and/or accessing valuable educational resources
- The need to rethink the role of the teacher
- The need to rethink what is worth knowing, and therefore what the curriculum should cover
- The importance of ensuring value for money and accountability
- The need to revise the assessment systems to take into account the currently unassessed skills and competencies that ICT use can develop
- The need to develop public-private partnerships in this area

One concern was the influences of major players in the ICT resources market (such as the USA) on national values, social cohesion and social inclusion. Some European countries such as Denmark, Sweden and the Netherlands have a longstanding tradition of well-documented achievement in multilingual competence amongst their citizens, and the level of national competence in English as a second language is high. The Internet and other ICT resources offer opportunities for young people to develop second language skills even before they start formal schooling. The impact of ICT in such national contexts serves to provide new and more motivating routes to support the development of linguistic competence, to an enhanced sense of citizenship and to a more active participation in critical thinking about alternative World views. Other European countries such as France have not as yet attributed such importance to second language learning. Thus, whilst for each of the countries ICT opens up new opportunities and challenges from educational globalisation these differ fundamentally from country to country.
From a different perspective, some European countries such as France and Portugal highlighted the important contribution that they could make by providing ICT resources in mother-tongue languages for other countries worldwide. Furthermore, any exploitable non-domestic ICT products and services would need to be tailored at a national level to reflect the values of their own educational systems.

The next concern related to digital literacy and digital fluency (being able to use ICT effectively to support learning by understanding when, why and how ICT is relevant and useful). The requirement for ICT competency and skills will change over time as technological innovations and developments continue. In addition, those learners who are not able to identify when and how to use ICT to support their learning are perceived to be seriously disadvantaged.

Teachers’ professional development is seen to be crucial. The identification of the knowledge, skills and competencies of the teacher that need to be raised and inculcated into the school system is a key requirement in realising the potential of ICT for the future of education. Adequate levels of training provision are required including guidance on innovative pedagogical approaches with ICT, steering teachers away from the use of technology to support existing traditional practices. The potential benefits of online networking both nationally and internationally are also highly valued as are those of online provision and other innovative uses of ICT in in-service training.

Issues relating to the current range of ICT tools available to educationalists and learners were also highlighted. The Internet does not have guides or signposts to high quality educational resources. The creation of such resources was problematic due to the complexity of copyright laws. Whilst the availability of ‘digitally archived resources’ on the Internet is increasing, tool for accessing these materials are not always suitable for educational purposes. There may be a need for more collaboration between educationalists and technologists to ensure that provision meets the needs of learners. ICT has an enormous potential to help inform and support learners, parents and teachers in formative assessment, feedback, guidance, careers advice and in the creation of educational portfolios to carry forward beyond schooling.

Another issue is the changing role of the teacher, perhaps necessitating a rethink of their roles, contractual obligations and career structures. In some countries, more flexibility with regards to timetabling is already being introduced. ICT is not yet ‘mission critical’ and may demand increases in resources and support in the near future. Recruitment and retention may be negatively affected by ‘up-skilling’ teachers offering them greater choices for career changes.

A consensus to emerge from the interviews was that the nature of what is worth knowing to fit the learner for the future differs from that deemed appropriate in the past. Furthermore, the ways in which knowledge may be acquired, made manifest, and be used have changed and will continue to change in response to the impact of ICT. The curriculum needs a rethink in terms of what is required to skill up the workforce for the 21st century. In addition, assessment and examination systems need to be adjusted. Where decentralisation of decision making about the curriculum has already begun, some educationalists expressed concern about inconsistencies and the potential impact on students changing schools. Additionally there are tensions between facilitating learner independence whilst ensuring ‘equity and equality of educational opportunity’.

Another issue raised in two of the six countries involved in THINK was that of accountability and value for money in the provision of ICT resources within the education system. Without an assessment system that focuses on the kinds of learning that can be achieved with ICT it will be
difficult to provide concrete evidence of the impact on attainment. Even in relation to the assessment of traditional knowledge and skills, it is quite possible that:

- The potential of ICT in this area has not been explored at the upper limit because the pedagogical expertise needed to derive its benefit has not yet been developed throughout the school system.
- Examinations and assessments are insensitive instruments with which to try to evaluate what learners have achieved in ‘traditional’ areas.
- ICT impacts on a range of knowledge, skills, competencies and attitudes that we have never developed the tools or infrastructure to assess.

A final issue relates to the perceived need to develop public-private partnerships for ICT content and services provision. Some countries with centrally controlled educational policies already have in place centralised procurement and approval mechanisms for such resources. Other countries have noted that whilst control has been devolved to schools there is a need for central management of ICT content and services.

A major theme within the THINK report is the need to face what are often shared perceptions of the problems, but within the context of very different distributions of control and influence between national, local and school levels from country to country. Here the role of cities and regions is a key one, both in planning and supporting innovations, wherever they originate.

The NOW studies start from a number of assumptions about what kinds of benefits ICT can provide, but also from views on the pedagogical and organisational requirements that need to be met to achieve these. Overall, the four studies emphasise:

- Process learning aims
- Vocational purposes
- Active modes of thinking
- A perception of the student as an individual learner or a member of a small group
- Changes in the educational roles of students, teachers, parents and (to a lesser extent) businesses
- Vertical integration of schools and the regional and national education system
- Horizontal integration of schools into their local communities

The last two requirements pick up key dimensions represented in THINK Scenarios 1 and 3 respectively. Scenario 2 elements are also present. However none of the NOW studies is a clear-cut embodiment of one or another of the scenarios. One of the Barcelona initiatives (Castells and Dènia, 2002), for example, illustrates how in practice priorities from different scenarios are being combined in regional curriculum initiatives. In describing the implementation of an educational portal in Barcelona, Edu365, they refer to objectives that might serve Scenario 1 such as reinforcing curriculum areas in conjunction with design principles of promoting self-access and learner autonomy which are more readily aligned to Scenario 2.

Nevertheless the studies do provide concrete exemplifications of elements from the various scenarios (see D1.1, revised July 2004, for more discussion of this).
2.3 Implications of NOW and THINK for Schools of Tomorrow projects

- ICT can be used to help prepare students to be good and competent citizens, armed with the knowledge, skills and competencies required for life which will be evolutionary rather than static. What contribution do Schools of Tomorrow Projects make to this? Can this contribution be developed further and if so how?

- In a market place that has been dominated by ICT originating from the USA, there are major issues for consideration relating to language use. In some countries the level of national competence in English as a second language is high and ICT offers opportunities to extend and develop these linguistic skills. In other countries, there is a greater need either for ICT services that are designed to support (one or more) specific mother-tongue European languages or for those that are easily transferred or configured. The more flexible such systems are, the wider the potential audience will be. How flexible in terms of linguistic demands are the Schools of Tomorrow Projects? Can this flexibility be improved either immediately or in the future and what additional resources would be required?

- Digital literacy is commonly acknowledged to be an essential life-long skill. This includes the ability to understand when, why and how ICT is relevant and useful to the demands of particular contexts and situations. The needs of learners who are not motivated by ICT should also be considered to ensure that this minority of the population is not disadvantaged. What levels of support for schools, teachers and students need to be in place in order for Schools of Tomorrow projects to maximise the impact on digital literacy? Are there ways of supporting less ICT-motivated learners? Do projects address the needs of disadvantaged groups?

- ICT can be perceived as a tool to improve efficiency. Alternatively it can be used as a catalyst for change. What kinds of tools are provided within the Schools of Tomorrow projects? Can they be presented as catalysts for change? What are the benefits for schools, teachers, students and parents? Do the projects improve 'learning efficiency'?

- Crucial to the effective integration of ICT in any education system is the development and support offered to teachers. What are the minimum levels of support that teachers will require when integrating Schools of Tomorrow projects into their daily practices? What, if any, new skills will be required? What support will teachers need with regards to pedagogies and when it is appropriate to incorporate ICT? What additional support will be required to ensure take-up is widespread and not limited to those teachers who are early adopters or innovators? Can the Schools of Tomorrow projects support teachers' professional development in other ways such as providing professional online communities? To what extent will face to face support structures be required? How can the projects be used to stimulate cultural changes within individual schools, cities, regions, nationally and internationally? What educational traditions can be challenged and what is the best way to approach this?

- ICT provides opportunities for teachers, students, parents and others to access resources and communicate with others beyond the confines of the school wall and the school day. In what ways can the Schools of Tomorrow projects be used to support ambient learning? What support structures need to be in place to maximise these opportunities and facilitate such access? In what ways to the projects facilitate communication with other schools (locally,
regionally, nationally, internationally)? How do they promote increased membership of such networks? What measures are taken to increase levels of use among members?

- The development of many ICT systems has been driven by the needs of industry and subsequently adapted for education, often without real consideration of the needs of educators and learners. In what ways can the Schools of Tomorrow projects meet such needs? Can this be developed in any way either now or in the future? How and when are learning processes supported? To what extent are the users (teachers, students and/or parents) consulted?

- Online resources are increasing rapidly. There is a need to develop robust and functionally rich tools specifically designed for educational purposes to access digitally archived materials. Teachers are experts in pedagogies and this should be utilised in the creation of resources. To what extent do Schools of Tomorrow projects address these issues? Can further developments be made?

- ICT has an enormous potential to help to inform and support learners, parents and teachers in formative assessment, feedback, guidance, careers advice and in the creation of educational portfolios to carry forward beyond schooling. This potential, and such issues, will probably emerge as critical questions for the design and use of ICT networks within the next few years. In what ways do the Schools of Tomorrow projects support this? Can they be developed to provide more appropriate levels of support? Will they require different approaches to internal management?

- When ICT becomes "mission critical" it will place demands on resourcing in schools and the support required by teachers. What demands will the Schools of Tomorrow projects place on school resourcing in order for the potential impact of implementation to be maximised? What infrastructure needs to be in place?

- ICT can offer opportunities for a more individualised approach to learning. To what extent do the Schools of Tomorrow projects offer such opportunities? Can these be developed further?

- Similarly, ICT can offer opportunities for active learning and collaboration. To what extent do the Schools of Tomorrow projects offer such opportunities? Can these be developed further?

- The issue of value for money from ICT cannot be disassociated from fundamental political questions about what a nation considers to be worth knowing. To what extent do the Schools of Tomorrow projects offer value for money? What about scalability issues? What about sustainability issues? How would cross-European use of such services and products affect value for money? Internationally, value for money may be assessed in different ways. How flexible are the Schools of Tomorrow projects in this regard?

- ICT literacy involves not only technical skills but an understanding about how technology impacts on the process of communication and learning. To what extent do Schools of Tomorrow projects address this for teachers, students and/or parents? Is it appropriate to develop this aspect within the projects?
• ICT has the potential to transform knowledge in traditional curriculum areas. To what extent do the Schools of Tomorrow projects support this? What new opportunities are offered and how can they be assessed?
3. Innovation and the School of Tomorrow projects

The main objective of the School of Tomorrow action line is to improve the quality and accessibility of learning at primary and secondary school level through embedding information and communication technologies, in particular addressing knowledge and skills required by future citizens of the Information Society. The School of Tomorrow projects have the potential to lead to change in teaching and learning in European educational institutions through:

- Developing new ways to develop knowledge and skills
- Promoting
  - Autonomy
  - Creativity
  - Problem solving
  - Team work
- Using the latest technologies
- Supporting learning, anytime and anywhere
- Using ICT to link schools, educational institutions, and homes, locally, regionally, nationally and internationally
- Networking learners, teachers, educational researchers, subject experts, community members and parents

Common themes linking the 11 projects together include:
- The use of innovative technologies designed for education such as online services, tools and resources
- The development of innovative teaching and learning practices
- Building in a European perspective by facilitating multilingual and multicultural exchanges
- An emphasis on the involvement of teachers and learners in project and resource development

In addition, some specific themes are represented:
- Supporting the science curriculum through for example modelling and experimenting
- Facilitating learning beyond the curriculum
- Linking learners across borders and cultures
- Providing a range of tools designed to work with existing ICT tools/resources or be tailored to meet individual needs
- Providing authoring tools to support content creation
- Incorporating 3D technologies and avatars
- Developing cost-effective solutions and commercial models, designed for scalability and sustainability

The innovations should lead to changes in where and when learning takes place, who the learners and teachers are, and how learning takes place, making it active, visual, and autonomous. In addition, some of the innovative projects are underpinned by contemporary pedagogical approaches such as constructing knowledge, problem solving and collaboration.

The school of the future should support **ambient learning**. That is, learning that takes place any time and any where, facilitated through technology, but rooted in schooling as an institution of society. Thus is it not simply concerned with ubiquitous learning but also provides support emanating from school organisations such as provision of learning resources, and access to teachers, experts, mentors
and co-students through networked learning communities. This shift in the way that education is delivered and supported will demand new models of learning, new mobile technological tools, and innovative ICT resources to facilitate communication, interaction and management of learning resources. ValNet will seek to investigate to what extent School of Tomorrow projects can facilitate ambient learning and what can be learned from the outcomes in relation to the development of new models of learning. The challenges are:

- How to use resources effectively
- To identify new ways of knowledge building
- How collaborative learning in a virtual world can be supported
4. Introduction to the five School of Tomorrow projects included in the validation

In February 2003, the five leading ministries (from the UK, Portugal, Italy, Flanders and Iceland) and representatives from the ENIS schools in a range of countries were introduced to the School of Tomorrow projects through workshop sessions at the ENIS workshop, EUN School Networks Conference.

4.1 The Fifth Dimension, 5D (IST-2000-25435)

Description of project. The Fifth Dimension (5D) is largely a theory on learning and teaching. It requires the development of an environment of learning, research and play. Collaborative and reflective learning is characteristic together with the use of a wide variety of tools and the mix of participants (intergenerational and inter-institutional). Collaboration is organised between different school institutions and school levels. Children, as well as undergraduates, researchers and teachers, have opportunities to find out new ways of teaching and learning. 5D initiatives tended to involve students or members of the community acting as coaches or teaching assistants engaged in collaborative problem solving tasks. ICT is a medium that facilitates new ways of interaction, communication and problem solving.

5D, extended until July 2004, has produced a portal designed to support the development of communities engaged in 5D projects across Europe, developed a start-up toolkit for teachers and produced two ICT tools for structuring collaborative learning activities: LAByrinth and LABuilder. The project has involved commercially available software, most notably Active World which facilitates collaborative problem solving in a 3D virtual environment; a subscription fee is required for full-functionality. Non-ICT tools include the use of a physical ‘labyrinth’ (Figure 1) – a structure with a number of rooms, each containing a task card with a different activity with three levels of difficulty.

![Figure 1: Labyrinth of a number of 'rooms' each with a task card explaining how to undertake an activity](image)

5D is a pedagogical and not primarily technical oriented project, although it is intended that all activities use ICT. It is stimulating the creation of rich learning environments with a large learning power for all participants and effects on the group of learners/teachers/coaches within the school and
the community outside the school. The use of ICT was evident, but it only has the place of an artefact and a tool in a new defined learning context.

The goals were:

- To understand, explain, and describe processes of learning and development. This objective, described as ‘scientific’ was clearly designed to contribute to knowledge rather than provide new processes/tools that could be used within schools. Therefore this outcome is not addressed in the validation.
- To develop inter-institutional and intergenerational learning communities, including the development of ‘new’ European 5D sites.
- To develop ICT artefacts to support collaborative learning, including a web-based community site to support users engaged in 5D projects and a virtual maze/task card application (based on physical approaches undertaken in the original 5D project which started in California over 15 years ago).
- To develop a start-up toolkit for teachers and others wishing to implement 5D in their institution.

Outline of validation. The lead validator/coordinator was Fernand Mesdom, under the direction of Jan de Craemer, representing the Flemish Ministry of Education. In Israel the validation was undertaken Ayala Avni, and coordinated by Dov Winer and Ronit Ashkenazy (Makash). In Sweden the validation was undertaken by Martin Tallvid and Ylva Bergstedt, and coordinated by Angela Andersson. In The Netherlands the validation was undertaken by Max Kruitwagen and Margriet Jansen, and coordinated by Wim Didderen.

This validation began in November 2002 following a study visit to Sweden by 10 Flemish schools. This first cohort of teachers developed a series of projects in their schools that were undertaken in the academic year 2002-03. In September 2003, schools in the partner countries, Israel, Sweden and The Netherlands, joined the validation as well as 12 additional schools from Flanders. The validation report (D3.2) gives an account of activities undertaken. A total of 49 schools participated (Table 3), including 22 from Flanders where the implementation was perceived to offer benefits for learners and soon spread to other schools. This included nearly 4000 students (3908) and just over 300 teachers (302) in addition to 85 members of the community including parents, experts, teacher training students, adult education students, families and elderly people (Table 4).

<table>
<thead>
<tr>
<th>School</th>
<th>Elementary School</th>
<th>Secondary School</th>
<th>Elementary to Secondary School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanders</td>
<td>9</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Israel</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Sweden</td>
<td>0</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3: Schools participating in the 5D validation

<table>
<thead>
<tr>
<th>Countries</th>
<th>Teachers</th>
<th>Students</th>
<th>Community*</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanders</td>
<td>132</td>
<td>2145</td>
<td>66</td>
<td>2343</td>
</tr>
<tr>
<td>Israel</td>
<td>100</td>
<td>957</td>
<td>15</td>
<td>1072</td>
</tr>
<tr>
<td>Sweden</td>
<td>63</td>
<td>736</td>
<td>1</td>
<td>800</td>
</tr>
</tbody>
</table>
In the validation ENIS teachers had two challenges:

(1) To develop learning activities and artefacts to fit with national curriculum requirements, for use in real school settings.

(2) To become researchers of their own innovation, formulating at least one hypothesis, and undertaking action research.

The validation team provided support through a carefully planned introduction to the 5D project:

- a theoretical explanation and handouts
- showcasing work generated by the first cohort of teachers in Flanders demonstrating the potential and possibilities
- encouraging teachers to adapt 5D to address localised issues and challenges ensuring that the project was purposeful
- and providing guidance on action research.

In addition, the lead validator encouraged schools to share their experiences through face-to-face meetings and online communities. The validation tools included questionnaires and interview schedules. These included a selection of questions taken from the validation framework which were adapted and translated as necessary. Teachers were not compensated financially for the time they devoted to developing the projects but they did receive expenses for attending meetings and training events. 5D was not perceived by participants to be time-consuming or placing too many additional demands upon teachers time. But it was noted that financial rewards for teachers’ time might ensure that the project would be sustained in the future.

Examples of implementations.

In a primary school in Flanders, students aged 11-12 years old developed interactive exercises to support the topic ‘waste’ using Hot Potatoes. These students then coached younger ones when they attempted the exercises. The goals of the project were to see whether the coaches would be able to summarize and identify key words in texts, develop their ICT skills, and learn how to develop learning environments and how to coach younger students. In addition, an anticipated outcome was that the younger students would learn about waste management through the online tasks.

A Flemish secondary school, students aged 15 coached adult learners (Figure 2, Figure 3) – the adult learning unit was located within the school - in the use of a virtual learning environment (Claroline) and e-mail (hotmail). The aims were to identify whether such approach would help adult learners to learn how to use technology, make more use of ICT at home particularly their assignments. An additional area of interest was the affect of such a project on the students in terms of developing both ICT skills and pedagogical skills, and in turn the impact of this on their confidence and self-esteem. The ICT resources were free; there were no additional costs. The project was easy to integrate
with the curriculum because students (as well as the adult learners) learnt how to use the virtual learning environment and e-mail. The students were highly motivated, with one firmly stating that he wished to become a teacher as a result of the experience. The outcomes of the project were disseminated widely within the school, to the local community, nationally and internationally.

Figure 2: 15-year old student demonstrates the virtual learning environment to adult learners
In a compulsory comprehensive school in Sweden 6 special needs students with Asperger’s Syndrome were connected to an external teacher via a virtual platform. The project investigated whether ICT could be used to provide external mentorship in order to improve special needs students’ learning. Additional interests included the amount of time required for mentors to tutor students in special projects and what kinds of ICT were appropriate for such use. One student and one mentor were involved and used First Class as the conferencing system. The student involved enjoyed the autonomy and attention: “Every day it’s exciting to see if the mentor has written something for me, for me only.” The mentor and classroom teacher perceived that there had been a positive impact on the student’s learning. This project continued beyond the end of the validation period.

In one primary school in Israel, 6th grade students (aged 11-12 years) helped 1st and 2nd year Ethiopian students to create PowerPoint presentations about Ethiopian culture (Figure 4, Figure 5). The research questions included the impact of the project on the social status of the Ethiopian students, whether the 6th grade students learned about Ethiopian culture and whether the project helped the Ethiopian students to develop their ICT skills. Although difficult at first, the Ethiopian students became more open-minded and “showed cultural pride”; they also developed relationships with the older students. In
addition, they developed valuable ICT skills. The class teacher noted a change in the
teacher-student relationship, the teacher becoming more of a guide and a counsellor. The
student-coaches developed a sense of pride in their achievements as well as an
understanding of Ethiopian culture. It was perceived by the classroom teacher that
learning was achieved in a “positive and nurturing way.” The project was implemented
outside normal classroom hours which placed additional demands on the teacher’s time.
The cultural impact was incredibly important: “The project contributed to developing ties
between the students and the different groups in the community, the children developed
greater tolerance for others, the spirit of contributing and giving to others, familiarization
with the leaders of a different culture.”

Figure 4: Israeli student demonstrates PowerPoint to Ethiopian student
In The Netherlands students aged 11-12 years old coached younger students who were learning to read, preparing reading activities for 30 minutes each week including computer-based resources and assessing progress. The aim was to see whether this approach would be beneficial and free up teachers’ time. The student coaches liked the responsibility.

4.2 Innovative Teaching and Learning Environments for Schools, ITALES (IST-2000-26356)

Description of project. The overall objective of ITALES was to develop a European-wide virtual teaching and learning community whose key aims are the promotion of pedagogic content sharing and re-use, exchange of opinions and innovation and the provision of both pedagogic and pastoral support for learners. These tools are intended to support teaching and learning for younger students (target age range 7 to 13 years old).

The aims and objectives were:

- Develop a set of authoring tools that would enable teachers to prepare digital content for personalised learning.
- Develop new content management tools that could be used by teachers to plan and build their own online courses.
- Develop a library of databases to allow content sharing and re-use as well as teacher configuration of the 3D virtual learning environment in terms of its visual appearance and the tools and content accessible by the learners.
- Develop a web-based 3D virtual system for learning and teaching.

Outline of validation. The validation was led by Jón Torfi Jónasson in Iceland, supported by Andrea Gerdur Dofradóttir, who were directed by the lead co-ordinator Harpa Hreinsdóttir, representing the Icelandic ministry of education. The national coordinators were Wim Didderen (The Netherlands), Julijana Juricic (Slovenia) and Angela Andersson (Sweden). In this validation, national validation reports were not produced and the data were collected locally or via networked technologies where appropriate, and analysed centrally.

The validation was undertaken with prototypes of four of the proposed tools as the ITALES project was still underway. The tools available were:
ITALCO – a novel kind of authoring tool for teachers allowing them to create learning scenarios (quests) with ‘edutainment’ features and assessment activities.

ITALES-3D – the 3D e-community environment creating a learning environment based on a representation of a virtual school using avatars to represent physical presence. Communication tools included avatar gestures, multi-user chat, message boards, newspapers and voting tools. This environment was customisable by teachers such that they could enable/disable tools and features, set a default language and delete or move objects. The three languages supported were English, Italian and Spanish.

ATENA – an authoring tool to construct exercises and tests.

MCAT – a metadata and course assembly tool enabling teachers to assemble courses for their students, describe individual elements using metadata to facilitate re-use, and access a digital repository of other learning objects.

The teachers largely focused on the ITALCO product to create their own material. About half the teachers had an initial look at ITALES-3D environment but the 3D server was very slow and the schools’ firewalls limited its use. About a quarter of the teachers looked at ATENA and four teachers tried MCAT.

The ITALCO product did suffer from a number of technical issues due to the fact that it was not fully developed at the time of the validation. However, the ITALES project team provided an online forum for participating teachers and promptly responded to queries and issues. There was close collaboration between those validating the project and project team members which had a positive impact but perhaps this form of collaboration would not feasible on a larger scale.

Teachers from four countries (Table 5) were involved in the validation from August 2003 to March 2004. The teachers that participated from Iceland, Slovenia and the Netherlands (which did not have an active ENIS network) were hand-selected enthusiasts from schools where leaders welcomed and supported innovative projects. About 30 of the 39 participating schools were already engaged in other computer related projects. These were largely primary schools as the software tools were intended for younger children. In addition cultural differences in education systems exist which make the categorisation of schools into elementary and secondary challenging. For example, in Iceland secondary education covers the age group 16 to 20 years. The teachers largely had positive attitudes to using computers in education and the majority felt that computers should be used to a greater extent than currently. Each teacher, in each of the four countries, received some money for their participation, although this did not always reflect the amount of time invested. The national validations received additional funding from national sources for travel costs, meetings and training events. In Slovenia, arrangement for technical support was formalised. Not all teachers completed the development of a scenario. The validation report fully describes the activities that were undertaken (D3.2).

<table>
<thead>
<tr>
<th>Country</th>
<th>Elementary Schools</th>
<th>Secondary Schools</th>
<th>Elementary to Secondary Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland</td>
<td>7</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Slovenia</td>
<td>10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sweden</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>7</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5: Schools participating in the ITALES validation
Table 6: Teachers who participated in the ITALES validation

Examples of implementations.

Two Icelandic teachers created a scenario called ‘Little Red Riding Hood’ to support teaching English as a foreign language to beginners. Every ITALCO scenario is based on a quest, based on some kind of a map where the user has to travel between places (in this case the wood) (Figure 6). In order to do so the user has to earn travel-units (in this case flowers). Travel units are earned by solving a test (multiple choice, fill-in gaps etc.). Usually the quest has to be solved within a certain time limit. Below are examples of the map (a small red flag shows where to go and the user travels between places in a pre-decided order), the learning material and the question to answer (to earn flowers) (Figure 7).
In Slovenia, one teacher created a scenario to support the teaching of physics (Figure 8). This was used to teach principles of potential energy, kinetic energy, centripetal and gravitational forces, through a scenario based in a theme park, where the student visits the amusement from a physical point of view, discovering how the energy changes its form. In this example, the ‘map’ shows the curve of the ride. At different points on the map the student is presented with a screen. On different screens the user reads about different types of energy and earns travel units (in this case Anti-joules), by correctly answering the multiple choice questions relating to the changes in energy at the particular point in the rollercoaster ride. The journal ends when the student reaches the top of the second slope. If the student completes all questions correctly, within the time limit, they are rewarded with the opportunity to visit a Slovenian website connected with Physics that contains online games.
In the Netherlands, one teacher created a learning scenario relating to the solar system to support teaching in science with a ‘map’ showing the relative position of the planets (Figure 9). Here the travel-units are space miles. This project was set up as a trip through the Solar system, starting at the Earth and moving next to Mars. To "fuel" the trip the user needs to earn space miles. Each screen has information on the planet the user has reached (Figure 10) and by answering a short multiple-choice test about that planet enough space miles can be earned to move to the next planet.
4.3 Innovative Technology for Collaborative Learning and Knowledge Building, ITCOLE (IST-2000-26249)

Description of project. The main goals of ITCOLE were to:

- Develop pedagogical models of collaborative knowledge building for European education
- Develop a modular knowledge-building environment
- Evaluate, test and disseminate the environment in European schools in order to build meaningful pedagogical practices and to advance the use of collaborative learning technology
- Provide an online environment to support the use of collaborative knowledge building approaches in schools and Open Source software

The learning environments produced to support collaborative learning and knowledge building were designed to:

- Promote pedagogical change
- Support the progressive inquiry model
- Support collaboration between students
- Facilitate community building

This project was evaluated widely internally by the ITCOLE project team prior to the validation, and involved 20 primary and secondary schools from five European countries. The project developed:

- Two learning environments. These environments provide software tools and facilitate the use of pedagogical models, based on the Progressive Inquiry Model, to support the development of shared knowledge (Lakkala, Rahikainen and Hakkarainen, 2001).
  - Synergia, based on BSCW, which has communication tools, content management tools, plus shared workspaces (e.g. shared whiteboards) and document sharing facilities. In addition it has scaffolds to support types of ‘thinking’ including: theory, question and summary.
  - Fle3, is an open source alternative, which has the same range of tools and support for structuring knowledge building, and additionally a tool for prototyping.
- Integrated technical and pedagogical user manuals for both Fle3 and Synergia.
- A website to support computer supported collaborative learning across Europe, with a bank of ideas representing best practice and guidelines for scaling up pedagogical practices.
- A teacher training module.

The validation has focused on Fle3 only. This offers knowledge building areas with ‘thinking types’. These are labels such as ‘problem’, ‘my answer’ or ‘summary’. The underlying concept is that by labelling individual contributions higher order thinking will be invoked.

The project was completed in the spring of 2003, prior to the start of the ValNet validation. Therefore teachers participating in the validation were asked to use tools and pedagogical models that were complete and had already been thoroughly tested, together with clear documentation and supporting guidance.

Outline of the validation. The validation was led by Candido Varela de Freitus from Portugal, under the direction of José António Palma, representing the Portuguese ministry of Education. The national validators were Marie Munk (Denmark), Julia Mag and Attila Fozo (Hungary), and Wim Didderen (The Netherlands). A total of 31 schools were involved across three of the four countries, of which about half were elementary schools and the remaining half were secondary or professional schools (Table 7). Over 700 students participated, together with 84 teachers and at least 34 members of the community (Table 8). The validation focussed on one of the two learning environments, Fle3. This was described by the Danish validator to be a ‘technically modest but pedagogically new thinking knowledge-building programme’.

<table>
<thead>
<tr>
<th>Country</th>
<th>Elementary</th>
<th>Secondary</th>
<th>Technical/vocational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hungary</td>
<td>2</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Portugal</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7: Schools participating in the ITCOLE validation

<table>
<thead>
<tr>
<th>Countries</th>
<th>Teachers</th>
<th>Students</th>
<th>Community*</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>20</td>
<td>299</td>
<td>?</td>
<td>319</td>
</tr>
<tr>
<td>Hungary</td>
<td>34</td>
<td>128</td>
<td>?</td>
<td>162</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>11**</td>
<td>-</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Portugal</td>
<td>19</td>
<td>311</td>
<td>34</td>
<td>364</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>84</strong></td>
<td><strong>738</strong></td>
<td><strong>34</strong></td>
<td><strong>856</strong></td>
</tr>
</tbody>
</table>

Table 8: Number of participants in the ITCOLE validation

* Including families
** These teachers were not involved in the process development; they participated in a workshop with Wim Didderen discussing the Fle3 environment and pointing out its advantages and disadvantages.
The validation in The Netherlands was undertaken very differently due partly to a much later start. A group of adults were asked to try out the environment and evaluate it in terms of how useful it might be in educational settings. Those involved included 3 teacher educators, 2 trainee teachers, 4 classroom teachers representing elementary and secondary education equally, and 2 members of staff from an educational service.

There were sharp contrasts between these four countries. Schools in Denmark at the time of the validation were reported to be well-resourced and in the words of the national validator ‘have related to modern IT-technology in an outreaching and conscious manner for a number of years’. In Hungary, computers were not in regular use to support areas of the curriculum other than for IT skills; computers were located in labs and mobile technologies were not in general use. In Portugal the schools selected to participate in the validation were well-equipped in relation to others nationally. Some schools had chosen to locate computers in a lab and others had opted to locate them within classrooms. The infrastructure was in place, although there was scope to increase computer-to-student ratios, but use in schools was mixed. The teachers who participated were all enthusiastic users of technologies and generally technically competent.

All teachers in Denmark, Hungary and Portugal attended orientation training events that were essentially one day hands-on workshops. The validation in The Netherlands took place in April and May 2004. It was introduced through a two day hands-on workshop at which 6 educationalists participated face-to-face and 4 educationalists participated virtually through the Fle3 environment. Teachers in Hungary and Portugal adopted a common theme. Teachers were supported during their project work through websites designed to support ITCOLE and direct help from the validation coordinators via email, telephone or face-to-face contact.

The activities undertaken as part of the validation are described fully in the report (D3.2). The participating teachers explained to their students how to use the Fle3 environment and setting some initial questions/problems to address. Students could also identify their own topics. Progressive Inquiry Methods follow five stages: problem identification, student explanation, scientific explanation, evaluation and summary. Unsurprisingly, most students did not reach the final stages either because of time constraints or because of their age. All tasks were set as group activities although one Danish school introduced the project as individual rather than collaborative task.

**Examples of implementations.**

Schools in Portugal set the initial overall topic to be ‘water’. Teachers began the process by explaining to students how to use the Fle3 environment and setting some initial questions/problems to address. The students themselves also generated further questions/problems. Figure 11 shows some of the 72 contributions made by students in response to the problem ‘What are the causes of pollution in rivers?’ These are examples of student explanations where they try to answer the question/solve the problem before conducting some research to find the scientific explanation. Other topics included: pollution in the sea, water shortage, tourist opportunities in relation to the Caia dam, the water cycle, and mini-hydroelectric plants. A total of 490 contributions were made by the students in Portugal.
Schools in Hungary also set the main theme of the project to be ‘water’. The project involved students researching the watercourse in the local neighbourhood. The students carried out chemical examinations, measuring the pH, the water hardness, the nitrate/nitrite/phosphate concentrations. The students were also required to do some research on the Internet, some of whom had never experienced this kind of activity before. The main task was to conduct scientific studies on the watercourses or lakes in their local community and to publish the results in several languages (Figure 12).
In Denmark Fle3 was used largely in cross-curricular projects covering subjects such as physics, Danish, social studies, geography, biology, natural science, technology, Business studies and History. The specific topics were wide-ranging from the visionary and barrier-breaking projects (a visit to Mars) to the more traditional ones concerning the history of Egypt or the descriptions of animals.

**4.4 Lab of Tomorrow, LoT (IST-2000-25076)**

*Description of project.* The LoT project was a very rich and complex project and although the focus was very much on technical and pedagogical innovation, the reflection stimulated by it concerned a much wider area and touched upon several different aspects that were very relevant to the current debate on the teaching of sciences and to the future of schools, education and learning in general and to the role of students and teachers in the learning process. The underpinning theories related to constructionism and inquiry based learning. It was intended that students would be involved with modelling, hypothesising and evaluation. In addition, it was intended that students and teachers would design their own experiments and opportunities for measurement.

The original goals were:

- Development of a pedagogical framework that will allow successful application of the emerging technology in everyday learning. The goal is to shift away from classroom learning to day-long learning and to use the axions to facilitate that shift.
• Enhancement of a constructionist approach in science teaching. The procedure of scientific inquiry is fully simulated and will allow for a deeper understanding of science concepts.
• Development of new educational tools and learning environments. The developed axions, and a user interface will be developed to be adding tools that will bridge science teaching and technology.
• Equal and parallel development of pedagogical and technological innovations. The aim is that the technological innovation is designed with educational targets and criteria. Students and teachers will come together with experts to re-engineer the lab of the school of tomorrow.
• Development of a concrete evaluation scheme of the educational and technological aspects. Evaluation aims to develop a better theoretical framework on how different types of tools and instruments support different types of thinking, reasoning and understanding.

First of all, the main technological research strand related to the ‘disappearing computer’: ordinary item sensors and other measuring instruments can be made smaller and smaller to disappear into clothes and other everyday objects; and on the pedagogical level what the project set out to investigate were the implications for teaching and learning of the availability of these intelligent objects and clothing, highlighting:
• the relationship of front-end technology in the teaching of sciences especially in the teaching of physics
• the nature of lab activities in school
• the role of the student in the learning process

Physics is a curricular subject which many students find difficult; it is hard for them to see the connection between the mathematical formulae they learn at school and the real world. In the traditional method employed in the teaching of physics, the practical lab activities are again an abstraction, a simplified model of reality; experiments can be reproduced and provide the same results each time. In LoT instead there was an attempt to break away from the traditional method and present to students the real world in all its complexity and in the project vision, the physics lab would no longer be a physical location in the school building.

The project proposed to develop a family of tiny, fully programmable computational devices, the axions that can be embedded in everyday objects and cloths and integrate them with existing resources. Proposed axions included the sensvest, ball, shoes (these were not developed in the end) objects, bracelets, bicycle that could receive information from sensors, communicate with one another and transmit the collected data to a base station. For example, students could use a ‘wearable instrument’ (one of the previous quoted) that analyses the relationship between a person’s heartbeat and their level of exertion throughout a day. These software educational tools could support teachers and students in the new learning environment and at the same time be compatible with graphics and analysis software components, so students could easily investigate trends and patterns in the data they might collect. Students would be able to graphically view all quantities under study and the data correlation through a scatter diagram on the computer screen. This specially developed interface would also be used for data download (i.e. transfer from the “axion” to the PC), analysis and presentation of data, in an organised educational way.

What was actually produced was a tri-axial accelerometer embedded in a ball and a number of modules relating to the sensvest containing bi-axial accelerometers. The sensvest enabled body, arm and leg acceleration to be monitored as well as body temperature and heart rate. A parallel video
stream could be gathered by two high-resolution cameras dedicated to the evaluation of the data source position. These could be connected to a client PC to form the local positioning sub system (LPS).

Outline of validation. The validation was directed by Donatella Nucci from Indire, Italy. The national validators were Wim Didderen from The Netherlands, John Anderson and Roy Downey from Northern Ireland, Elisabeth Zistler from Austria and Giuseppe Anichini from Italy.

The LoT project presented a challenge for those involved in the validation. Rather than projects that were largely conceptual or offered readily accessible software tools, LoT produced only four sets of physical objects which were also required by the LoT project team themselves for evaluation purposes. Therefore, it proved impossible for 40 ENIS schools to experiment with these objects in normal teaching activities with students for an extended period of time. The LoT project co-ordinator made arrangements for schools that were already involved in the LoT project user testing to also participate in the ValNet validation activities. The schools were located in Germany, Italy and Austria. Workshops were arranged within these schools for ENIS teachers from The Netherlands, Italy and Austria to attend. In addition, staff from Birmingham University, one of the LoT project partners, took equipment to a workshop held in Belfast for teachers from Northern Ireland.

The workshops were organised to provide a practical demonstration of the LoT tools and also to enable interviews with teachers, head teachers and LoT experts to be undertaken. Teachers were able to take the equipment into their own classrooms for short periods of time (usually one week) to try it out with the assistance of the LoT project team. The teachers were subsequently able to discuss details, practical aspects of using the equipment and students reactions. There was also a focus on the theoretical ideas and approach rather than the tools themselves, to which teachers had very limited access. This was facilitated by providing teachers with videos of experiments undertaken by LoT project schools, an implementation guide and research papers. The main validation tool was a questionnaire, grounded in the MENON framework, and adapted from the ITALES validation.

In Belfast 21 participants from schools and further education colleges attended the workshop. The workshop was characterised by informed and robust discussion around the possible use of equipment in schools and of the issues likely to arise with implementation. Comments were recorded during the event and also sent afterwards via email. Equipment was offered to one of the schools in Northern Ireland for a week long trial but it arrived late and opportunities to use the equipment were constrained further because of examinations. Teachers were unable to get the Sensvest to work but managed to use the Axion Ball with a few classes.

In Italy, there was a preliminary workshop with teachers in October 2003 followed by a two-day workshop in February 2004 which 14 ENIS teachers attended together with expert teachers who had worked on the LoT project and representatives of the LoT project team.

In Austria, two workshops were organised to which a widely representative group of teachers were invited. This included a school from the Czech Republic and two teachers from The Netherlands. The first workshop involved 5 teachers including those who were working with the LoT tools as part of the LoT project. There were a total of 25 teachers and 23 students involved in the validation activities.

In The Netherlands, innovative science teachers together with some student teachers and teacher trainers were involved in the validation activities. They visited a school in Dortmund, Germany in
order to participate in a workshop about the LoT tools. They were also able to take some tools back to The Netherlands to test further. Those involved in the validation were supported through extensive telephone and email communication with the expert teachers at the school in Dortmund.

<table>
<thead>
<tr>
<th>Country</th>
<th>Teachers</th>
<th>Students</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
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<td>Unknown</td>
<td>9</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>21</td>
<td>Unknown</td>
<td>3</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>20</td>
<td>Unknown</td>
<td>8</td>
</tr>
<tr>
<td>Austria</td>
<td>25</td>
<td>23</td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>72</strong></td>
<td><strong>23+</strong></td>
<td><strong>20+</strong></td>
</tr>
</tbody>
</table>

*Table 9: Schools participating in the Seed validation*

**Examples of Implementations.**

In Austria, teachers and students attended a three day workshop in March 2004. The Axion ball (Figure 13) and SensVest tools (for the wrist and waist) were demonstrated. These tools send data through wireless communication to a base station, linked to a workstation or laptop. Teachers and students had access to laptop computers which provided graphical representations of the data that was collected with each experiment as well as access to the data readings themselves. Examples of activities with the Axion ball included throwing it to each other, dropping the ball from a height (top of step ladder and top of stairwell), bouncing the ball down the stairs, throwing it up in the air and kicking it. Examples of activities with the SensVest tools included serving in tennis and curling (Figure 14). In addition, an expert gave a presentation on how the blood pressure measurement device was used to monitor students during exam conditions.
In The Netherlands, during a similar workshop, participating teachers had the opportunity to experiment with the Axiom ball by throwing the ball up into the air. In this workshops arm and leg accelerometers were placed in objects such as trolleys to investigate what happens when a moving trolley collides with a stationary trolley. In another example, the accelerometer was placed in an object on a spring. Teachers
wearing SensVest belts and leg/arm accelerometers did squats and walked up and down steps.

4.5 Seeding Cultural Change in the School System through the generation of Communities Engaged in Integrated Educational and Technological Innovation, Seed (IST-2000-25214)

Description of project. The name of the project takes the metaphor of sowing seeds to bring about change: ‘Seeding cultural change in the school system through the generation of communities engaged in integrated educational and technological innovation’. An integrated community is seen to be a group of people from different backgrounds including teachers, researchers and software developers. The intended outcome of the integrated communities is to collaboratively produce online content, learning tools and scenarios for the use in teaching and learning.

The main objectives of Seed were:
- The design and development of technologies supporting integrated learning activities
- The design and development of innovative activities supporting a social mode of learning in a collaborative setting
- The design and development of methods for generating integrated communities of education researchers, teachers, students and developers who could work collaboratively (through social participation) to generate educational technological tools and pedagogical models that could be adapted to suit individual needs
- The development of methods for using the above experience, tools and infrastructure to infuse innovative activities in the school system

The Seed project produced outputs including the following:
- Community, Content and Collaboration Management Systems (C3MS) – open source tools designed for developing educational portals, referred to as ‘bricks’ or modules. Bricks were developed as part of the project and supplemented with modules generated by 3rd parties, potentially enabling teachers to assemble them together to produce learning scenarios and activities, facilitating computer supported collaborative learning and the development of communities of practice. Facilities included weblogs, news engines, forums and polls. These tools were used in the PostNuke portal by the Swiss partners and were available in English and French. The project was also supported by a team of programmers who were able to develop specific modules (or bricks) on demand.
- The Collide Seed project produced learning scenarios and collaborative modelling tools for the curriculum areas chemistry, biology, mathematics and languages using a set of three tools.
  - Coolmodes – a set of four ‘palettes’ that can be used in Java programming to support discussions and cooperative modelling processes, provided through a shared workspace environment with synchronised visual representations.
  - FreeStyler – a tool supporting collaborative mind mapping with facilities to hand write notes and build up amendments through collaborative processes.
  - NoteIt! – software facilitating the recording of hand-written notes using electronic whiteboards or tablets (pen driven devices) and layered over other resources.
- E-Slate – tools to create microworlds with learning activities. A team of 14 teachers, 4 developers, 3 administrators and 5 researchers developed together 7 microworlds to support
the curriculum areas of physics, programming, mathematics, languages, history and geography. This allowed teachers to both design and construct interactive materials (although with training and support). These microworlds facilitate modelling and simulations using multiple representations. The main aim was to enable secondary development of software by non-technical users using plugs and programming languages.

Outline of validation. The lead validator, from the UK, was Andrew Moore who also undertook the role of coordinator, under the direction of Philippa Lee representing the British Educational Communications and Technology Agency (a government agency). The national validators were Karianne Helland (Norway), Fina Denia (Catalonia, Spain) and Alan McCluskey (Switzerland). The validation report (D3.2) gives an account of activities undertaken in schools in England and the three partner countries’. A total of 43 schools participated (Table 10).

<table>
<thead>
<tr>
<th>Country</th>
<th>Elementary Schools</th>
<th>Secondary Schools</th>
<th>Elementary to Secondary Schools</th>
<th>Special Schools</th>
<th>Unspecified</th>
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</thead>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>England</td>
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<td>7</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 10: Schools participating in the Seed validation

<table>
<thead>
<tr>
<th>Country</th>
<th>Teachers</th>
<th>Students</th>
<th>Other</th>
</tr>
</thead>
<tbody>
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<td>Catalonia, Spain</td>
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<td>300</td>
<td>0</td>
</tr>
<tr>
<td>England</td>
<td>14</td>
<td>310</td>
<td>1</td>
</tr>
<tr>
<td>Norway</td>
<td>32</td>
<td>340</td>
<td>3</td>
</tr>
<tr>
<td>Switzerland</td>
<td>10</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>Totals</td>
<td>88</td>
<td>950+</td>
<td>4+</td>
</tr>
</tbody>
</table>

Table 11: Teachers, students and others participating in the Seed validation

In adapting the project for ENIS schools, the national validation coordinators agreed that participants should:

- create one or more integrated communities
- use digital communication technologies, and
- allow (passively) or encourage (actively) change in the culture of teaching and learning.

This project was presented largely as a concept; schools were made aware of the tools and resources that were produced by the Seed parent project and they were encouraged to investigate the possibilities of using them in their own self-directed Seed projects. However, the majority of teachers involved elected to use existing tools that they were already familiar with. Furthermore, the resources that had been created through the Seed project were either not available in an appropriate language or did not match local curriculum aims and therefore were rejected on these grounds. In addition, it proved impossible to create integrated communities with researchers and software developers in such
a short timescale, with the exception of schools that had already developed relationships of this form. Seed was integrated with existing projects in Switzerland and Catalonia. In England and Norway, the choice of activities was left with participating schools, all of which did different things, though some of them joined with other schools in their own country, or one or more of the others, to form communities.

Examples of implementations.

One teacher at a secondary school in England designed a learning community to support teaching and learning in chemistry. He also set up, with the help of the EUN office, a list serve to support teacher collaboration through sharing experiences of ICT. To support student collaboration the same teacher set up a password protected bulletin board and asked students on two occasions to describe what they knew about the topics they had been studying. The students were asked to either: comment on a statement made by another student, ask a question or answer a question. This was an example of a cultural change using existing ICT resources. The teacher found that students needed to be explicitly taught how to use a simple bulletin board (e.g. to reply to a message rather than to respond in a new thread) and that some students were reluctant to use this facility. However, the interactions that took place allowed the teacher to become aware of students’ misconceptions, which he then addressed through classroom activities.

One school in Catalonia created a virtual journey based on Jules Verne’s novel ‘Around the World in 80 Days’ (Figure 15). This cross-curricular project involved IT, geography, language, history, and mathematics. A group of 24 students aged 11-12 years participated in the project. Students read the book and each week answered questions on chapters, found out information relating to topics in the book working collaboratively, and participated in a virtual trip around the world, through the Internet, collecting information about the cities visited. In addition students sent letters and postcards from each place, exchanged feelings and opinions about the different countries and take part in additional activities. The site is open to students from other countries.
Four teachers and 44 students from a school in Norway collaborated with partner schools in Hull, England and Flix, Catalonia. The school also collaborated with a local university in order to create resources on the Aurora Borealis. The schools collaborated with a Catalanian musher taking part in a sled dog race in the Alta region in February. They recorded interviews and made maths resources in connection with the race. The school used the ClassFronter Learning Management System, sharing texts, films and pictures with their partner schools (Figure 16).
In Switzerland, upper secondary students participated in a project relating to the International Space Station. It involved collaboration between Swiss schools from French and German speaking regions, as well as students from other countries. This involved introducing scientific concepts grounded in real-life examples, collaboration and interaction between students from different schools locally, nationally and internationally, and the development of language skills, ICT skills and writing skills. In addition, from a teaching perspective, the approaches to online collaborative learning with students were explored, particularly in creative working on the design of projects.
5 Introduction to the remaining School of Tomorrow projects (COLAB, METIS, MODELLING SPACE, OASIS, SCHOOL+, YOUNGNET)

All information below has been reproduced and/or adapted from the project websites and other available documentation. Therefore these sections should be attributed directly to the project teams. At the time of writing this report the outcomes of project evaluations were available from METIS and YOUNGNET. The lessons learnt from these two projects are incorporated in the findings from the validations of the five School of Tomorrow projects presented below.

5.1 Co-Lab (Collaborative laboratories for Europe)

This environment facilitates collaborative inquiry learning and the construction of knowledge in the domain of science. Two particular example projects were created: one on water management and one on climate control. It employed online whiteboard technologies for collaboration and modelling. Teachers can use ready made experimental tasks or author their own, either adapting existing tasks or creating their own. The experiments represent real life situations and include computer simulations, online experiments, remote experiments and video measurements (of moving objects). Through collaboration students will be able to participate jointly in the design and implementation of an experiment within Co-Lab. The collaboration whiteboards will facilitate synchronous and asynchronous communication, enabling students to draw diagrams or sketches of their ideas. A modelling tool together with a modelling whiteboard will enable students to construct models of their experiments and visualise the outputs/models generated. Students can communicate with each other and teachers through the online chat facilities.

Evaluation took place in a number of stages. First of all usability, efficiency and effectiveness tests were undertaken using a guided walkthrough with five experts and a guided walkthrough with nine students aged 16 to 17 years old. This highlighted the need to modify the environment in a number of ways. Formative evaluation was undertaken to establish whether students could use the environment to undertake authentic assignments. The first formative study involved 43 science students aged between 16 and 18 years old, engaged in unguided activity using the environment. Again this enabled the team to identify usability issues. The second study, involving 39 science students aged 15 to 17 years old, focussed on student regulation of learning, working patterns in group activities, and the identification of problems in the environment (in terms of usability) and in the students regulation of learning. Summative evaluation enabled the project team to compare face-to-face collaboration with online collaboration and also to explore whether the tools enabled students to take more control of their learning experience as measured by instances of planning and monitoring of a learning task, and improved modelling quality. However, the results of the summative evaluations were not available at the time of writing this report.

5.2 METIS (Multimedia Interactive Environments for Distributed Teamwork Promotion in Schools)

Aimed at elementary and secondary school students through the provision of two separate environments, this project was designed to promote cooperative teamwork, enabling students to share experiences with others from different places and cultures, through providing a multilingual educational resource centre, as well as promoting student autonomy and creativity. This project was
also designed to involve parents and facilitate learning anytime and anyplace. Using XML technologies, the project provided a collection of tools intended to foster collaboration among students, teachers and parents. It provided email, chat, forum, videoconferencing and news facilities, together with a library offering dictionaries, glossaries and library facilities, and content generation tools. An additional aim was to ensure that the environment was easy to access with minimum requirements for installation and also incurred minimum costs in terms of videoconferencing, teachers’ time, and system administration. Schools that participated in the evaluation were carefully selected in order that they would be open to change. The schools were from Scotland (1), Spain (3) and Sweden (1). The language selected was English. Primary schools undertook a project about water and secondary schools undertook a project about energy. Schools collaborated regularly using existing tools such as Netmeeting and Messenger. This project has been completed and the team are investigating opportunities for continuing its development through commercialisation.

The internal evaluation conducted by the METIS project team (Liceo Europeo, 2004). There were two trials. The first was set up as a 10 week programme and involved 5 schools, 168 students and 30 parents. The second trial was slightly shorter and involved 5 schools, 164 students and 63 parents. The data collection methods included: heuristic evaluation by usability experts; usability walkthroughs involving teachers and students; a questionnaire (Software Usability Measurement Inventory) which measures efficiency, effectiveness and satisfaction; focus groups with teachers, students, parents and other stakeholders (technical staff for example).

5.3 MODELLINGSPACE

The objective of modelling space was to provide an open learning environment enabling students to model activities by expressing their ideas, designing and testing models, and collaborating with other students and teachers via Internet technologies. It was designed to be used by 11-18 year olds in a variety of curriculum areas. It was developed in four languages: English, French, Portuguese and Greek. The system included multiple representations and tools for communication such as whiteboards, chat and forum. Although based on an existing tool, MODELLINGSPACE was developed further to incorporate additional features such as alternative and multiple forms of representation, tools to support the development of meta-cognitive skills, new approaches to providing online help (i.e. not reliant on text alone), and an interface facilitating direct manipulation of tools and components arguably more suitable for younger users. It was intended that videoconferencing tools would be provided. Students would be able to create public modelling spaces in which to demonstrate their knowledge and understanding, offering a form of apprenticeship by allowing less experienced students to observe the activity.

The evaluation was largely qualitative. It included participant and non-participant observations of students interacting with the tool, video and audio recording, records of interactions and communications made within the tool, teacher interviews, and pre and post-test of scientific concepts. Discourse analysis and the identification of ‘speech acts’ will be used to explore the kinds of communication and collaboration undertaken. The evaluation involved 3 schools from Greece, 4 schools from Belgium, 3 school from France and 2 in Portugal.
5.4 OASIS (Open Architecture for Schools in Society)

This project aimed to promote Open Architecture for Schools in Society. Five pilot studies were conducted to investigate a range of low cost technical and infrastructural solutions to both management and pedagogical problems. The underlying philosophy of the project was that schools can provide and increasing social function and that ICT could support this. In effect a prime aim was to connect learners with actors beyond school such as experts and external organisations, blending the school with the surrounding community and beyond. A range of different solutions and approaches were investigated. Particular foci included interoperability, cost-effective solutions, and innovative pedagogical models. Additionally the pilot studies looked at wireless ubiquity and media-rich environments, thin clients technology, safety and metadata, and collaborative learning.

The evaluation of the different projects was undertaken using the ValNet POETiC framework, describing successes and challenges within each of the five dimensions in relation to each of the five pilot studies. In addition the evaluation sought to identify whether users were satisfied with functionality, whether there was an impact on the quality and efficiency of their work, and whether the solutions were easy to use. Data were collected via interviews, reflective notes, multimedia observation and case studies.

In one of the pilot studies the Fle3 environment and Progressive Inquiry Methods/the Jigsaw Model (Emans et al, 2004) were evaluated in relation to supporting collaborative learning online and learner autonomy. These were also validated as part of the ITCOLE validation described in this document.

5.5 School+

This project had a strong pedagogical and educational thrust, of equal importance to the use of technology, in a bid to avoid teachers adapting ICT to fit current practices. It aimed to develop a state-of-the-art communication platform to offer unified access to teaching materials, class schedules, school news, international collaborations and so on. On the pedagogical side, it aimed to break free from the constraints of traditional school-based learning. An emphasis was laid on group and project-orientated activities, involving parents, members of the community and international collaboration. The project was designed to promote cognitive, emotional and social activities, emphasizing autonomy, creativity and teamwork. 20 European schools were involved in the evaluation activities, dedicating at least one hour per week to discussion and reflection.

5.6 Youngnet

The aim of the YoungNet project was to set up an Internet-based, virtual reality education environment, taking into account what was developed by a previous IST project (VIRLAN). It was a community-based platform designed to enable young people aged between 8 and 14 years to use innovative services and learning materials and communicate and collaborate at school and with each other across national boundaries.

YoungNet set up an integrated real-time virtual education environment which offered both synchronous and asynchronous communication based on leading edge ICT technology (Virtual Reality, 3D representations, audio communications, shared applications).

More specifically the project objectives were:
• to provide a community platform that enables young people up to 14 years of age to communicate and co-operate across national borders and cultures;
• to provide a comprehensive rights/roles concept for the community with electronic identification and registration;
• to offer a fascinating and edutaining multiuser environment with innovative services and learning materials with clearly defined, sensible content;
• to provide a platform the use of which is induced by intrinsic motivation and thereby overcoming the borderline between learning (school) and leisure.

The environment was closed offering protection to young participants. It could be set to operate in three different languages: Finnish, English and German. Teachers could act as administrators and create new or customise existing learning games (either a pairing activity or a quiz). An email system enabled users to communicate with each other. 3D games could be played alone or collaboratively. A discussion forum facilitated the exchange of ideas about pre-specified topics. Each person could choose a virtual landscape to be their home and represent him/herself as an avatar, inviting friends in to come and ‘play’ with yet more games. The underlying pedagogy was constructivist, promoting active learning and the construction of knowledge through collaboration.

The design of the project team’s evaluation (Arnold et al., 2003) was as follows. The evaluation included pilot testing, laboratory tests (7 students), expert analyses (usability), log file protocols, and questionnaires (16 teachers, 310 students). Five lessons were observed in Germany, Finland and the UK. One of the aims of the YoungNet evaluation was to establish ‘acceptance’ by users, being robust and serving a purpose, covering both technical and pedagogical perspectives, as well as ‘usability’, ‘pedagogical value’ and ‘socio-economic aspects’.
6 Findings: Positive outcomes, barriers and how they were or could be overcome

The findings of the five validations undertaken as part of ValNet and the School of Tomorrow project evaluations are now presented with the POETiC framework: pedagogical issues, organisational issues, economic issues, technical issues and cultural issues. The validations and evaluations each make different contributions and not always equally across the five dimensions of the validation framework. There is an inevitable bias towards pedagogical issues, reflecting the importance of this aspect when validating tools to support education. However, the remaining four dimensions prove to be revealing and should always be considered.

The five School of Tomorrow validations were: Fifth Dimension (5D), Innovative Teaching and Learning Environments for Schools (ITCOLE), Innovative Technology for Collaborative Learning and Knowledge Building (ITCOLE), Lab of Tomorrow (LoT) and Seeding Cultural Change in the School System through the generation of Communities engaged in Integrated Educational and Technological Innovation (SEED). School of Tomorrow project evaluations have also been considered from: Multimedia Interactive Environments for Distributed Teamwork Promotion in Schools (METIS), OASIS and Youngnet, as well as ITCOLE and SEED.

6.1 Pedagogical issues

Products/Tools created through School of Tomorrow Projects

Two tools were produced by the 5D project, LAByrinth and LABuilder, but unfortunately they were not available until November 2003, during the middle of the validation period, once schools were already underway and therefore not keen to incorporate new activities. Two schools in Flanders evaluated the tools and could see the potential but the teachers chose not to use them because they were perceived to be too complex. At the time of writing this report the LabBuilder tool was not accessible on the 5D.org site. The traditional 5Dmaze with task cards from the original project was only used in two schools. Tools were not perceived by the teachers as the most important thing; the key issue was the vision and the pedagogical ideas behind them.

In the ITALES validation, teachers largely focused on the ITALCO tool. About 75% of the teachers created a scenario using the ITALCO tool, spending between 3 and 80 hours, with an average time of 22 hours. The demands on teachers’ time may be unrealistic. Students took between 10 minutes and 80 minutes to complete the activities created. Therefore, there is a ‘serious issue concerning the effectiveness factor when time spent on creating one scenario is compared to the time spent on the particularly scenario by individual students’ (teacher, ITALES validation). 70% of teachers who presented the scenarios to students felt that the activity had been received positively. About 60% of teachers also used scenarios created by other teachers in the validation although not to any great extent. There was some interest in future uses of resources created by others. About 90% of teachers felt that a ready-made bank of resources created by ‘expert’ teachers would be helpful.

Although the underlying pedagogy of ITALCO was perceived to be sound, the main issues were that:
- the technology was too complex (although 24% reported that it was easy to use), particularly for use by ‘normal teachers’
- the instructions had limited information
- it required too much investment in terms of teachers’ time
It is notable that the majority of teachers (who were ICT enthusiasts) did not find the tool easy to use. For example, one teacher commented that it was hard to modify the materials once they had been created. In contrast there was a substantial positive attitude to the pragmatic usefulness but this opinion was not shared by all. There was a healthy division of opinion and the potential benefit, which is never guaranteed, and may not hold for everyone. There was a diversity of experience and expectations. Although the benefits of technically competent teachers creating their own resources and sharing them with others were perceived to be sound, 15% of teachers said that they would not use ITALCO in the future. When asked to compare the resources to other educational innovations only one third perceived that ITALCO had greater potential. Rather, they noted that ITALCO demanded more technical knowledge and time than other innovations. The potential of the tool for authoring resources was more valued than the possibilities offered by a bank of ready-made resources. Only 50% of the teachers perceived that students used the resources mostly as intended. The potential or conceptual value of such tools was more greatly valued than the current versions available together with their limitations. There was strong support for further development of the ITALES tools. However, it was not possible to make any comparisons with existing tools offering similar functionality of which there are potentially many.

In the ITALES validation, primary school teachers in Iceland tended to overestimate the capability of the ITALCO tool (for creating scenarios), and created large-scale projects, hence spending disproportionate amounts of time preparing resources. On the other hand, secondary school teachers, perhaps more experienced and often with in-house technical support services, focused on small manageable tasks achievable in reasonable time frames. In Sweden, there was uncertainty among the teachers about what they were expected to do which had a negative affect on commitment to the project and thus to outcomes.

22 teachers tried the ITALES-3D tool but only half of them felt it was pedagogically useful. However, 75% of them felt that it would be beneficial to develop the tool further. In addition, whilst it was perceived that young children might enjoy such activities, it was suggested that the 3D effects would not appear exciting to older students who might be used to sophisticated graphics in computer games. ATENA was perceived as having the greatest potential by the 10 teachers who were able to try the tool. Only 4 teachers were able to try MCAT and of these, two felt that it had potential.

Primary school teachers in ITALES would have liked more face-to-face meetings to explore the product and tools together. However, although the teachers lived in close proximity to each other and were encouraged to meet they generally only did so for organised events. In Slovenia, teachers who were experiencing difficulties creating scenarios using the ITALCO tool helped each other, highlighting the importance of collaboration and mutual support in such projects.

The product evaluated in the ITCOLE validation, Fle3, was easy to translate into national languages. Although there were some initial technical challenges (see Technical issues below), it was considered to be relatively straightforward to install and customise Fle3 on a local network. The challenges arose when installations were required within regional and/or national infrastructures. However, overall ‘the running of the platform was not a problem’ (school manager, Portuguese validation). The training events proved useful and teachers appeared to learn how to use the platform with little difficulty. The manuals and online guidance were well structured and provided a clear introduction to the tools and facilities. The learning environments were considered to be ready to implement. Login procedures were considered to be straightforward and the home page was perceived to be easy to use and well-structured. It was noted by Dutch educationalists that strengths of Fle3 were the facility to
customise the environment and import new definitions of types of knowledge (Thinking Types) to tailor its use to specific pedagogical approaches. Students who used the tool in the Portuguese case study felt that:

- Fle3 would be improved if there was a spell check facility
- Fle3 would be improved if there were improvements to the user interface such as larger font sizes and more use of colour
- Translation tools would be beneficial
- Scaffolding tools should be provided for younger students
- Moderation tools for teachers would ensure that contributions are not inaccurate or misleading

The tools provided through the Lab of Tomorrow project were perceived to be user friendly and easy to use. The tools, software, implementation guide and the lesson plans were easy to use. The implementation guide and CD-ROM provide clear background information and ready-made teaching resources. Teachers, mainly from Italy, The Netherlands and Northern Ireland, commented that similar tools were already available commercially.

The LoT tools as they stood were perceived to be best suited to students aged 16 or above. Teachers however felt that with some modifications the tools could be useful in primary schools. Alternatively, the tools would be useful in further education to support vocational sports and health related courses. Some of the graphical representations of the data were perceived to be confusing in relation to the standard theoretical models that are used in current curricula. But the benefits of seeing the data readings analysed in real-time were seen to outweigh these small disadvantages.

Future developments, specifically the provision of a Web database for experiment results, will enable students from different classrooms, schools, regions and nations, to gather the same kind of data relating to particularly areas of investigation. Communication tools would enable them to formulate hypotheses collaboratively, exchange opinions and discuss results.

The products created within the Seed project were evaluated by some schools but were not perceived to fit with schools’ requirements; instead, many schools in the Seed validation used similar tools and products that already existed and that staff were already familiar with. This suggests that teachers and learners are autonomous in their choice of resources; resources must be appropriate and their use must be purposeful.

All the teachers participating in Seed were invited to attend a workshop on the tools produced by the Seed parent project in Athens in October 2003. Unfortunately, most schools had already started and in addition teachers were expected to meet travel and accommodation costs. Therefore, only two teachers from Norway were able to attend. These teachers carried out evaluations of the products in their classrooms but rejected the tools because:

- they did not have the time or resources to translate the tools/products from the language that they had been created in (German, Greek)
- they were aware of other available tools that offered the same features
- developing their own modules using E-Slate (designed to be used by integrated communities of teachers and software developers) was too demanding without extra resources and support
Impact on learning

Teachers find the benefits of these kinds of project difficult to measure, particularly because there are skills and competencies involved which traditional forms of assessment in many nations do not currently recognise. The perceived benefits included: facilitating independence and student autonomy, promoting self-reflection and a critical evaluation of knowledge, developing research, pedagogical, organisation and collaboration skills, together with social and motivational advantages. For example:

Students… cooperate and give each other feedback. This has led to increased verbal activity, more cooperation and more learning. The students have to a greater degree become the subjects of their own learning, and producers of their own knowledge. It looks like they have become better at seeing relationships/connections and better at presenting subject material… The average grades in project work have improved. (teacher, Norway, Seed validation report)

However, reservations were expressed; another teacher in Norway in the Seed validation for example was concerned that a one-week project with students was inefficient in terms of the time spent preparing for the activity in relation to the impact on learning objectives.

In the 5D validation the teachers were pleasantly surprised that students were able to take responsibility for their own learning and that student satisfaction and motivation were high. It was perceived that students in the role of teaching assistants developed some pedagogical skills, although the nature and extent of this was not clarified. Some learners benefitted from the experience in terms of learning but others were perceived to need a more structured and controlled approach than that offered through the 5D initiatives. Teachers in Sweden felt that increased personal feedback to students had a positive effect on the learning process.

In the ITALES validation, the majority of teachers perceived that ITALCO was only slightly effective or even ineffective in helping them build a learning environment that was novel, exciting and motivating, or which would make students learn more.

The ITCOLE project was perceived to be highly innovative, introducing collaborative knowledge building as a learning strategy:

because students, besides the research [they had to do] build and deepen their knowledge’ (teacher, Portugal, ITCOLE validation)

The students worked together in a new way. Suddenly the product was not personal, but useful to the entire group. They used each other in the groups and across the groups – far more than in usual group work. It was something that was completely new to the students, but they liked the idea of it. (teacher, Denmark, ITCOLE validation)

The students got more and more critical towards information, so source criticism ended up being very present for them. The co-operation between students also became very flexible, as they could work together at all hours. (teacher, Denmark, ITCOLE validation)

Students noticed that they had an opinion about certain subjects and after the research work in group, after the classroom discussion, and the confrontation with the opinion of the other groups, their opinions has changed. (teacher, Portugal, ITCOLE validation)
Whilst teachers were already aware of this approach to knowledge building, they did not commonly use it in their daily practices. Students, and particularly the younger ones, were perceived to learn effectively despite the short timescale. The younger students themselves were also very positive about the use of Fle3. Older students had mixed opinions about the benefits of Fle3, with some stating that they did not like to work in groups, perhaps because of their prior experiences. Portuguese students made the following positive comments regarding the impact on their learning:

It is better than reading books, there are lots of ideas, things we did not know … We can learn much more! (student, Portugal, ITCOLE validation)

It was very interesting learning through the Internet … We used the Internet [previously] for many useful things, but almost never to learn. (student, Portugal, ITCOLE validation)

We could share ideas with other schools’ students. (student, Portugal, ITCOLE validation)

When we raise problems, answering them is learning. (student, Portugal, ITCOLE validation)

We were given the opportunity not only to answer questions but also to explain our ideas. (student, Portugal, ITCOLE validation)

Some students and teachers, however, were more cautious, noting that this project did not differ markedly from existing approaches:

When we start a project, whatever the content, we learn something new. Well, I think I did not learn more with this project. (student, Portugal, ITCOLE validation)

I did not learn anything I already did not know, in spite the project is interesting. (student, Portugal, ITCOLE validation)

The students were very curious, and found it exciting to fill in their personal data – and read what the others had written. They were very engaged in exchanging assignments and comparing the size of files (quantity as opposed to quality was not discussed in this connection!). They found it interesting to have a database with all their assignments. We did several assignments, and so each student had his or her own folder. (teacher, Denmark, ITCOLE validation)

Students in the Portuguese case study believed that their use of Fle3 had enabled them to learn more because:

- they shared questions and answers with students from other schools, who were in different school years
- used the Internet to find information in Portuguese
- worked as a group
- enjoyed what they were doing which made learning easier

However they felt that the task was too structured and limited their flexibility and freedom of choice.

The majority of students in the ITCOLE validation enjoyed working together and perceived it to be beneficial:

Perhaps it was [the collaborative work that was] the main incentive to a good job. (student, Portugal, ITCOLE validation)
Collaborating with others is an opportunity for all of us to learn and progress. (student, Portugal, ITCOLE validation)

Working in a group encourages tolerance and respect for other people. (student, Portugal, ITCOLE validation)

In the Portuguese case study, one group of students were particularly motivated by an exchange of ideas involving groups of students in other schools within Fle3, particularly opportunities to interact with students who were older. Working collaboratively also enabled students to share their ‘know how’ with each other.

In the LoT validation, the benefits were perceived to be the facilitation of student-centred and collaborative learning activities in real life situations, interacting with real objects. Teachers felt that these type of tools could promote a deeper level of thinking about physics. One of the students participating in the workshop in Austria commented he had learned more in two days with regards to aspects of the physics curriculum than had been achieved in the whole school year. A few other students commented that they felt they had learned much more in comparison with normal classroom activities.

As with many ICT innovations in education, teachers across all validations perceived that the projects that their learners had been engaged in had a positive impact on motivation. For example, in the LoT project, the number of students that signed up for the Physics class doubled after the first year in which the LoT tools were introduced. Publishing for a real audience using ICT resources was particularly powerful as was collaborating with students and adults from other schools. Increasing the number of social contacts was seen to be a benefit and collaboration between different age groups was also perceived to have had a positive impact.

In the SEED validation, the social aspect of learners collaborating with other learners was considered to be another important factor:

Students showed a huge enthusiasm while we were working. They are keen to keep up the collaboration. During the project, there was some social chatting in the evenings as well, some have kept in touch with their new friends in the other school. (teacher, Norway, Seed validation report)

Learner autonomy was perceived to be also a contributory factor to increased motivation:

They have developed a greater autonomy in that they can now use the Internet independently, as well as send messages. It has created friendships among the students from the different school, and given self-esteem to my students, as well as awakened their curiosity. (special needs teacher, England, Seed validation report)

The METIS environment was perceived to enable students to become more autonomous and to support learning by doing, learning by example, collaborative learning, and problem solving approaches. It was perceived that the students’ learning was improved and that they developed better reasoning skills. Students also developed new skills in relation to communication and collaboration. There was a perceived positive impact on language and ICT skills, particularly searching for information. Students found the platform to be highly motivating. Parents perceived that METIS had contributed to developing communication and reasoning skills.
In Youngnet, teachers perceived that the content of the environment supported some of the curriculum themes, as well as facilitating social learning and promoting co-operative learning. In addition the environment offered extra-curricular benefits such as communicating with international partners. Teachers found the guidance and exemplar activities to be useful. Teachers commented that students were enthusiastic and motivated, particularly by opportunities to communicate with students in other classes (in other schools, and from other countries). Log file protocols revealed that students updated their personal details first then used asynchronous communication tools (email and forum) before moving onto synchronous communication tools and games. Some teachers perceived the activities to be supplementary to normal lessons, partly because of the amount of time required to undertake activities.

In the evaluation of FLE3 for OASIS, its use was perceived to lead to greater collaboration between colleagues and between students. Learning was believed to become more student centred. It was also noted that the use of the environment had a motivational impact on students.

In the School+ pilot study the student’s role also changed; learning was more active and self-directed, students were more motivated.

**Impact on teaching**

There were noticeable cultural differences in relation to teaching practices. In addition there were tensions between change (and resistance to this) and adopting new tools in ways that complement existing approaches. Teachers in the Seed validation for example perceived that they had taken part in new forms of collaboration (for example, sharing experiences via an email list server) but they had not necessarily developed new communities; rather they had continue to build existing ones. They considered that they had gained support from others and integrated new technologies with current practices. There were however cultural differences within this validation (as there were in all validations); schools in Norway already had extensive experience working on cross-curricular projects and had well-developed ICT infrastructure, and therefore the impact on teaching here was not as great as it may have been in other countries.

Many teachers reported that they had not made any significant adjustments or changes in their practice as a result of the Seed project. Nor did they to any significant extent feel that their role as teacher has changed in relation to either students or colleagues. From another perspective, teachers engaged in the 5D validation welcomed the project as it was perceived to closely match the way in which they wanted to work, although some had reservations about the potential impact and the risks involved. However, it was also noted that this approach was not necessarily novel and innovative; many schools in the 5D validation were involved or had been involved in similar initiatives. In the ITALES validation almost all teachers in Iceland, Sweden and the Netherlands perceived that ITALES complemented current teaching practices. Only about 60% of the 11 teachers in Slovenia felt that this was the case, with the remaining teachers stating that ITALES did not fit well with current practices and that they were more used to ‘traditional ways of teaching’, suggesting a mild resistance to change. The Slovenian teachers also found it harder to integrate the ITALES tools into the curriculum.

Teachers in the ITALES validation believed that changes were required to maximise the benefits of computers in education but that technology should not be used for the sake of it:
It is both a question of learning new skills and developing a new approach and attitude towards learning in general. It is also a question of where and when computers can increase the quality and make learning experience richer. In other words, one has got to develop a sense of both the traditional ways of learning and also a deeper understanding of the ICT-area to make good choices in organising education now and in the future. It’s important to have the courage to both say yes and no, when meeting the pressure from the ICT-force as it has been experienced the last decade.

Many teachers involved in the LoT validation felt that the concepts and tools had great potential to help teachers build a new learning environment that could be exciting, stimulating and motivating for teachers and students. Enabling students to be active participants of experiments could be very powerful. However, some noted that the underlying ‘constructionist’ approach was already commonly in use in the teaching of physics. It was also clear that the tools could be used to supporting cross-curricular investigations for example in physical education and also in biology (heart monitors for example).

In 5D most of the activities incorporated cross-peer tutoring, where an older student (or another adult in some cases) took on the role of teaching assistant. This change in relationship between teachers and learners, and learners and their peers was viewed positively. The communication was described as more equitable and more comfortable in comparison to teacher-centred approaches; learners were more concerned with learning how to ask the right kind of questions, than focussing on getting the right answers. Some students however felt insecure with this approach whilst others preferred traditional approaches because they were not prepared to make the effort. Some parents had concerns in relation to negative impacts on learning outcomes of students teaching other students; this was addressed through events for parents to explain the known and potential benefits. For example, three primary schools in Flanders created web diaries with pictures on the school websites so that parents could keep track of the project. Teachers involved in 5D initiatives were keen to continue developing the approaches and found it did fit with the demands of the curriculum.

Teachers in the 5D validation emphasised different aspects in their self-devised implementations:
- the role of the assistant (usually an older student), engaging with society members beyond the school walls (for example, parents and grandparents);
- using the labyrinth concept (a map with many rooms, each room associated with a particular learning task, in which students could choose which room/activity to visit) developed as part of the original Fifth Dimension project (developed by Michael Cole in San Diego, 1986) providing a particular format for learning tasks;
- and developing students’ problem solving and learning strategies (including learning how to learn, metacognitive skills, self-reflection, and diaries).

This demanded a change in the teacher’s role. These teachers in the 5D validation found the feeling of loss of control slightly disconcerting and felt the need to be cautious. They also expressed concern about how parents and the inspectorate would react to these radical changes in their classrooms. However, they did not perceive this to be de-skilling; rather it demanded the development of new skills in addition to traditional teaching skills; the teachers valued the new challenges that this change brought to their day-to-day practices.

Initial results from the School+ pilot study showed that the project did lead to a change in the teacher’s role, requiring the teacher to develop new skills in facilitating teamwork and communication amongst students.
There were some reservations about the transferability/re-usability of activities that the teachers created as part of the 5D validation both nationally and internationally. The teachers were motivated by the opportunity to develop their own learning resources although they would appreciate inspirational ideas and exemplars of good practice (rather than a bank of off the shelf resources). It seems that innovative teachers do not only want to be only users of tools, they want to be creators of learning situations and artefacts. However, this may be different for less innovative teachers.

Teachers who used Fle3 enjoyed the experience but found it a challenge:

[the use of the platform] is much more risky to teachers … When a methodology is more structured … we know how it is … this methodology [progressive inquiry] is more uncertain. (teacher, Portugal, ITCOLE validation)

The Hungarian validator in the ITCOLE validation noted that collaborative learning methods changed the traditional teacher-student relationship such that teachers became mentors and students became more autonomous, being creative, working independently and in a team. In addition, the educationalists from The Netherlands noted that this innovative approach would also demand greater collaboration between teachers in the development of learning activities and subsequent demands for coaching learners.

More than half of the 11 educationalists in The Netherlands who looked at Fle3 stated that they were unlikely to use the learning environment in the future, despite being regular users of ICT in the classroom. This is likely to be due to the mismatch between national pedagogical practices and the underlying pedagogical principles of this particular learning environment. In The Netherlands collaborative approaches and knowledge building were not widespread at the time of the validation. It was suggested that Virtual Learning Environments would be more suited to supporting current pedagogical practices in The Netherlands. In contrast, and prior to use, teachers in Hungary were very positive about the potential use of the platform and felt it would enrich the range of tools that teachers could use and have a positive impact on student motivation. Their Dutch colleagues made similar comments about the future potential of Fle3 although they perceived that it would be unlikely to be adopted in The Netherlands on a large scale. They felt that it could be an effective tool for teachers promoting collaboration and knowledge building techniques to build an exciting and stimulating learning environment for students that would improve student learning through encouraging them to share knowledge.

In a case study conducted in the ITCOLE validation in a Portuguese elementary school, students’ contributions were mediated by the teacher who ensured that the contributions were accurate. This was noted to be the only activity in which students were not fully autonomous.

Issues arising from all validations included:

- the importance of ensuring that teachers have clear objectives and an understanding of what can be achieved (and is not achievable) with tools
- the importance of ensuring that ICT projects have a clear pedagogical focus (learning objectives and outcomes) to avoid the activities being technology-driven
- the importance of establishing rules for different uses of technology (e.g. Internet browsing)
- the difficulties of implementing innovative ICT projects in secondary education (in some but not all countries) where the curriculum is more tightly defined and teachers specialise in subject areas
• the impact of experience and technical competence
• the importance of in-house technical support
• the importance of educating parents and others about the known and potential benefits

These issues demand awareness, experience and competence from the teacher, which is different from and required in addition to, traditional pedagogical and subject skills.

In the Seed validation in Catalonia the project was more explicitly identified with regional priorities and existing innovative activities than in the other three participating countries. Similarly, in the 5D validation, the enthusiasm of the participating teachers and perceived positive outcomes were attributed to fact that teachers were encouraged to adapt the project to local and specific needs, ensuring that the use of ICT was purposeful.

From a different perspective, in the ITALES validation, the Slovenian teachers were pleased that they could compare the tools with existing products and were able to judge how advanced teachers were already in using ICT in the curriculum.

In the SEED internal project evaluation a mismatch was identified between the pedagogical model applied and the pedagogical potential of tool (for example, not enough time was allowed for students to explore scenarios). But it was noted that teachers may not have wished to take such risks. In some cases it was attributed to misunderstanding capabilities and in others resisting change. There were also different interpretations of pedagogical models – how knowledge is generated for example. In addition a tension was identified between teacher as technician (those prepared to deal with technical hitches in the classroom) and not (where teachers expect that technology will be robust and reliable).

In the evaluation of FLE3 for OASIS, initial training was perceived to be crucial followed by pedagogical support through asynchronous chat, which all participants whether active or passive found helpful. Learning to teach according to the progressive inquiry model, a new pedagogical approach, was not perceived to be easy. In addition, the development of new ICT skills placed additional burdens on teaching staff. The importance of continued support through ‘facilitators’ was noted. It was also noted that ‘time to mature was required’; the short time scale for the evaluation did not provide an opportunity for this to take place.

In the METIS evaluation it was notes that the roles and relationships between teachers and students changed. Teachers became tutors and students began to teach each other.

Digital literacy
School of Tomorrow projects did not always require specific training and the development of particular digital literacy skills, or at least not beyond that required for existing ICT practices. However, where this was required it created a local ‘digital divide’ within a school; teachers and learners with limited ICT skills and confidence were left behind:

..those who had a lot of computer knowledge and experience to start with, were able to use the potential of the PDAs, whereas those who had less skills and experience soon started to lag behind, lost interest and developed negative attitudes. There are big differences from one class to another. Among those who have used the PDAs actively and have been enthusiastic, we have seen a big development in their technical competence. (teacher, Norway, Seed validation report)
Teachers using ITALES tools had above average technical skills; even so, training was perceived to be important for maximising the potential of the tools. Despite being competent users of ICT, many teachers experienced difficulties and described the tools as being too complex. About half the teachers who participated perceived that the tools could be used by ‘expert’ teachers and ‘ordinary’ teachers. However, 46% felt that the tools were only appropriate for use by expert teachers who have been trained in designing curriculum and teaching materials.

I suspect that the technical know-how of the average teacher is over-estimated. Therefore, I think that only a small part of the teacher population will use the ITALES tools to create something. But I do think that most teachers can easily use already made material with the students given that they have the facilities to do so. (teacher, Iceland, ITALES validation)

...the lack of complete instructional tuition on how to use for example ITALCO makes the use much harder and forces the teacher to ‘waste’ a lot of time on trial and error activities that in the end damage the motivation. (teacher, Sweden, ITALES validation)

The technical skills demanded of teachers using the LoT tools is considered to be average. However, the teachers involved in the validation workshops largely had above average ICT skills.

6.2 Organisational issues

Leadership

Projects had more impact in schools where they were directed by or had the full support of senior managers:

The principal was 100 per cent behind the project and gave help when asked. This gave a sense of security and motivation to all involved. (teacher, Israel, 5D validation report)

It is important that leaders and senior managers engage staff who are resistant to innovation and change. In some cases in the 5D and ITCOLE validations, involvement of the inspectorate and community officials gave the project additional status.

In contrast, projects had less impact or were deemed to have failed in schools where participating teachers did not receive support from both senior management and their colleagues. In one or two cases, school leaders or teachers attended initial project workshops but did not take any further steps to implement the projects within their schools. This highlights the difficulties of overseeing large-scale validations in a range of schools when staff are not fully committed to participating in such projects. The importance of a positive attitude to ICT by school managers has often been highlighted in research on ICT in schools (see for example, X). In many cases however it was difficult for school leaders to allocate (non-teaching) time for staff to develop their projects.

External support appears to have been important. For example, in the Seed validation, the national validator in Catalonia had a well-developed relationship with the participating schools prior to the start of any activities and took a leading role in overseeing the implementation. This was considered to have been helpful. Similarly, the lead validator who oversaw the implementation of 5D already had well-established relationships with many of the participating teachers in Flanders and maintained close contact with them throughout the validation. The impact of this relationship is evidenced by the take-up of 5D by other schools and activities continuing beyond the validation period.
Impact on school management practices

No immediate impact on management practices were perceived but this may have been because of the limited duration of the projects. To maximise opportunities for positive impact within the short time frame many teachers chose to integrate the projects with existing systems rather than to set out to make radical changes. The schools’ perceptions of their priorities, and those of national ministries and regional or local administration, have constrained the scope for what one teacher calls ‘opportunistic innovations’. Thus, there is a need for systemic change to be driven from the top-down; policies and national curricula must become more flexible. That is, there is a need to move towards THINK scenarios 2 and 3 to maximise the potential of innovation through ICT. Where educational practices already offer such flexibility (e.g. Norway) teachers believe that existing management and leadership practices promote collaborative working, and allow innovation to flourish.

Impact on other staff and school as a whole

Where school leaders introduced the project at a strategic level, or as a trial for something that would in future spread to a whole school or even a group of local schools, there was some evidence that dissemination had taken place beyond those immediately involved in the validation process. Elsewhere, there was little evidence of this occurring although it is likely that this would have been constrained by the limited duration of the project.

However, some projects had greater impact than others; 5D for example, was perceived to be a starting point for involving more teachers in the process of innovation. Indeed, this is demonstrated not only because more schools in Flanders volunteered to participate in the second year of implementation but also because the 5D concept will be introduced to all schools in Flanders. One of the Swedish schools commented that ‘the 5D- initiative started in November 2003 and will continue forever…’

Several schools report that they started out too ambitiously, and had to adjust the scope of their project to meet the time constraints. Among things that took more time than expected, teachers in the Seed validation mentioned the initial planning stage, establishing contact and good working relationship with partner schools, as well as working with the internal dynamics of the student groups – the social training involved in getting project groups to work well together. Some teachers in ITALES devoted extensive periods of time (for example, one teacher claimed to have spent 80 hours) to creating the learning resources for their students to use.

The 5D initiative required a lot of effort: rearrangement of timetables in order to enable students from different year groups to work together, opportunities to plan collaboratively, time for training the coaches and assistants, a willingness to work with others from the community, and the rearrangement of teaching spaces. This required goodwill and flexibility from many staff. The demands on teachers’ time were substantial. Meetings organised hurriedly or in personal breaks were not effective and had a negative impact in terms of staff motivation.

Just under half the teachers participating in the ITALES validation found it difficult to fit the validation into tightly controlled curricula and existing timetables, although there were considerable national differences relating to this. The majority of teachers, including all teachers in the Netherlands and Slovenia, found it difficult to find time for the preparation work within their working
timetables. It was a challenge to fit it into their normal workload. Educationalists from The Netherlands who evaluated the potential of ITCOLE perceived that the implementation of the project would demand major organisational changes to the curriculum and to the whole organisational framework in order to maximise positive impact. The Portuguese case study also revealed that there were tensions between the validation project and the delivery of the national curriculum. In addition, there was not enough time set aside to use Fle3 and particularly to prepare students and teach them how to be more autonomous and take more responsibility for their learning.

Participation in the 5D project did not lead to revolutionary changes in school practices, although there was a perceived impact on the teacher-student relationship, but some schools noted that participation in the validation initiated interesting and important discussions, and generated curiosity from other staff. Additional positive side-effects included improved collaboration between staff and an increase in the use of ICT.

In the ITCOLE validation where cultural differences meant that teachers were starting from different points overall in terms of skills and competencies, the validators anticipated that the project would have more impact in terms of dissemination and spread to other staff in countries that were less well-prepared than others. However, this was not the case. Only those teachers and students involved in the project in Portugal were aware of it. There was one exception; one elementary school attracted the attention of the local Mayor who provided additional investment. This funding and the raised profile led to the initiative spreading across the school; teachers who had not been involved initially requested training workshops. In Hungary, several teachers organised in-service teacher training to share their experiences with other teachers. They also presented the results of their work in professional and regional forums as well as in the media.

As a result of the participating in the project, the Fle3 platform is being disseminated to a wider range of schools, through the participation of Competency Centres belonging to the Nónio Network. At the time of writing this report, 20 additional workshops had been run which were attended by more than 100 teachers.

In the LoT validation it was perceived that it would be challenging to manage a whole class using more than one set of equipment (i.e. different groups of students involved in different experiments). The teachers participating in The Netherlands workshop for example commented that it may be difficult and even ineffective to use LoT tools in a normal classroom setting with large numbers of students in one group over a period of 50-60 minutes. Additional constraints included the amount of time required to set up the experiments and exam pressures. This could be resolved through special half-day lessons which would allow enough time for the experiments to be run and the data to be collected, analysed and discussed. The software is easy to use without requiring complex instructions. However, to maximise the opportunities offered by these tools one user (whether teacher, technician or even student) should have advanced technical skills in relation to Windows applications and data transmission. The lack of data storage in the sensors could be challenging in relation to organisation issues in some creative outdoor experiments.

In the evaluation of METIS it was found that the environment demanded more flexibility in relation to student groups. Students benefited most when they were able to form groups according to personal interests, ignoring age and ability. There were some additional demands on teachers and students in relation to learning how to use the environment. The METIS platform includes a calendar tool that was perceived to help with timetabling issues but students did have to cope with some timetabling changes because of the need to connect with other schools at specific times of the day.
The evaluation of one of the OASIS projects suggested that many tasks were made easier using Fle3 but some were made more difficult. The teachers involved noted that there was an increase in preparation time but perceived gains/savings later on.

Supporting and integrating learning beyond the classroom

Due to the short timescale of the validation, the majority of activities across the five validations were largely classroom focused. Some Seed validation projects involved learners working from home, outdoors, and in rural areas. In the ITCOLE validation in Hungary students, who devoted two-three hours a week to their project work, although mainly in lesson time, also stayed on after school to work together and used the school and community library to conduct research. A small number of these students did some further work at home. Danish and Hungarian students in the ITCOLE validation also worked together outside the confines of the classroom wall using the technology to work together virtually.

They liked the fact that they were in contact – also outside of school. It has been an advantage for the more unpopular students to feel as part of a community. (teacher, Denmark, ITCOLE validation)

It was noted in the METIS evaluation that the platform has the potential to support learning anytime and from any place, and could be adapted to support specific learning contexts such as hospital tutoring or providing additional support to special needs students. Being able to work from home enabled students to spend longer periods of time developing their projects further but there were issues concerning time differences when trying to communicate synchronously with international students.

The Youngnet evaluation reported that there was some home use (by more than 1 in 5 students) but the nature and extent of this is not clear. The environment was perceived to be of potential benefit in relation to supporting after school activities.

Involvement of the local community

This was not a requirement of the validation projects but in some schools involvement of parents and/or community members occurred as opportunities arose. For example, a female student at one of the participating elementary schools said:

At home, with my dad, I went to a site in the Internet to search about water, for instance, waves, rivers, the sea, water pollution … and many things … (student, Portugal, ITCOLE validation)

In one school in Portugal 13 out of 40 parental questionnaires were returned suggesting that parents had limited knowledge of and involvement in the project. In Hungary, some parents had expressed concerns about the likelihood of negative effects on their children’s results at school but others were supportive and believed that their children could learn many new things, and gain new experiences.

In the 5D validation, the Swedish teachers and students reported that they appreciated the opportunities to work with community members; it was thought to contribute to the preparation of learners for life after school and life-long learning.
Involvement of the wider community and international partners

In the Seed validation, several schools in each of the four countries involved the wider national or international community in ways that were appropriate to the projects, and general principles of community relations. For example, a Norwegian school was already involved with a national research institution and integrated their Seed project with an existing one. And an English special school worked closely with a commercial company that develop learning objects that use symbol writing. Issues concerning languages are discussed under Cultural issues below.

The Seed internal evaluation concluded that professional development opportunities relating to working with software developers were a strong motivational factor. However, communication including face-to-face opportunities was crucial in building integrated communities. There were different expectations about roles in collaboration which led to some challenges. The evaluators concluded that role divisions need to be clear and that negotiation is crucial. In addition the teachers and developers had to learn each others’ language.

6.3 Economic issues

The LoT validation was perhaps different to the other four as the equipment is likely to be costly if the tools are produced commercially. There were concerns about cost-effectiveness (i.e. the benefits arising in relation to the costs) and that schools may not be able to justify such expenditure to support one-off projects. Teachers in the workshop in Northern Ireland commented that other commercially available sensors would enable teachers to achieve a similar impact in their classrooms at a fraction of the cost. For example, there are two-week loan services available via Brussels for EU schools.

The validations were largely not dependent on the cost of digital and material resources, but of human resources. The costs of the time given freely by teachers in most schools cannot be easily quantified. Even where teachers were given some payment for their participation, it did not fully cover the amount of time invested. Certainly it is not feasible to rely on the goodwill of staff in this way. The limited expenses offered to each participating school were generally spent on travel expenses to project meetings or on providing a limited amount of cover to release teaching staff from their daily duties, although this was sometimes inhibited by lack of availability of staff to cover and the limited notice to make such arrangements.

If all teachers in my school would spend as much time as I have on this project (most of them would probably need more time actually), and if they would get paid accordingly, it would be tremendously expensive for the school. That alone is enough to prevent projects like this to ‘settle’ permanently in schools. We have a few entrepreneurs in most schools who are ready to experiment with things like these in their own time, but most teachers will not spend the necessary time unless getting paid accordingly and most schools are not willing to pay. This is obviously very odd, because most schools (at least in Iceland) are ready to pay large amounts of money on hardware, but not on software or training staff. (teacher, Iceland, ITALES validation)

The wish to reduce expenses frequently led the teachers to use freeware or open source technologies, where they were not validating specific tools (e.g. 5D and Seed). But it also led them to use some products that were ‘free’ because of advertising or commercial sponsorship. The projects were also subsidised through other existing sources of national and regional funding. The benefits of the investment of time in developing the projects were the resources and learning objects that could be shared with others and made publicly available. It was perceived that face-to-face meetings were
important at the beginning of such projects, requiring some funding, whereas later communication could be facilitated through technology minimizing costs.

The 5D project promoted the use of commercially available software, ‘Active Worlds’, but it required a subscription fee which meant that schools in the validation chose not to use it.

In the Netherlands and Israel, the economic issues were more prominent and related to the need to fund hardware and internet connections, and the installation and maintenance of network facilities. More importantly perhaps, cultural differences in these countries meant that teachers expected to be paid for the time that they needed to develop and implement the projects. [add in something from ITCOLE – Hungary]

In the ITALES validation, time was required to develop familiarity with the complex software as well as time for the creation of resources, more so for those with limited experience and weaker ICT skills. In relation to this the opportunity to access ready-made material would reduce time costs.

The importance of training and the implications of this is term of time and costs were noted:

> Software like [ITALCO] cannot be thrown into the hands of teachers, without proper introduction and training. In fact, I think it should be a decision made by school authorities, whether they want tools like this to be used at their school. The authorities should then provide their teachers with support, training and added preparation time to implement the tools in order to use the software to it’s full. (teacher, Iceland, ITALES validation)

Over one third of the teachers in the ITALES validation said that ICT equipment had to be updated in order to use the tools.

There were cultural differences noted in the ITCOLE validation. In Denmark for example, schools are well-resourced, teachers participate in excellent training programmes, and schools pay Internet access costs for home use by teachers. It was noted that in Hungary and Portugal some funding would be required to facilitate the scaling-up of such a project, particularly to involve schools that are less-well resourced. In The Netherlands concerns were raised about the costs of setting up a Fle3 server, particularly the need for technical expertise and the amount of time involved. In addition, the implementation would demand some additional work to meet the national infrastructure standards. Furthermore, the likely costs for ongoing technical support and training were considered to be high.

In relation to the economic dimension, teachers in the Youngnet evaluation indicated that a ‘pay-as-you-go’ model would be preferable in relation to YoungNet contents. A sponsorship model would be acceptable as long as sponsoring organisations were appropriate.

**Scalability issues**

Costs relating to scaling up will vary from country to country according to existing local provision for resourcing and teacher training. Seed and 5D would not necessarily require additional funding if implemented on a wider scale and therefore are not limited. These projects did not require special technology. However, teachers may need more of an incentive in order to participate, particularly in terms of demands on teachers’ time. This could be a financial reward, or formal recognition through accreditation. The costs of developing resources collaboratively and of co-ordinating the sharing of resources in Seed were noted to be a barrier to sustainability by one of the Norwegian teachers. This
could equally be applied to the other projects in that networking teachers and providing repositories of exemplar materials would clearly be of benefit but incur additional costs to facilitate management and co-ordination. Extending the scale might justify the expense of developing a more structured approach.

It was noted in the ITCOLE validation that despite the platform being open source and freely available there would be costs associated with scaling up in relation to training and support, and ensuring that schools that are less-well resourced can be involved. In terms of scalability in the LoT validation, it was perceived that increasing the potential number of users and multiple licences for software resources should decrease costs.

6.4 Technical issues

Teachers involved in the LoT validation workshops perceived that better computer facilities might be required (e.g. hi-end Pentium 4 PC running Windows XP). Transmission of data from the sensors to the base station can operate over 10 – 20 metres without any real problems. However there is a 10 second delay in transmission which can be confusing, particularly in relation to identifying peaks of activity in the graphical representation with actual activity. In addition teachers from Northern Ireland noted that the acceleration graphs that were plotted were too complicated and that the data should be ‘smoothed’ to counteract the sensitivity of the accelerometers and eliminate some spiking effects.

The sensors are stable but the Axion ball is a prototype that cannot yet be used in all situations where activities with balls are undertaken. For example, it could cause injuries in volleyball. The software is considered to be easy to learn but limited in its output. The data export facility is perhaps too flexible, as a huge amount of data is generated in the files. Teachers perceived that for regular use by students the equipment would need to be more robust. It was also suggested that future developments could include a variety of sensors that would fit the ball to measure rotation (for biomechanics), gravity, light, sound and distance.

One of the partner ministries in the Seed validation developed a range of open source authoring applications and learning objects, Clic, freely shared in a distributed digital community, or collection of communities, for different ages of learner, different abilities, different subjects and different languages. Clic does not generate such sophisticated learning objects (in terms of structural complexity and variety of interactions) as the E-Slate microworlds. But the fundamental difference is that non-expert users can create learning objects in Clic, without prior training, whereas the writing of E-Slate modules requires both skill in programming and extensive time – so that it necessarily excludes most, if not all, serving teachers from making the learning objects without additional support. Clic, by contrast, is truly demotic, allowing any teacher with enthusiasm and even a little time, to create and share learning objects.

In the ITCOLE validation initially, the learning environment had to be translated into the national languages. Of the technical challenges that arose, the most serious were overcome. Intermittent access to the Internet in Denmark, Portugal and the Netherlands had a negative impact on the project. Possible future developments that were suggested included: making the user interface more colourful, including a spell checker, search and replace facilities, integrated email, videoconferencing and secure chat facilities. However, these could be addressed locally as the software is open source. In Portugal for example, the spell checker is already under development. It was also noted that it would
be beneficial to be able to publish the documents created as part of the knowledge building process (ie. the records of the interactions that have taken place). It should be possible to erase contributions after the end of a discussion. Teachers would also like artefacts in the ‘jamming’ (prototyping) area to be identified by their authors. When there are a lot of participants the number of icons identifying each individual causes the browser window to enlarge such that not all information is visible. It is not clear from the icons which participants are students and which are teachers; it would be helpful if such a distinction was clearly visible. Interestingly, students made very similar comments about the user interface design and lack of spell checker. One student from Portugal noted that it would be helpful to have an automatic translator in order to communicate with students from other countries.

There were a number of technical issues reported by the Danish participants relating to issues of speed and capacity, both of which affected access, and the impact of an automatic back-up procedure which led to difficulties. This was a barrier for some participants preventing them from getting started and interrupted activities that were already in progress. Staff experiencing these difficulties were naturally frustrated. Some schools in the other countries experienced similar challenges. The result was that not every school completed the projects that they had set out to do with their students.

In the ITALES validation, some teachers experienced initial challenges in relation to installations, particularly the need to download the tools, and usernames and passwords. The ValNet co-ordinator and the ITALES project team made it very clear in training sessions that the tools would only work through Internet Explorer on a PC. However, due to a misunderstanding, teachers in Sweden believed that the tools would operate on a Macintosh platform which caused some delays. They also experienced some technical challenges using the tools. In Slovenia, there were some difficulties relating to Internet connections. One teacher commented that ‘it will never be widely used unless the scenarios can be accessed on the WWW without a special ITALCO application having to be set up in the computer or the user’.

In the ITALES validation, 25% of the teachers felt that the technical support within school was insufficient. In ITCOLE, it was considered that professional expertise was required to set up the Fle3 server initially.

At the end of the METIS evaluation it was noted that some minor technical challenges were yet to be addressed. In particular, it was not perceived by all to be efficient enough for day-to-day usage; it was slow to respond to some inputs and some students (particularly secondary school students) found it difficult to learn. However, students, parents and teachers were very enthusiastic about their experiences in the environment, although elementary school students were more positive than secondary school students. The user interface was improved in many ways following feedback from the heuristic evaluation and usability walkthroughs. Home use was subject to technical problems in relation to low capacity Internet access.

The Youngnet evaluation reported a number of technical issues. Although many similar environments exist to support online communities, albeit with lower levels of technical sophistication, the security offered through YoungNet is seen to be hugely important in relation to protecting young learners online. Whilst teachers and students perceived that the tools and games were easy to use there were challenges relating to the speed of access, largely due to low capacity Internet connections. This was partly addressed by modifications to the server hosting the environment. Student and teachers found the system to be easy to navigate. The games provided in the environment were subject to minor technical problems and were not rated as highly as the communication tools. However, it should be noted that the student questionnaires were completed before many teachers and students had the time
to fully explore the environment. Whilst the environment was designed to incorporate leading edge technologies such as 3D, avatars and audio communication, the specific benefits of these facilities were not fully explored in the project’s evaluation.

**Implications for ICT resourcing**

The provision of resources in schools was perceived to be adequate and meet the needs of the project. However, until every learner has substantial and flexible access to the technology, then the use of it for such projects may be competing with many other demands on finite resources. This appears to have been an obstacle for some of the participating schools. This may diminish over time with increased provision in homes and schools, although the digital divide may continue to be an issue. Schools in the Seed validation already had appropriate tools and resources to fit their needs. They did not however have sufficient access to the technologies such that they could use these resources regularly. The participants used common productivity tools such as office software. Additional resources were not required for the 5D validation but in some countries (notably the Netherlands and Israel) there were additional demands for hardware and access to the internet.

> ...The ITALES project does not require higher technology than my school can meet. It requires high bandwidths (good internet connections), which my school has. On the other hand, I think that the ITALES project would have been difficult to participate in if the technical level of the school had been lower. (teacher, Iceland, ITALES validation)

Where projects were largely conceptual/pedagogical, schools were able to use existing ICT tools and therefore technical challenges were easier to solve due to greater familiarity. The more sophisticated tools such as VLEs demanded a greater level of support. In 5D in Israel, old technology and slow Internet connections were perceived to have impeded the project.

The installation procedures for ITCOLE were also challenging for some. Staff in The Netherlands felt that the installation guidelines were not always clear. A teacher in The Netherlands who was considered to have a high level of ICT expertise was still unable to install the Fle3 software after 4 hours. The implications of this are that schools will need professional help to install the Fle3 software. It was noted that it would have been helpful if everything required for the installation process from software to manuals was provided on one CD-ROM.

In the ITCOLE validation there were clear cultural differences with schools in Denmark generally being better resourced than schools in The Netherlands, Portugal and Hungary. In The Netherlands where the platform was installed within the educational internet services provider serving all institutions, schools would not be able to access Fle3 without paying for additional contracts and costs. There is a tendency in The Netherlands to move toward open source products but to date this has been implemented through individual pilot projects.

**Adaptability to the needs of schools**

Teachers in the Seed validation were more willing to make minor adaptations to tools and resources, and integrate it with existing practices than they were to create or localise complex learning objects.

For children with learning disabilities the projects may have been more beneficial than elsewhere as the affordances of ICT can address specific challenges that other children do not face:
People with SLD find the idea of the existence of other places they cannot see very difficult to grasp, but sending and receiving messages and files has made the understand that people are out there and that they have real lives just like us. (special needs teacher, England, Seed validation report).

Some of the teachers participating in the ITALES validation considered that the technical demands would make it unreasonable to expect it to become of general use, whereas many of the teachers thought that given reasonable development, it might become a tool for many teachers.

As ITCOLE is open source it will be easy to customise the environment to meet local needs. However this may demand a level of skill above that acquired by teachers and even school technical staff. Therefore it will be easy to adapt to the needs of schools with appropriate technical support.

6.5 Cultural issues

On the one hand, the partner schools all wish to form communities that work across regions and national boundaries. But they also find a security in starting with local links that they can easily sustain by traditional means and face-to-face meetings. Language appears as an obstacle to some, but many teachers are ready to use a common (often second) language as a lingua franca. A bigger obstacle than language is the difference in national education systems and national curricula.

Translation issues

The special characters used within Dutch, Icelandic, Slovenian and Swedish written languages presented challenges for about half of the 39 teachers who participated, particularly in Slovenia and Sweden. The majority of these teachers felt that it was important to translate the ITALES tools into national and regional languages in order to ensure that the tools would be widely used both by teachers and students. This was mainly for practical reasons, although a small number of teachers felt that this was primarily as a matter of principle. Again there were regional variations; the principle of providing resources in home languages was most important to teachers in Iceland, stemming from a national language policy, and in Slovenia:

In general I think that all software that Icelandic teachers or Icelandic students are supposed to use should be in Icelandic. It's essential that they're able to work in an Icelandic environment. The language will have much to say when the teachers choose whether they should use the software or not. (Besides this is a very important issue from the view of the importance of preserving and maintaining this rare language … ). (National coordinator, Iceland, ITALES validation)

In contrast a small number of teachers felt that it was important to use English to facilitate international collaboration:

It's very difficult if one makes content in his/her own language. I think English should be the main language in which all content should be made, otherwise it will never be an internationally usable environment. (Teacher, The Netherlands, ITALES validation)

The Dutch translation of the Fle3 interface for the ITCOLE validation was considered to be incomplete and inaccurate in places but this could be easily addressed.

The LoT tools need to be translated into a wide range of native European languages. It was perceived by teachers to be particularly challenging for students in some countries, notably Austria and Italy.
Multilingual issues

Issues related to the use of a second language are that fluency in speaking a language does not automatically mean that a person is competent in writing the same language; sometimes a person will appear to have a competent command of a second language but there may still be some level of misunderstanding. In Switzerland the Seed validation was challenging in terms of identifying partner schools, and exchange and collaboration because there are four official national languages. Although most Swiss people speak at least two languages, writing in a second language is not easy for everyone.

Initiatives in 5D were localised and not designed to be transferable to other countries or regions. However, the teachers that produced learning materials would like to share them with others. Examples of good practice would provide inspiring examples of how such an approach could have a positive impact and would highlight the potential benefits. Additional resources and support would need to be provided to ensure that resources were accessible to non-native language speakers. It would be beneficial to translate the 5D websites produced as a result of participating in the validation.

In the ITALES validation, just over half of the 41 participating teachers commented that they had experienced difficulties with language when using ITALES. A similar number of comments were made concerning students who had used the platform. Unsurprisingly, more students than teachers experienced some or very serious language difficulties. However, there were national variations. It was perceived to be a greater issue by teachers in the Netherlands and Slovenia in relation to both teachers and students. About 80% of teachers overall felt that they could use materials created by teachers from other countries. Again there were national variations, with around one third of teachers in the Netherlands and Iceland stating that it would be unlikely that they would be able to use resources created in other countries.

In the ITCOLE validation it was considered that English would need to be used for transnational projects. However, this was not explored as intercultural exchanges were not pursued as part of the validation. The educationalists in The Netherlands believed that Fle3 has potential to support collaborative learning in transnational projects, particularly because of the multilingual interfaces and clear symbols in the user interface.

English as a foreign language is a central subject in Norwegian secondary schools, and projects which require use of English are seen as positive – an opportunity for both teachers and students to develop their competence and skills through using the language in real situations – speaking or writing to real recipients, and getting authentic examples of the language in return. This is seen as learning potential, not as an obstacle.

However, there are also difficulties involved in English-language collaboration, for instance when involving partner schools in countries where the use of English is less widespread, and where teachers and students therefore may not have sufficient language skills for direct communication:

We do have challenges when it comes to communication with our Slovakian partners. The media teachers in Slovakia don’t speak much English, so we depend on support from the English teachers there. The students also have limited knowledge of English, so direct student-to-student contact will be difficult. (teacher, Norway, Seed validation)
The LoT tools were not designed specifically to support multilingual activities but activities based on their use could be devised to support second language learning (e.g. students from two countries discussing the results of their experiments).

The METIS and Youngnet products both had potential to facilitate language learning although this was not really explored within the project evaluations.

**Intercultural issues**

It was not a requirement of the validations to integrate intercultural objectives. It was possible for teachers to embrace this or ignore it if they chose to do so. There are some contexts in which cultural differences may constrain the impact of collaboration. For example, national science curricula differ.

Where initiatives focused on national or regional community building, such as 5D in Israel, it has been possible to bring people from different backgrounds together as well as transmit cultural values from one generation to another. Sweden ran an interethnicity project; a school in Israel brought together Palestinians and Jews; a Brussels-based project brought together French and Dutch speaking students.

**Transnational collaboration**

Although the teachers who participated in the ITALES validation had not tried any form of international collaboration with the available tools, they did comment on the potential benefits:

> I think that ITALES framework could be a very useful way for international cooperation, especially for foreign language learning and nonverbal themes - art. (teacher, Slovenia, ITALES validation)

International cooperation has its obvious disadvantages when it comes to different languages. Some of the projects made in this framework, however, have focused on teaching English as a second language, and that is a field that most nations can meet on. It also matters which nations you are working with, e.g. the Swedish and Icelandic languages are similar in many ways, while Slovenian is very unfamiliar to us. International cooperation can work well, however, when it comes to sharing ideas and comparing the ways we work. (teacher, Iceland, ITALES validation)

Clearly, the opportunities for international collaboration could be beneficial with support for transferring resources between countries and opportunities for teachers to learn from each other.

The implementation of Seed or 5D could potentially facilitate transnational collaboration but due to lack of time and the need to develop projects locally first, this did not take place. A handful of schools initiated new international collaborations in the Seed validation. However, teachers were positive about future opportunities and expressed an interest in experiencing other cultures. Two barriers impeding this are:

- differences in national curricula
- differences in national school calendars

Such projects that could offer positive impacts such as improved language skills and increased awareness of other cultures require careful planning and preparation and enough time to identify activities that could be beneficial to participants in more than one country.
The METIS evaluation reported that the platform offered students the opportunities to exchange ideas with students from other cultures. Parents commented on the value of enabling students to access different cultures, traditions and languages. Relationships between teachers and students in the four countries were improved and new contacts were established. When developing topics for study, teachers needed to negotiate and agree on what would be appropriate and relevant for students from different countries following different curricula. The Younghost evaluation found that cross-border collaboration was problematic because of differences in school calendars and timetabling.

In relation to the cultural dimension, the Younghost evaluation noted that the promotion of European awareness through cross-border communication and collaboration was perceived to be a major strength of the environment. Topics included ‘my locality’. Communications tools enabled students from different cultural contexts to exchange and develop ideas.

Educational practices and national policies: pedagogy, teaching cultures and THINK

Teachers participating in the ITALES validation felt that students were already used to using technologies to support their learning to some extent and therefore, that the tools available for validation complemented teaching practices in three of the four national settings. In Slovenia however 4 of the 10 teachers felt that they were used to more ‘traditional ways of teaching’. The ease with which technologies can be integrated into current practices relates to alignment of national policies with the THINK scenarios. For example:

Swedish teachers are not tied to a strict curriculum and have a huge freedom to use various materials other than text books as learning objects (traditionally this was newspapers, study visits etc.). Sweden does not have a governmental body publishing text books, this is done by publishing companies and teachers or schools choose what they want to buy. (National coordinator, Sweden, ITALES validation)

Alignment with THINK scenario 2 or 3 seems to enable teachers to integrate new resources more readily and easily as teachers have greater flexibility and autonomy. However, it is not straightforward and depends on the level of schooling (primary or secondary), the facilities offered through the technological tool and tools that already exist that might serve the same purpose:

The answer to this differs with the respect to the subject and school level and the different parts of ITALES. As an example the ITALCO idea of a quest fits nicely into the approach of Problem based learning, which is getting popular in Biology and some Science modules of the secondary schools in Iceland. … It's more difficult to see how this is supposed to work in Maths, for instance. On the whole I suppose one could find use of this working method (of ITALCO) in most subjects, if needed. The 3-D probably relies more on the school level and the teachers' tastes. The idea of the Metadata Course Assembly Tool fits well into the ideas of putting whole modules or courses on the WWW but also competes with other similar software, some of which are open source or free to use, like WebCT, Learning Space, Claroline, Manhattan … even ITCOLE (one of the other ValNet projects), which the EUN has already started to use. The ATENA tool (for making interactive tests) has to compete with the free and popular Hot Potatoes tool etc. (National coordinator, Iceland, ITALES validation)

The teachers themselves had mixed views about whether or not new tools like ITALES would lead to changes in teaching practices. For example:
I don't think this will make much difference, since I think the application will never be more than just supplementary to the traditional teaching methods. This is just like the application of videos; they're used now and then in education but haven't made any fundamental changes. (teacher, Iceland, ITALES validation)

In the beginning it will not affect the teaching culture, only replace paper with computer. In the long run, however, I believe it will change the way students will learn significantly; more interactive, more self-learning, learning at your own speed, less limitations in courses etc. (teacher, The Netherlands, ITALES validation)

Fle3 is most appropriate for supporting flexible approaches that involve project-based work and cross-curricular activities. That is, Fle3 would suit schools located with THINK Scenarios 2 and 3. Fully developing students’ competences in learning to learn, through progressive inquiry and collaborative work, can take some time and perhaps demands flexibility which can cause tensions in a highly centralised curriculum. Fle3 would be more challenging for educational systems that currently have tightly controlled curricula but not impossible. A teacher in Portugal who has continued to use Fle3 has commented that a project for Biology students (based on a somewhat rigid curriculum) perceived that the students had benefited from participating.

In Denmark, radical reforms of educational systems are due to take place from August 2005, including a greater emphasis on project-based learning, cross-curricular activities, embedding ICT in education, student autonomy, interactivity, and a team-teaching approach. Fle3 was seen to be a simple tool that would facilitate many of these aims.

In another example, the education system in Flanders and its ICT policy fits with Wood’s THINK Scenario 2. Schools have full autonomy to draw up curricula that meet common agreed and centrally developed attainment targets. There is a clear belief that investment in ICT will act as a catalyst for innovation. Perhaps, this cultural context provided the right conditions for cultural change. On the one hand teachers in the 5D validation said that the ‘innovative’ approach was not novel, yet they also spoke of changes in teacher-student relationships; they were ready to adapt and extend their practices. In 5D validations whole schools became involved, suggesting that it was pedagogically sound yet flexible enough to promote small-scale but systemic change.

The change in learning processes and the role of the teacher achievable through 5D initiatives would integrate well in educational systems that are working towards or have reached THINK scenario 3. The affordances include: personalised learning, learning on demand, learning everywhere and learning communities. These are all strategies that would support ambient learning. The ideas represented in 5D fit quite well with the national educational visions. For example in Flanders the new government wants to focus on a broad school that creates a rich and positive learning, working and living environment which 5D could support.

Two of the countries in the Seed validation, provided stark contrasts in national educational polices and practices. Norway places itself somewhere between THINK scenario two and THINK scenario three. Some of the schools taking part in the validation were, in their methodology and organization, very close to the situation described in scenario 3. Among the initiatives of the Program for digital competence is the project "learning networks", which aims to enable teacher training institutions, schools and school owners (i.e. local authorities) to strengthen their integration of ICT in education through building networks for sharing knowledge and experience. In contrast, England corresponds most closely with THINK scenario 1: the national ministry uses digital technologies to send guidance
into schools, and to pull data from schools (e-government). However, recent policies (leading to
greater autonomy for schools in defining some parts of the curriculum) reflect a desire to move
towards scenario 2. In these diverse settings, Seed was perceived very differently. For schools in
Norway, it encompassed practices and approaches that they had been using for some time. In
England, whilst some individuals clearly embraced change and innovation, the constraints of the
curriculum and assessment practices provided limited opportunities for radical cultural changes in
relation to teaching, learning and ICT.

Implications for ambient schooling

Learners should be supported at times that are convenient to them and anywhere that they choose.
ICT through mobile technologies, online communication and resources, and blue skies developments
offers these opportunities, providing the contexts in which ambient learning can take place, offering
flexibility together with guidance and structure as required. The learner and the community must be
central to the learning process; their needs and preferences should be prioritised rather than learning
being governed by organisational systems such as curricula, assessment and timetabling. This is not
to say that in the future all learning will be facilitated in virtual spaces. There needs to be a balance
between virtuality and physicality such that learners have real and concrete experiences to draw upon
when constructing and reconstructing knowledge. Consultation is key: learners must be involved in
designing curricula, assessment practices and learning spaces; teachers must be involved as
pedagogical experts and work together with technical experts to build creative learning resources; the
community must be involved both in defining local curricula and in valuable collaborations with
learners. Ownership is crucial: students must be able to contribute to designing their learning
pathways and be able to be autonomous; teachers need to be supported (both in relation to training
and time) to contribute to resource development without demanding high levels of technical skills.
This is the THINK 3 scenario.

Some nations are making radical shifts (such as the Danish upper secondary schooling reforms that
will be implemented in August 2005) towards these educational reforms whilst others are slowly
moving in this positive direction. Perhaps ICT truly has acted as a catalyst to disrupt the time-served
‘traditional’ approaches to education. This message is not new and unique but is becoming
increasingly important in order to serve the needs of our future citizens in the knowledge society. It
will demand risk-taking and trust from all concerned, be they policy makers, school leaders, teachers,
researchers, parents or other members of the community. The same may not apply to learners,
particularly the younger generations; for them the implications of risk-taking may not be considered,
whilst technological advances and educational reforms may be taken in their stride. They simply want
to be heard, included and respected for their individual contributions to citizenship and society, and
be able to have some influence regarding their (chosen) learning pathways.
7 Did the School of Tomorrow projects work in real settings?

While the main findings arising from all validations were considered above within the POETiC framework, we now present summaries of individual validation, before commenting on the outcome of this process for each project in the conclusions below.

7.1 5D

5D as implemented in the validation was conceptual and focused on pedagogy. This was perceived to be the only feasible way of proceeding as when the validation started the products and start-up toolkit were not available.

It was perceived by teachers to require small changes to their current practices, to be flexible and adaptable across the curriculum for short and longer-term activities. However, many of the teachers in the four participating countries were already involved in similar innovative practices involving cross-peer tutoring and so this was not seen to be novel by all participants. Nevertheless, teachers interpreted 5D in a wide variety of ways to suit their individual needs, involving older students and members of the community in teaching assistant roles, and experimenting with problem solving approaches to delivering areas of the curriculum, using action research as a mechanism to drive the change process.

The innovation was not perceived as a top-down approach; the openness and flexibility of the 5D concept and the action research approach gave the teachers the feeling they could really solve a real problem in their daily school life within the framework of the 5D-vision. Teachers were able to develop new practices in small, manageable steps; the concepts and implementation were not overwhelming. When presenting the project in the different countries all participants did not perceive the 5D-vision as alien but as something very natural.

Most teachers involved were aware of the necessary shift in their role from a traditional teacher to a tutor or a guide. They felt that a student-centred approach did not mean that their professional role was less important. Rather, they were motivated by the need to develop a new range of skills. Students responded positively to the changes in their role and enjoyed the opportunity to act as coach or be coached. Perceived benefits for students included developing pedagogical skills, social skills, creativity, organisational skills, learning how to learn, and learner autonomy.

In terms of general impact, teachers perceived that 5D made school life better and contributed to a positive community feeling. Building an intergenerational and/or an inter-institutional community of learners had a big impact on the feelings of well-being in schools. Most schools which participated want to continue to work in the 5D-spirit in the next school year.

In terms of organisational issues, a number of difficulties were faced. In common with the other four validations, there were demands on teachers’ time to learn about the approach, to devise the activities and train the teaching assistants. Integrating the activities within the curriculum was challenging, more so for secondary school teachers than for primary school teachers. The validator noted that this may be because primary school teachers work together as an integrated team, rather than in specialist disciplines, and have closer relationships with the community. As with other project validations the support of school leadership was a major factor. Interestingly, there was some concern amongst parents about cross-peer tutoring. One of the positive impacts was that the intergenerational aspect of the innovation gave the project more visibility in the schools and towards the broader community.
Staff and leaders in schools need to be open to moving beyond the classroom walls and building relationships with the local community. The innovation stimulated a lot of discussion because a wide range of classes and generations were (and still are) involved. The implementation was not undertaken by an isolated innovative teacher in any of the validation schools. A positive side-effect was an overall increase in ICT use within schools.

In terms of economic issues, it was perceived that this was minimal although there were cultural differences. Therefore, financial constraints are not likely to be an issue in terms of scalability although there is a need to provide incentives for teachers beyond the potential benefits of a positive impact on their students. The importance of this need varies according to cultural practices and policies. In some countries for example, teachers expect financial rewards for additional activities. What is clear is that schools must be adequately resourced in terms of technology; if this is not the case then additional funds will be required. The commercial software used by the 5D project team, Active Worlds’ required subscription and so was not used by any school in the validation.

Technical issues were not a major concern as teachers used tools and resources that were already in use. However, it should be noted that initial impressions of the tools under development for 5D were that whilst the underlying pedagogy was perceived to be valuable, the tools were too complex to use. In countries where ICT infrastructure is inadequate, with slow Internet connections and out of date hardware, there was a perceived negative impact on implementations of the 5D project.

5D had a big effect on local culture in terms of involvement of the surrounding community, improving understanding of cultural issues and differences, and taking learning beyond the confines of school walls. International collaboration was not a focus of the 5D activities; rather teachers focused on the local community and developed tasks that were relevant to the needs of their students and that met national/local curriculum needs. However, the experiences of the teachers involved in 5D to date could be shared with others and it would be valuable to disseminate the outcomes and activity templates more widely.

The widespread take-up and continued developments of the 5D implementation could be partly attributed to the way in which it was supported by the validators/coordinators. From the outset it was possible to present examples of good practice from the first year of the validation in Flanders, a pilot stage. This was vital when the concept was presented in the different countries; otherwise it could have been perceived as yet another theory. When presenting the project the validators and coordinators stressed that the 5D projects should be integrated within the normal curriculum; so teachers did not perceive the innovations as supplementary but as a part of their daily job. The ENIS group in Flanders consists of a strong network of great teachers that has existed for five years; existing group dynamics played an important role in the start up of the validation. Personal contacts between the schools, and between the validator and the schools, motivated teachers to be creative in building learning situations. The situation where innovative teachers were solo-players was avoided; at regular intervals they could get in touch with other, present their innovative projects, discuss and share as well good results as failures; the ENIS-group was perceived as a real “community of learners”. It should be noted that the teachers involved were motivated, dynamic and innovative. Strategies for involving and inspiring less innovative teachers may need to be developed.

In fact, the 5D-concept was not only effective as a vision on teaching and learning but also as part of the validation approach. All the characteristics of 5D can be used to support innovative teachers:

- by making innovation meaningful for them such that it is not yet another task to be done but is perceived to be part of their daily schoolwork
• starting from a problem situation to be solved
• ensuring that innovative teachers are not alone by providing coaches who could help the teachers but respect their autonomy and personal pride
• creating a “community of innovators” that share their projects, in the same way that a community of learners is created
• building in periods of self-reflection and, opportunities to showcase results and share concerns

These points guaranteed that the small-scale 5D-initiatives of the ENIS-teachers were perceived to be have positive benefits for their students; so much so that the teachers were motivated to continue with similar projects in the following school year. The 5D initiatives were largely perceived by teachers to beneficial across all four countries. The overall perceived positive impact is evidenced by the Flemish ministry of education’s decision to implement 5D across all Flemish schools and the interest of individual teachers and learners in participating further.

7.2 ITALES

The validation team concluded that even though teachers’ opinion on the pedagogical value of the ITALES tools is somewhat divided, the general conclusion is quite positive: the majority view is that it deserves to be developed further. It was thought by many of the 39 participants to be a potentially interesting and powerful educational tool, particularly for authoring learning materials but also to access and use resources created by others. The ITALES project was still in progress and the tools were still under development. However, the ITALES project team were quick to respond to technical faults and queries.

The underlying concepts of the ITALES tools fit well with the THINK 2 scenario but it has not been possible in this validation to explore the extent to which school staff or the school as an entity wanted to change and innovate, apart from participating in this project. Thus we cannot say enough about whole schools and therefore it has not been possible to comment on whether or not the ITALES tools, potentially interesting and conceptually flexible as they are, will be able to stimulate sustained innovation and change in the whole school culture. It should not be expected that tools of this sort, not specifically the ITALES tools, can be used to alter a school culture in any very perceptible way unless a much more powerful support and developmental environment is provided. Moreover, such tools could be used inadvertently within educational systems that are more closely associated with THINK scenario 1. Thus, rather than acting as a catalyst for change, ICT tools might be used to fit into a different setting from that for which they were originally devised.

The ITALES tools appear to be easy to integrate with existing teaching practices, supporting flexibility and problem solving approaches as well as involving students. However, unsurprisingly, there was little evidence that the use of the ITALES tools on this scale has contributed to long-term and systemic changes. The evidence suggests that there could be changes in the ways students work and teachers teach, but also indicates the potential for the entrenchment of traditional, if very professional modes of working. The ITALES tools may not dramatically change the ways these ICT-literate teachers think about computers in education, simply strengthening existing positive beliefs, but may help to change the views of their colleagues.
Moreover, the participants perceived that the tools were not superior in comparison with other available educational innovations although they were positive about its future potential and its conceptual value.

There are a number of important organisational, economic, technical and cultural issues, which emerge as quite important and perhaps challenging irrespective of the positive pedagogical value of the tools.

The prototype tool that was available at the time of the validation was not easy to use and required a significant investment of time from the participating teachers. Careful consideration should be give to the allocation of time for preparation of resources using the tool in normal practices. As well as the demands on teachers’ time, many found it difficult to integrate the tool into their daily practice, being constrained by time-tableing issues and demands of national curricula. There were, however, considerable national differences. In relation to funding, the main cost is teachers’ time but it was noted that for future sustainability some form of reward should be offered, whether financial or not. The goodwill of enthusiasts should not be relied upon. This of course has major implications for scalability and sustainability.

There were no additional demands on schools’ ICT infrastructure. However, some members of this group of (largely) technically competent teachers felt that the tools were complex and demanded a high level of technical expertise. It was not perceived by them to be suitable for ‘ordinary teachers’ although had potential as a tool for teachers trained as ‘expert’ curriculum material developers. Others however felt that with further development it could become a tool that many teachers would use. There is a need for clear documentation and opportunities for training. The technical status of the ITALES tools used in the validation was not yet fully developed whilst their comparative status with existing similar tools did not reveal major advantage.

In terms of cultural issues, whilst teaching practices differ between regions and nations, it was also noted that differences can occur within discipline areas. Therefore, ITALES could be useful for some teachers, in some subject areas, in a number of countries. However, it is clear that any educational tools should be fully translated into national and regional languages for general distribution. Within this validation the possibilities of transnational collaboration were not really explored. Teachers noted that there needed to be clear objectives relating to such use and procedures for handling the transfer of materials created using ITALES between different schools, regions and countries.

The validation has raised some questions regarding the whole process of developing tools like ITALES so that they have a chance of a sustainable future within the education system. The main issues are complexity (requiring clear documentation and training opportunities), time (requiring strategies for rewarding teachers for their investment), and the potential competition from existing similar products. For example the ATENA tool designed to create interactive tests was not perceived to offer any advantages over ‘hot potatoes’ which the Icelandic teachers were already familiar with. These issues all have implications for sustainability, scalability and future adoption by teachers across Europe. However, the ITALES tools that were validated were not yet fully developed at the time of the validation and therefore this should be taken into account when interpreting the findings.
Despite initial concerns that the limited timescale for the validation would not reveal anything about the impact of Fle3, there was clear evidence that the use of the platform could be a facilitative tool for knowledge building, a valuable approach to learning. It was thus seen to be a project that would be beneficial for both teachers and students with great potential for the future.

The strength of Fle3 is that focussed on a new philosophy, that of an innovative approach to learning, learning how to learn collaboratively thus building knowledge. The advantage over previous tools that have been used to support collaborative learning in this way is that Fle3 has integrated the pedagogy with the ICT tools. The perceived impact on students was that they built and deepened their knowledge. Students enjoyed sharing ideas and problems, and explaining ideas or suggesting solutions to each other, researching scientific explanations, and contributing to building knowledge. Most teachers shared the opinion that Fle3 and progressive inquiry methods were highly motivating for students. In Hungary for example students devoted 2-3 hours a week to project work. They used Fle3 mostly in IT lessons but also stayed on after school to work together and in a few instances worked from home. In addition they used the school and community libraries to conduct research for the project. The Danish validator also noted that students worked together at all hours, facilitating anytime, anywhere learning. In addition there was a shift in the relationship between student and teacher, with the teacher becoming more of a guide or coach and students becoming more autonomous.

In relation to organisational issues, it should be noted that this project was not completed in schools where senior management did not give full support to the project, highlighting this as an important factor contributing to the likelihood of engagement with ICT tools in educational institutions. In contrast, the involvement of the local Mayor with one school led to further investment in infrastructure and raised the profile of the validation, which promoted awareness among all school staff. In Hungary, the outcomes were disseminated widely through in-service teacher training.

In relation to economic issues, Fle3 is open source and thus can be obtained free of charge and customised to meet local needs, whilst being robust, well documented and easy to use. There were cultural differences in relation to provision of infrastructure and speed of access to the Internet. However participating schools had above average ICT equipment and teachers who had received substantial training in ICT use and therefore the validation did not incur any major additional expenses. As with the other project validations it did rely upon teachers’ good will. In terms of resourcing, funding would be required to scale up the project and this would differ from country to country.

In relation to technical issues, the ITCOLE products are well-developed and ready for implementation. Supporting documents and guidance on the web are of high standards. There are some further developments that could be made but as it is open source software, it can be tailored to meet individual and local needs very easily, making it a very flexible resource. For example, it is straightforward to customise the user interface for native languages and in Portugal, a spell check facility is already being developed. The minor technical challenges that arose (for example installation on servers was not straightforward) were easily solved.
In relation to cultural issues, this was not explored within the ITCOLE validation. However, it was noted that the tool would be appropriate for cross-border collaborations in a shared language and of course the topics selected could focus on the development of intercultural awareness.

It would be straightforward to scale the project up to include more schools subject to adequate provision of infrastructure and resources. In fact, in Portugal this is already happening. From September 2004, 50-60 schools will participate in a longer validation, funded by the Portuguese ministry of education. The main focus of this further work, having established that students like the approach and Fle3, will be to evaluate the impact of such experiences on learning processes and learning outcomes.

The Danish validator noted that upper secondary education will be facing extensive reforms from August 2005 including a greater focus on project-based learning, cross-curricular activities, increased student activities, integration of IT, increased responsibility in own learning and a team-teaching approach. The validator concludes that ‘the little Fle3-programme will become a simple but genius tool in this context.

The ITCOLE project was also evaluated by the project team (Dean and Leinonen, 2003). In sum, this involved 80 collaborative projects with 100 teachers and 2100 students, across four countries: Finland, Greece, Italy and The Netherlands. The tools proved to be technically robust (although it was acknowledged that further improvements could be made) and flexible as they were used in a range of subject areas with students of different ages. There was a positive reaction to the underlying pedagogical model but teachers concluded that new knowledge building by students is a complex process, especially when teachers do not explicitly guide students through activities as is the case in ITCOLE. The importance of face-to-face communication in addition to virtual collaboration was noted by many students and teachers; it was a natural extension in many projects. It was also noted that collaboration is not a natural activity for students, particularly in secondary schools. Teachers perceived that extra support and guidance was required to develop deeper collaboration skills, demand new skills. Two factors emerged: projects were perceived to have greater positive impact on higher order knowledge acquisition when students and teachers had prior experience of computer supported collaborative learning; and furthermore projects were perceived to have a greater such impact in primary schools than in secondary schools. The evaluators commented that perhaps primary school students are more open to new approaches whereas secondary school students have been conditioned by prior experiences and preparing for formal assessment. In many countries (but not all) the primary curriculum is more flexible making it easier to incorporate specific projects. In addition, it would be easier to integrate Fle3 within secondary education if the national curricula were more focused on problem based learning. Teachers needed pedagogical and technical training, and time to design the activity and consider how to integrate it with the curriculum. It was noted by the evaluators that pedagogical change will not happen overnight. Recognising the importance of training and support, the ITCOLE project team developed a teacher training module consisting of both traditional workshops and virtual learning. There were issues at the end of the project regarding open source licensing agreements. This was particularly problematic for Synergeia which was based on an extension to an existing product.

7.4 LoT

As demonstrated by the activities carried out by the LoT project team in their own test schools the technology works in a real setting and there should not be any problem in the implementation and use
in different European countries. What remains to be seen is whether schools across Europe, not just ENIS schools, that represent leading edge schools, have the necessary basic infrastructure for using the LoT technology; an issue that is pertinent to all the School of Tomorrow projects. In addition ENIS teachers are generally very motivated, real innovators, open to the experimentation of new tools and methods and this cannot equally be said about the generality of teachers.

Schools involved in the validation have not had the possibility of implementing LoT in their schools. To consider this possibility it would be necessary to have a larger number of sets produced, at a cost. Some Italian technical schools were very interested in actually constructing the sensors and the other electronic equipment. This option would represent an additional benefit on the pedagogical level – the student that actually constructs the tools for his/her learning. Perhaps the LoT project could consider the selling of licences for building the equipment as well as the marketing and selling of the finished product.

In relation to pedagogical issues, the teachers in the workshops perceived that the LoT tools were user friendly and easy to use. In addition they felt that students would think more deeply about scientific concepts through direct experience. However, it was noted that commercially available tools are reasonably priced and offer similar functionality. In relation to the underpinning learning theory, it was also noted that ‘constructionist’ approaches were already used in the teaching of physics and so this was not necessarily a novel approach.

In relation to organisational issues, the constraints of national curricula, timetabling in schools (fixed periods) and assessment practices was perceived to be a barrier. It was suggested that a half-day workshop would be the best way of organising LoT activities, ensuring that students had sufficient time to conduct the experiments and reflect on the findings.

The LoT project has not investigated issues relating to costs, mass production of equipment, distribution channels and other aspects relating to a business model. The local positioning cameras do not appear of general interest to schools, considering as well the high cost, and cheaper solutions developed by other partners in the LoT project, for example the simple web-cam used by the Polytechnic of Turin seem more suitable for school use. It is difficult to say whether there is potential for the project being implemented in other schools in the future; the equipment has already some competitor products available on the market and a school would base very much a decision on costs and performance in relation to other products commercially available. Still the project and the tools developed were considered very relevant to teaching in school. Teachers participating in the evaluation, suggested other uses of the equipment in addition to the teaching of physics, in particular in sports related courses, as well as the possibility of using the equipment, with a simplification of the user interface, in other levels of school other than secondary schools.

There is general agreement that the equipment developed in LoT could be used in different countries in Europe and could fit in the curriculum of many schools, moreover, it has been suggested that the equipment could be very useful for trans-national school co-operation projects. Teachers were very positive about the site created by LoT project partners for the exchange of experimental data between the LoT schools participating in the testing http://www.lotexperiments.net/

The main difficulty in the implementation for the validation was due to the non availability of the equipment for testing in a real school setting. Nevertheless the workshops were perceived to have been successful in identifying the potential benefits and pitfalls of classroom use of such technologies. In addition the workshops provided for a closer collaboration with the LoT project
partners, who tried to compensate for the non availability of the equipment for validation, by being very co-operative and forthcoming in sharing with Valnet partners, experiences, information and expertise. One negative aspect of this arrangement, however, was the fact that the four partners participating in the evaluation had each a different experience because each of them dealt with a different LoT partner that, understandably, gave its own vision of the project and demonstration of the equipment. So the personal element was very important in the outcome of the workshops; there were slight variations in the equipment available and in the area of expertise of different partners and there was no clear indication of what should be considered the official output of the project in terms of set of documents and equipment.

7.5 Seed

In some cases, projects in Seed were implemented with very little support and perceived by the teachers involved to have a positive impact on their students. This appeared to depend on staff levels of ICT competence and confidence, time, and enthusiasm. However, in other cases, many schools struggled; some achieved their aims, but called on support or guidance from the validation coordinators or from elsewhere. And a very few did not complete the project.

In principle, it would be quite possible to adapt the concepts behind the project for any educational context. But this would, and should, be a rigorous task, requiring sensitivity to the national, regional and local situation, to teachers’ autonomy and experience, and so on. In order to develop fully integrated communities there needs to be some form of funding to ensure that participating teachers receive adequate training and can be released from their normal classroom duties to contribute to the development of resources.

Although the majority of teachers explored the possibilities of using some of the tools and resources created as part of the Seed project, they were not perceived to be useful in relation to existing tools and resources. In addition, only some of the tools and resources were available in appropriate languages at the time of the validation. Whilst the majority used standard productivity software and communication facilities, some used open source authoring tools developed in one of the partner countries. The participants from the four countries were diverse in terms of competence, practice, expectations, resources and contexts. The validation revealed that teachers are very strongly autonomous in their choices of resource, and, although willing to explore new technologies and resources, are very discerning when choosing appropriate tools to support classroom practice. The participants in the validation perceived that existing products and resources offered the same, and sometimes more sophisticated, facilities as those developed as part of Seed.

We have access to similar programs in Norway already. Coolmodes and FreeStyler are only available in German, and we did not have the time or resources to have them translated, nor do we think this would be worthwhile – not because they are not useful programs, but because they do not offer anything which isn't already available in other programs. eSlate existing modules are only available in Greek, and to develop your own is much too demanding without extra resources. Translation also cannot be done without extra resources. Through the Celebrate project we have access to programs which do the same things better. (Norwegian teacher, Seed Validation)

Students perceived that the project had a positive effect on their learning and that they had communicated in different ways. They did not however feel that they had taken part in new kinds of learning activities. Interestingly, teachers felt that their relationship with learners had changed but the learners felt that their relationship with teachers had not. Teachers perceived that in participating they
had gained the support of others, integrated technologies with established practices and taken part in new forms of collaboration. They also perceived that Seed had a positive effect on teaching in their own schools. However, they did not believe that they had developed new communities; rather they had developed existing ones.

In relation to organisation issues, the project did not have much immediate impact on school management practices. But where a teacher was a school leader, or closely supported by a school leader, the impact was greater. The teachers who participated perceived that their individually designed Seed projects would have a gradual impact as others become aware of it. The teachers leading the projects were able to use existing infrastructure and resources within their schools and this provision was perceived to be adequate. Learning beyond the classroom is implicit in the Seed concepts. It occurred to varying extents with the four countries according the aims and objectives of individual projects. Several schools, in each country, involved the local community or the wider community in ways that were appropriate to the projects, and general principles of community relations.

In relation to the economic issues, strategies for rewarding the commitment of teachers are required. The Seed project and its interpretation by participants in the validation requires significant investments of time to prepare and develop resources, and to initiate and sustain online communities. Although freeware and open source software can reduce costs, personal/institutional costs in terms of staff time are hard to quantify. The project as adapted for this validation is not limited in scale but may demand a more structured approach in terms of support mechanisms and incentives to participate.

The Seed project did not require the use of specific or unconventional technology; teachers adopted technologies that were already in use and that required little or no adaptation. However it should be noted that teachers in special education found it more necessary to adapt existing technologies than the other participating teachers.

In relation to cultural issues, local languages were used most commonly but where international collaboration occurred English or Spanish were used. Teachers in Catalonia, Norway and Switzerland could generally speak a second (commonly used) language. Only in England was this not the norm. Seed as interpreted for this validation was adaptable to national or local educational culture. However, clearly there were issues regarding the products and tools developed as part of the Seed parent project. For example, the eSlate modules were tailored for the Greek curriculum and therefore not always appropriate for other national curricula. A few teachers initiated transnational collaborative projects but this was more demanding in terms of time and many participating teachers felt the need to develop local projects first.

The fact that Seed had to be adapted so flexibly for the purpose of the validation demonstrates the difficulties associated with developing fully integrated communities: funding staff time, providing adequate training and technical support, and allowing enough elapsed time for building communities so that the members become productive. In order to scale up provision of tools for generating integrated activities the following are needed: adequate documentation, training and support, and facilities to translate into other languages. Resources created in one school/region/country will not necessarily be appropriate for others depending on national and regionally policies and curricula.

Whether or not Seed could be adopted by schools without any support remains to be seen. In fact, a fundamental concept is the active involvement of a number of different parties. But it seems likely
that support is needed in bringing these different actors together. Where participating teachers were
given flexibility and little guidance in the validation, the outcomes were mixed. Some teachers had
clear ideas about what they needed to do and what their individual project aims should be. Others
struggled and called upon support from validation coordinators or from elsewhere. It seems that staff
competence and confidence are major factors, as are time and enthusiasm.

What conclusions can be drawn from the national reports? From Catalonia, the view is quite positive,
as this comment shows:

It has been a very interesting project and the outcome shows the level of work and active
participation of students. It has been very motivating for them to exchange experiences with
students with similar environments and difficulties. Language can be a problem, but motivation
helps everybody to keep trying and doing things. The period of time available was not very long
but we hope we can keep this collaboration and do great things together. (Catalan teacher)

The view from Norway is more cautious:

The Seed project as such has been much too isolated, too short-lived, too hurried, to in itself cause
any permanent changes in schools. However, in some cases it may have provided an opportunity, a
starting-point for something which may be developed in the future. Some school
twinning/partnerships have happened as a result of the project, which may continue and lead to
other activities. In some schools, Seed has been purposefully integrated into a long-term process
which was already underway in the school. In that sense, one may argue that Seed has contributed
to a development. […] Seed as such has only been an opportunity, a starting-point, a seed... It has
not in itself caused anything to happen. However, this fits well with Seed's vision of involving and
empowering the teacher as the expert. (Norwegian teacher)
8 Towards a sustainable and useful validation service

Much has been learnt in the EUN ValNet project by everyone involved. It was a bold decision to suggest the very notion of a validation service and for the Commission to support it. There has not been any similar attempt in the past to field test so many outputs of IST projects for schools in so many different countries and real settings in schools, or to attempt to synthesise the results. All this has happened in the short space of time dictated by the project-based culture in the European Commission and by the need for urgency in scaling up and implementing on a large scale those products that are proven to work, before the technologies are obsolete. The findings reported elsewhere and the meta-analysis carried out on them demonstrate positively that the concept was worthwhile, that its implementation contributed to knowledge and understanding about the potential impact of ICT in educational settings and that there is a case for a continuing EUN validation service.

However it is timely to reflect on the validation service itself and how it might be changed and suggest a model for a viable autonomous service. A workshop for the validation experts and others took place in Brussels on 25th May 2004 at which a number of reflections and conclusions were made about the service. They are reported in the following paragraphs.

8.1 Assessing the impact of the ValNet service

The view of the academics working in ValNet was that, “along with the other project implementations, and allowing for some refinement of the instruments, it has the potential to be a reliable method of quality assurance for research activities or projects.”

ValNet achieved its primary objective: to determine the likely impact of projects in the School of Tomorrow Action Line in a range of school settings. For example, it revealed the value of the ITCOLE Fle3 platform as a CSCL tool, elements of ITALES and the 5D model. Conversely, it indicated which might not be suitable for widespread uptake; as one validator noted the validation procedures demonstrated their own rigour and credibility through identifying the challenges of implementing Seed in real contexts. Through Commission and EUN channels to schools and policymakers the results of ValNet will continue to be disseminated widely. EUN will ensure easy access by education ministries, agencies and schools to those products that validation showed to be of value and are available.

The ValNet experience had a positive effect on the School of Tomorrow projects themselves. The very existence of a validation element running independently of the projects, even if it had no role to be judgmental on them, had a galvanising effect of them in terms of strengthening internal testing and evaluation and, importantly, in ‘going the extra mile’ (sometimes after the formal end of the project) to ensure that the product and user documentation was robust enough for the ValNet schools to use.

ValNet succeeded in providing challenges to schools that were already experimenting with ICT and new pedagogical approaches, and in bringing together the often discrete worlds of academic research, schools’ day-to-day practice and educational policy-making. The validation experts remarked on the positive attitude of most teachers; and their interest and dedication. They also noted students’ full and serious participation, contributing to an illuminative view of the Fle3, for example. The international dimension of the validation process too was an added benefit for schools and the researchers.
8.2 Validation framework

The MENON framework was found to be generally appropriate, addressed all the issues and worked well generally. It provided a very valuable structure for the validators but was not appropriate in its current form for teachers due to its complexity. While accepting that it was not entirely original work, the validators found that, without the POETIC grid, it would have been impossible to integrate the different validations. It helped to keep the balance between pedagogical and other dimensions. The ITALES validator said: “The pragmatics of the O-E-T-C dimensions of an essentially pedagogical tool turned out to be more important than we had anticipated when considering the up-scaling of the tool.”

However use of the framework was selective and some tools and instruments were not used. To some extent this was to be expected because WP2 aimed to produce a framework and toolkit to be adapted according to the specific project, validation process adopted and school circumstances. The toolkit was not used in its given form, but adapted and often shortened and/or simplified. The most popular instrument was the questionnaire, used in most validations, and usually completed by teachers. Interviews and teacher diaries were also commonly used. Therefore, the ValNet framework, as adapted, adopted primarily qualitative approaches, relying on the opinions of stakeholders such as teachers, students and parents, as well as classroom observations. It was not possible in the limited time available to ascertain the impact of the projects on learning in relation to formative assessments or through using other quantifiable measures.

It may be that the framework supports evidence-gathering for some THINK scenarios more than others. In a future version the vision of learning in it should be made more explicit.

8.3 The validation model

After the experience of ValNet, it was felt that some changes to the design of validation would have benefits in terms of cost-effectiveness and the validity of the results.

Given the diverse nature of the projects a ‘one size fits all’ approach may not be appropriate. Although a common reporting and analytical framework is important for cross comparisons, a different approach for testing might yield more valuable results. For example, the Lab of Tomorrow tools were tested in a similar way to the other products: in schools, with interested teachers and over the same period of time (subject to the availability of the equipment). The results, as reported earlier, tend to show that the product may not be suitable for use in large numbers of schools. The internal project evaluation in Germany found similar results, but it was noted that student numbers opting for advanced science courses in the school had increased (although this cannot be attributed to the tools alone). So the design of a validation should be capable of adaptation to detect unexpected consequences like this. The two-phase approach, described below, may help in this.

For each project or product, preliminary work should take place to establish the nature of what is actually to be validated. Some careful analysis should be made, including some informed judgement, about which age, ability and preferred learning style of learner might most benefit from using the product, the type of school and teacher where it might flourish, etc. Pre-conditions should be established prior to large-scale validations, for example, infrastructure requirements, teacher competence and expertise, availability of documentation. If they are not present then the project should not take place.
Some validation elements and instruments should be standard for all projects to make cross comparison easier. The service should nominate a chief validator and a team of assistant validators rather than, as in ValNet, five equals. While international, multi-institutional projects are never easy to manage, owing to differing cultures and the lack of the direct line management responsibility that is found in a single organisation, there should be strong internal coordination. There should be more school visits ideally and a move away from controlled experiments to empirical observation for example.

Placing validation within a wider context of school change towards ‘ambient schooling’ as described in THINK and NOW was an ambitious idea but worthwhile. The scenarios in THINK in particular provided a background into which to assess the wider effect of the project outputs under test. Without them the broader pressures on schools arising from technological possibilities, school modernisation, changing aspirations and public expectations for schools and policy shifts at national level would not be seen to impinge on the validation and the results would have lost considerable depth. THINK in particular helped to sensitise validation experts to such issues. Although it would have been surprising to have been able to detect seismic changes in school systems as a result of the introduction of a piece or technology into a classroom for a few months, there were nevertheless some indications as reported above and THINK helped to encourage validators to be alert for small scale but significant changes towards conditions leading to the school of tomorrow. ValNet was never intended simply to be a product testing service, easier as that might have been.

Design should also recognise a criticism with some validity of a host of innovations which receive a lot of hype, acclaim and promises that have then come to nothing. As one of the validation experts said: “I care very much about innovation and change and I think ICT has an enormous potential, but it should not be oversold, which would bring about lethargy which would be damaging in the long run.” Thus, reservations expressed in the validation reports should be seen in this wider context where measured judgements of technological ‘solutions’ are called for.

A major change in the future should be towards a simplified form to get a reasonable impression of a project like ITALES. As the Icelandic team put it:

We feel that there should be a more explicit initial evaluation phase (post-prototype) that should be used to point out some “serious” but “obvious” OETiC problems. We feel that such a device should be developed, with a short pilot test in one or two schools, in one country.

ValNet might therefore be divided more explicitly into two phases:

1. ValNet I; Testing of a prototype, with the normal testing and evaluation involving 1-2 schools. This is an initial screening, a preliminary validation, somewhat similar to ValNet, but more limited in terms of schools. The emphasis is on a pedagogical evaluation to establish the potential of the tools; the results feed into ValNet II.

2. ValNet II; a focus on organisational, economic, technical and cultural issues, by seeking to answer 3-4 challenging questions in each of the four dimensions. This would include contractual support of selected projects, plus support of their school implementation. Market the products that offer cost-effective solutions and clearly have potential to make a positive impact.
Such an approach gives an opportunity to fully explore the scalability and sustainability issues. It would also mean that the first phase could involve looking at more projects (assuming there is a Programme containing such projects). There could be a period of intense scrutiny and analysis of potential projects to validate and clarification of the underlying pedagogical aims of an innovative tool and then subsequently to investigate to what extent this fits with the developmental aims of schools. Even if projects have a user needs or audit phase this is often badly done so such a period of discussions and analysis could be useful to both sides. Some projects, notably those that are about vague principles, are difficult to validate, and may not lend themselves to ValNet treatment.

It has been challenging to conduct large-scale validations in such a short period, particularly when change and innovation often requires a great deal of time to embed fully within existing school practices. In addition, four of the five selected School of Tomorrow projects were still developing products and services at the time that the ValNet validations were undertaken, forcing the validators to work with pre-release versions of tools, or focus on concepts or tools that were feasible to implement. Therefore, in future the timing of validations must take into consideration the nature of the project, the expected dates of delivery of products and services, and the likelihood of a requirement for project extensions and potential delays.

Validators were frustrated at the delays causing the late beginning of the testing phase, as well as for writing the reports. In many cases validation started before products were ready. Furthermore, ten weeks testing in schools may not be enough in some cases. It is if the project is completed and fully documented. Even so it is too short a period to spot systemic change and empirical impacts on teaching and learning:

There needs to be sufficient time to both plan and introduce the project, and to implement it (including preparation time if teachers are required to create resources); the provision of funding to buy time for practising teachers will only be beneficial if schools can incorporate the project into their mid-term planning processes. In some cases the limited time for validation has limited the outcomes: ‘...the time available for validation was far too short to develop the kind of long-term process-based, learning-community work suggested by Seed so that it can be subsequently evaluated’ (national validator, Seed, Switzerland).

The experience with projects like the Lab of Tomorrow leads us to conclude that there is no ‘one size fits all’ validation model. This was reinforced in two workshops about analytical frameworks held in September 2003 bringing together validation experts from ValNet and other projects (ERNIST, CELEBRATE and OASIS). It considered a number of questions:

- Can one size fit all?
- Flexibility versus comparability
- Simplicity versus complexity
- Fuzzy boundaries / overlaps
- Time/resource constraints
- Language issues
- Cultural issues (attitudes to change, attitudes to research)
- What do we mean by change? Change from what? How is it measured (e.g. whole school change)?
- What is being evaluated?
  - Content, tools, services
  - Pedagogical models within the product and surrounding its use
  - Impact on practices, integration and transformative processes.
• Tool box (schools portraits, observations, reflective notes, diaries, interviews, questionnaires, templates, banks of questions)

The view of one expert was shared by many:

Education has much to do with the weight of the past, prevalent culture, and an evaluation has always to start with a thorough assessment of the environment, the people involved, their needs and their expectations. Therefore the evaluation design strongly depends on that assessment, and the evaluator must choose the appropriate tools, not those that are listed in a "menu". However, if one size does not fit all, a tentative schematic approach is possible and even desirable. One country might keep the Framework light, simple, when other one can sustain a more tied relationship with a more elaborated model. (Cândido Varela de Freitas, ITCOLE)

8.4 Management approaches and working with project developers

By the nature of the project, an accompanying measure requiring communication with all the School of Tomorrow projects, ValNet would succeed or fail by the rapport developed between the different actors. In theory validation could take place with no contact at all between ValNet and the different projects and this of course would avoid any ‘contamination’ between them. In practice though, a number of contacts were made, some from courtesy, but most in order to obtain information, guidance and materials relating to products that were still being developed.

There were differences of approach between validations, partly depending on the degree of co-operation from the School of Tomorrow project team. On the one hand, notably in 5D, there was close co-operation such that the ‘validation’ could be critically described as a ‘dissemination’. On the other hand there were projects where the original project team had been disbanded and moved on to other work (e.g. ITCOLE and SEED), so the validators had to make use of publicly available outputs and associated support materials. In projects that were still in operation (e.g. ITALES) the project team provided considerable help to the validators and schools in order to optimise the conditions for positive impact of the products.

In almost all cases, including the projects not selected for close validation, information and help were readily given, and the ValNet project team gratefully acknowledge the assistance and time given by the School of Tomorrow projects.

In future, there should be more clarity about the relationship between validator and developer, including protocols for working with other projects, e.g. who shows what when, clarifying the role of project staff in relation to technical support.

8.5 Involvement of countries and schools

The objective of ValNet to conduct co-ordinated validations of each project in schools in four countries was ambitious and on the whole provided valuable evidence about whether or not School of Tomorrow projects could be implemented in real contexts and achieve the predicted outcomes.

The five lead countries for the validation were partners in the original proposal and came forward in response to an invitation from the EUN office to participate in the project. One motivation for taking
part was the opportunity to involve schools belonging to the European Network of Innovative Schools in ValNet work that appeared to fit national and school interests. EUN then invited other ministries and agencies through the EUN network to join one or more of the five project validations. EUN also identified the five projects, in consultation with the Commission, and matched them to the preferences of particular ministries. In future this arrangement could be retained but consideration given to getting four countries to work more closely in harness and to simplifying payments for sub-contracted ministries.

School selection was a matter for each national partner. EUN provided guidelines and suggested criteria. In most cases countries were able to identify some ten schools and the validation process went well, as reported elsewhere. There were, however, a number of issues and in future there should be:

- Selection and support for schools so that they can take on validation easily
- Better matching of project principles to schools’ developmental aims
- An assurance from schools that the teachers involved have the active support of management
- Integration of validation into school plans and timetable.
- Strengthening of the visibility and pride of participating schools so that they take seriously their role as supporters of innovation. Issuing participation certificates to schools can help in this respect, as did face-to-face workshops (although expensive). This suggests that ValNet schools become a distinct cohort, and certainly not fully representative of the average school, but experience showed that if the product did not work in these innovative schools it really would not work anywhere. Such a network needs to be fed a regular supply of products and services to test, in order to give it purpose and value.
- Differential funding for schools according to GDP of the country
- A recognition of the crucial importance of the interest and dedication of teachers involved. Strategies should be developed for building communities of teachers (face-to-face meetings, structure, clear outline of objectives/obligations). Creating (action) research communities involving real teachers and with the involvement of universities and policy makers could be a real challenge for the future.

Selecting innovative schools is challenging. On the one hand such schools are not representative and may be in the process of change already, making it difficult to attribute any positive outcomes to the project being validated. On the other hand, without the involvement of enthusiastic and ICT confident teachers who are prepared to innovate and experiment, the integration of leading edge technology projects in educational institutions may not even happen.

One outcome of the involvement of the ENIS network has been for a number of the countries involved to rethink their criteria for selection of schools to the network and also to expand their networks. So in Italy, Portugal, Norway, Denmark, Sweden, Italy and the UK the ENIS networks have been revitalised and expanded and these countries are already expectantly looking for new projects in which to involve their schools.

Perhaps most importantly, innovative projects must have potential for effective use and impact for learners:

One of the major dilemmas of “scientific” validation of research results in schools lies in the fact that you cannot allow the use of the material to be a failure. Teachers are responsible for the education of their students and cannot jeopardise that process by using inappropriate material or processes. There is also the question of their own credibility. (McCluskey, Seed national validator, Switzerland)
8.6 Instruments

The main instrument chosen by validators from the framework toolkit was the questionnaire, adapted for particular projects and supported by other methods such as observation, diaries, case studies and focus groups.

There were a number of problems with the ValNet form of evaluation seen from an ideal point of view, i.e. unconstrained by time and finance. These are lack of observation, lack of independent pedagogical evaluation, and the lack of opportunity or effort to develop a scale. Quantitative methods have not always been appropriate, particularly in validations of projects that are largely conceptual and open to interpretation (e.g. Seed, 5D). Surveys, drawing from the templates provided in the validation framework, have in such cases not always been helpful in summarising common findings, as the outcomes have been diverse.

Some validation tools have been more successful than others in terms of the quantity and quality of evidence generated. The day-to-day demands on teachers in European countries have inevitably and unsurprisingly constrained the contributions that they were willing and able to make. Cultural differences have had an impact to differing extents. For example, teachers in Flanders in the 5D validation preferred to provide their opinions and evidence about the impact of their projects on their practice and their learners through group discussions rather than individual questionnaires. As with much research on ICT in education, the validation has relied on goodwill. The limited funding of 1 000 Euros has not been a significant incentive to schools to devote time or resources to the projects.

Action research was used in the 5D validation but not all teachers completed the cycle of identifying a change, implementing it, collecting data and evaluating it. The majority of those participating completed the implementation of their ideas and perceived that the process had been beneficial which they found satisfying. Further guidance and additional support may have led to a greater percentage of participating teachers completing the research in terms of reflecting on the change and writing it up. Some teachers did not feel able to do this in the limited duration of the validation period. The professional development opportunities of this form of engagement with research were welcomed by some.

In future it was felt that the instruments could they be more standard. The provision of online tools to administer web-based questionnaires with technical support and translation facilities would also be beneficial. Online questionnaires were used in the ITALES validation (through WebCT) and the ITCOLE validation (through Zoomerang). Zoomerang is an online survey facility that provides templates and instant analysis of data. Zoomerang was considered for the Seed validation but with a limited number of participants was not considered to be a worthwhile facility to pursue, considering the amount of time required to master the required complex procedures, despite the fact that the full service had been subscribed to by the European SchoolNet. One 5D-school in Flanders (Gullegem) used a self developed online questionnaire-system to collect opinions from participants. During one of the final validation meetings other Flemish ENIS-schools asked him to present this way of working. This was a very enhancing training moment and nice side-effect of the project.
8.7 Reporting

Equal attention needs to be paid to all dimensions of the POETiC framework, even when innovative tools and services are primarily pedagogically focused. A number of challenging questions should be asked in relation to the viability of the project being validated, on the assumption that the project is pedagogically sound. The dimensions of POETiC are interwoven and it is clear that innovative tools will not survive if there are major organisational, economic, technical or cultural issues, irrespective of the pedagogy.

The technological absolute (current status), comparative (with similar commercially available tools) and prospective status (how it might be developed and/or integrated into daily practice in the future) should be assessed carefully when the innovative viability of a tool is being assessed.

8.8 Dissemination of results

There is no point in validating products without a means of disseminating the results and making change happen on a larger scale. ValNet was set up partly to amplify the results of the School of Tomorrow projects themselves, recognising a previous failure in European projects to achieve any lasting impact after the end of the funding period. Owing to the time schedules being compressed to the end of the project period this has affected the potential of ValNet to disseminate fully within its own timescale. However, there are plans to organise a dissemination workshop at the end of the project to invited policy-makers, to publish the outcomes online and on paper and to provide inputs at key conferences in 2004-2005, using other funding sources. Measures have already been taken to make available the tools that were most welcomed by ValNet teachers. For example the ITCOLE Fle3 environment has been installed on EUN and the Portuguese national servers and is available freely to schools to use; and the 5D model has been adopted throughout the Belgian Flemish community school system. It has also been built into new projects, for example to support knowledge-building and sharing in INSAFE, an internet safety co-ordination project.

The results, as well as being published on the project web site, will be published on the Insight portal of the EUN (http://insight.eun.org). This is where all significant project outcomes are posted and presented in a way that appeals to policy-makers and practitioners.

In a classroom teachers use different coaching strategies according to the learning styles of the students. In this validation we gathered a lot of information about spreading innovation within a group of innovative teachers. We think that strategies to disseminate and implement innovation to a broader group of less innovative teachers could be different. It would be valuable to investigate/research this topic in the future.

8.9 Marketing ValNet

ValNet is currently known (if at all) as a project. In future it is proposed to keep the ValNet brand and network but to identify it as a validation service and test bed network. This will provide continuity and a trusted label.

In the original proposal, written before the burst of the dot.com bubble, 9/11 and the economic downturn, the intention was to make ValNet a self-sustaining service. Pricing was to be tiered, ranging from a basic no frills desk-based assessment to a bespoke large-scale field testing of a
product, whether commercial or EC project-based. Despite the production of a publicity flier and a number of discussions during the lifetime of ValNet no commercial client has materialised. However, the ValNet approach has been used to test other project outcomes on a small scale and built into new project proposals.
9 Conclusions and Recommendations

One clear message arising from the huge amount of work undertaken is that ValNet is about innovation (new pedagogical approaches and teaching tools) and change, and not ‘product testing’ which was seen to be the responsibility of the project teams themselves. The five School of Tomorrow projects that were selected (5D, ITALES, ITCOLE, Lab of Tomorrow, SEED) were diverse, presenting a challenge for the validation team in relation to drawing together common findings. Moreover, each individual project was interpreted and implemented in a variety of ways by teachers from different countries, highlighting the impact of cultural diversity. In addition, individual differences between teachers from the same regions, cities and even schools were also apparent. The ValNet validation has demonstrated how elements of large-scale projects can be taken and used in different contexts (eg 5D, ITALES, Lab of Tomorrow). The outputs from the five projects and their validations include tools, theoretical models for teaching and learning, and examples of good practice.

The tools created as part of the 5D project were not available at the beginning of the validation period and therefore were not validated. The theoretical theory underpinning the project proved to be very popular with the teachers involved. However, it is challenging to attribute this directly and solely to the School of Tomorrow project. We can say that the concept behind 5D worked in real educational settings (as perceived by teachers) and while the support and involvement of the 5D project team was much appreciated and believed to be beneficial, the specific support tools generated as part of the project were not validated (because they were not available soon enough).

The validation of ITALES was also somewhat premature as the ITALES project (and hence the development of the products) had not finished, but the tools were received positively by teachers; they suggested that it should be sustained; they considered it to be a good idea and a worthwhile tool, although it was noted that similar (and often free) tools were already available. The ITALCO tool could be improved by making it simpler to use. The validation process was only really applied to one tool created through the project and while its potential was noted and it did enable teachers to create digital learning resources to support personalised learning, it also required a significant investment of teachers’ time.

The Fle3 platform that was validated in ITCOLE was perceived by the teachers involved to be a very effective and worthwhile learning environment. It is designed to support future shifts in teaching and learning, with an emphasis on collaborative and learning through investigation. It clearly had perceived positive outcomes (although there is no evidence of the effective learning gains compared with other situations due to the limited timescales for the validation). Teachers themselves were very positive about its potential and students, particularly younger ones, also liked it. It was considered to be easy to install and use, and is open source thus being versatile and adaptable. Its use has been widespread and is continuing to grow. It has however been constrained (as have the other projects) by national curricula and is not necessarily appropriate for all disciplines. In relation to the validation, the evidence suggests that ITCOLE is a tool that is easy to implement in any educational setting and readily supports the Progressive Inquiry Model, although teachers found mutual support mechanisms beneficial in relation to achieving the maximum potential. Due to the limited timescale for validation it is not possible to comment on the impact of its use on student achievement.

The Lab of Tomorrow tools were not fully developed at the time of the validation and due to costs, only a limited number of each tool was available. This meant that the approach to the validation was different to the other four projects. However, it did make the teachers involved consider the scientific
approach and move away from controlled experiments to empirical observation. Again it was noted that by the time of the validation similar tools were available. However, the validation did provide evidence that the prototype tools functioned as described. Nevertheless, the tools were not validated in real school settings (in ValNet) and therefore the validation process was not truly completed. It is not possible to say whether the tools work in real educational settings, only that teachers perceive that the tools have potential.

In Seed, the underlying concept of developing truly integrated communities involving teachers, software developers and members of the academic community was challenging to reproduce in the short timescales required for the validation. This project had to be interpreted more flexibly than may have been intended by the Seed project team. The tools produced by the Seed School of Tomorrow project were not perceived by teachers to offer anything different to commercially available products and hence were not implemented within classrooms. Therefore, it is not possible to comment on the validation of the outcomes of the Seed School of Tomorrow project although it could be argued that the decisions made by participating teachers not to use specific tools is an indicator of their perceived value and potential in classrooms.

Due to the limited timescales for validation and constraints such as national curricula and timetabling, it has not been possible to consider the impact of School of Tomorrow projects on learning gains in relation to formal assessments.

9.1 The effectiveness of the validation service offered through ValNet

As a way of conclusion about the validation service we want to make the following observations, which we suggest may well be put at one of the following levels:

- Procedural lessons learned
- Substantive lessons learned
- Pragmatic issues for the validation procedure
- Philosophical or metaphysical issues

Procedural lessons learned

The Valnet validation exercise has taught us important procedural lessons and is perhaps the most concrete and thus most valuable part for the future. We mention six lessons that we think are very valuable, simple and clear and can easily be used to advance the Valnet procedure considerably. Using ValNet as an exercise to develop a validation procedure, we think it was highly successful, informative and worthwhile.

1. The Menon framework developed as a procedural guideline is deemed to have provided a useful basis on which to prepare the evaluation. It was very helpful, is judged to have been adaptable and comprehensive. We might nevertheless have spent more effort explicitly adapting it (as a specific methodological exercise).
2. The Menon framework suggests an interrupted time series design, which allows causal inferences about the tools in question, without using the somewhat more cumbersome randomised experimental design. We find that it is methodologically both sound and sensible to use in this type of context, but because of the short period of time allowed (and because
some of the tools were not sufficiently developed) this procedure was difficult to use. Under less time pressure we could have presented more rigorous longitudinal data.

3. Because of the way we distributed the funds, any project had difficulties adopting a multi-method approach, using a combination of qualitative and quantitative methods. By hindsight it would have important to be able to do this more extensively. But instead most groups used one or the other with the narrower perspective this entails.

4. The most serious weakness we find in the Menon framework is its lack of emphasis on a baseline (at least as it was normally interpreted in the project groups). This relates to all the POETiC dimensions. We suggest that his should be attended to in any development of the procedure. (But it must be acknowledged that the Menon insistence on a measurement at the beginning of the project acknowledges of course the baseline principle, so one must tread carefully here).

5. A corollary to the last point is a call for a much clearer monitoring of the way the tool or the project was introduced in the school setting. This is potentially a crucial factor and should receive more explicit attention in the Menon framework.

6. On the basis of our experience we suggest that an alpha and beta testing phase should also be used at the validation level. Once taken out of the developmental environment into the validation phase several practical problems arise that can be simply corrected following an alpha phase. (We also suggest that validation in a “friendly environment” (as in the present case) and separately in an “inimical” or an “indifferent” one should be contemplated.)

Substantive lessons learned

The Valnet validation exercise has revealed a considerable number of valuable substantive points. We divide them into three categories.

1. The lessons learned about each individual tool which are described in much detail in our report and we think are both quite important and illuminating about the tools. We think that these lessons can stand independently as results of the study and are both extensive, quite clear and valuable.

2. The quite detailed lessons learned about the aspects of the POETiC dimensions that turned out to be quite revealing and are also described in some detail. We think that these lessons can stand independently as interesting, novel and very important results of the study.

3. In the third category are the suggestions of a hierarchical interrelationship between the POETiC dimensions, which is both novel and important. We mention an example, even though more detailed set of relationships may be worked out: It is very clear that i) teacher time (O,E dimensions), ii) how the tools fit into the school culture (C,O dimensions) and iii) how the tool becomes part of the school organisation through the curriculum (O dimension) are potentially the crucial determinants of whether a tool is successfully integrated into the normal curriculum. At least in the benevolent environment we were working in, these turn out to rank higher than both the tool’s “theoretical” pedagogical value (P dimension) and the technical aspects of the tool (T dimension).

Pragmatic issues for the validation procedure

1. We feel after this project that a validation phase is crucial for assessing the potential adaptation or innovative impact a new tool will have. We also think that the procedure we used and developed is sound and very usable.

2. We also feel that the tool (Menon-Validation) needs further developing, perhaps with somewhat more methodological leaning than we adopted.
3. We feel that the relationship between the schools and the Validation procedure need rethinking somewhat. Even though it was in many cases explained quite extensively to the teachers what was happening, they did not always appreciate the necessity for the extensive data collection that an independent validator required.

4. We also feel that even though the tool is meant to be robust, easy to use, inexpensive and flexible, it probably needs some expert overseeing; someone who knows the pros and cons of the device and how it shall be explained to participants; but also for developing it further and ensuring its continuity.

5. We think that we have demonstrated that a validation procedure is feasible, adaptable and noting the wide spectrum of results, also worthwhile. It is of course very important having a screening device of this sort that can be used as an advisory component when schools or governments are contemplating introducing ICT tools into their setting.

Philosophical or metaphysical issues

1. Is it clear what validation means? Yes this was spelled out quite clearly in the working documents and there need be no problems concerning it. We feel nevertheless that with hindsight the terminology should be better explained to the various participants. Even though the validating team was quite clear what it entailed it is probably true that some participants may have thought that we were doing a somewhat narrowly defined evaluation of a particular tool. But the difference is both clear and important and should be explained perhaps with examples.

2. The comparative issue. We also feel that the comparative dimension of the validation needs to be spelled out. We were validating the tools in their own right, finding out if the stood up to expectations in the environment we put them in. Our intention was only to find out if these tools worked (according the POETiC dimensions) in the particular environment we put them in, given the particular ideas the teachers received. We did not undertake a very different task, which is to pit the tool against other ostensibly equivalent products. That would be another task requiring another type of methodology and tools.

3. The issue of value judgement. It is not intrinsic in the Menon framework to judge the potential desirability of the intended innovative changes the tool being validated would entail, or even of innovation as such. This is of course a difficult thing to do. A method was however developed (i.e. the development of the THINK scenarios) which allowed a fairly objective comparison of the individual tools in their school environment to these scenarios. This may be carried much further using the methods already in place. Thus the THINK scenarios offer a way to make, fairly objective value judgement by using the scenarios as clear reference points.

9.2 Lessons learned

• **Timing.** Only one of the five projects had been completed at the start of the validation. The importance of timing was not foreseen initially. Many of the projects were granted short extensions further highlighting the problem. Further development is required to establish criteria to establish whether the development of a product/service has reached a stage where it is worthy of a full validation. The development of a two-stage approach to firstly establish viability and likely potential, before conducting a full-scale validation would overcome some of the problems we faced in ValNet.

• **Uniqueness and value-added.** School of Tomorrow projects were conceived at least four years ago and whilst at the time were ground breaking there now exist a wide-range of similar...
commercially available products, some of which are already being used by teachers. This relates particularly to ITALES, Lab of Tomorrow and tools created as part of the Seed project (Cool Modes, eSlate). Future consideration of project proposals should ensure that project teams present a case as to why the tools and services they intend to produce will be different (and perhaps offer greater value) than those available commercially.

- **Demands on teachers’ time.** In all projects involved in the validation, teachers’ time was the most significant cost. In many cases, teachers were offered a limited amount of financial support as an incentive to participate but were not fully compensated for the amount of time required. In some cases, even with limited funds available, schools were not able to provide opportunities for teachers to spend some time outside their classrooms to implement the projects, which meant that these individuals had to do this in their ‘own’ time. The financial support available was largely intended to cover costs relating to the validation (attending meetings, completing questionnaires, being available for interviews etc) rather than the project implementation. In many countries additional funds were provided by the ministries and other related organisations. The evidence suggests that funding is necessary in order to enable such projects to thrive in schools, and needs to be more substantial particularly to facilitate scaling up. It is not advisable to rely on the goodwill of individuals for sustained periods of time. Teachers are more likely to spend time on such projects if they feel that their efforts are valued by leadership and management within their school, and by parents and others in the community.

- **Alignment with national, regional and school cultures.** The implementation of School of Tomorrow projects (and by implication, any educational innovation) is most effective when tools and/or underpinning pedagogical theories relate closely to regional and national priorities. Educational policies and cultural differences in pedagogical approaches remain powerful forces, particularly in regions and nations that are most closely aligned with THINK scenario 1 and (to a lesser extent) THINK scenario 2 where for example curriculum constraints can be a barrier to change. By contrast schools and teachers with greater autonomy and flexibility both in relation to the curriculum and also to pedagogical approaches can integrate and adapt new products to meet the needs of their students more readily. The potential of many projects can be maximised by creating opportunities for learners to engage in activities for extended periods of time. However, timetabling constraints were found to be a barrier particularly in secondary schools in many (but not all) countries.

- **Flexibility versus complexity. Perceived educational potential versus risk.** Teachers do not have the time or the inclination to learn how to use complex tools, particularly those that require high levels of technical expertise. They would rather create or adapt resources themselves than use off-the-shelf learning materials. This highlights the need for ownership. They prefer tools that are intuitive and flexible, providing opportunities to create teaching resources that meet their particular needs and are purposeful. However, at the same time their prime aim is to educate their students and therefore they are not prepared to take unnecessary risks. Teachers need to be able to see the educational potential of a product and to be aware of the possible benefits and added-value for their students. In addition, the time investment required to prepare teaching resources must not be disproportionate to the perceived potential gain for students.

- **Actual use versus intended use.** Teachers can use products in unintended ways and often make them fit current practices rather limiting the kinds of pedagogical changes that take place. However, this may not affect the impact of such projects and does not mean that such use is not beneficial. It provides evidence supporting the idea that schools and/or teachers change reforms. However, in some cases unintended uses result from lack of understanding
of the capabilities of the tools and services, and different interpretations of the underlying pedagogies. This should be addressed through training and user documentation. Training and workshops should not simply focus on the technical operation of educational products but also the underlying pedagogical models and intended uses.

- **Importance of shared experience, learning from colleagues and external support.** Collaboration and mutual support for teachers was perceived to be beneficial. In the OASIS evaluation for example, a feature of Fle3 (the tool used in the evaluation) was used to facilitate ‘reflective chat’ between teaching staff and the facilitators providing a powerful mechanism for addressing problems, generating new ideas and stimulating continued use. Meeting face-to-face however appears to be an important element of developing strong working relationships, particularly initially. Teachers greatly valued external support of the validation team. Where relationships had been established prior to the validation and where validation team members were proactive in supporting school staff, school staff were more likely to engage fully with project implementations.

- **Importance of underlying pedagogical models.** The School of Tomorrow projects that were underpinned by specific pedagogical models appeared to be easier to implement (although required careful training and support) and were received more positively by teaching staff. It may have been partly due to these approaches demanding real pedagogical change whereas other projects were more readily adapted to meet current practice (and were not perceived to offer much advantage, if any at all, over similar tools and products). Teachers are less likely to have been aware of similar tools that they could make comparisons with. It could also be partly attributed to the approaches being clearly structured in relation to initial preparation and process. Furthermore, teachers found that their roles changed and valued the new challenges and development of additional skills that this brought. The professional development aspect may have been another incentive for teachers to participate in these implementations.

- **Importance of student-centred learning and collaboration.** Students who participated in ValNet activities greatly enjoyed opportunities to publish for a real audience, and to collaborate with students of the same and different ages, both locally, nationally and internationally. Student-centred learning approaches were also perceived to have a positive affect on student motivation.

- **Cross-cultural challenges.** All five School of Tomorrow projects proved to usable in different countries and have the potential to support multi-lingual and international/inter-regional learning activities. Some projects explored this to a greater extent than others. For example, some implementations in Seed involved international collaborations. In contrast, there was little transfer of results between schools in 5D both internationally and nationally, as each implementation was tailored to meet specific and individual needs. Partner schools all wish to form communities that work across regions and national boundaries but they also find security in starting with local links that they can easily sustain by traditional means and face-to-face meetings. This was particularly true of Seed which was primarily concerned with the development of integrated communities. Language appears to be a barrier for some teachers and students, but many teachers are ready and willing to use a common language as a lingua franca. The differences in national and regional education systems, particularly curricula and term dates, were greater barriers to international collaboration than language. This was a particular problem for Seed and 5D.
9.3 Recommendations/future priorities

Key Recommendations for the Commission:

- The evaluation of project proposals should ensure that intended innovative tools and resources are value-added both in relation to existing practices and teaching aids, but also in relation to existing commercially available ICT products and resources. Short feasibility studies would enable sound judgements to be made.

- Future projects should have an early review point by a validation agency, particularly as innovative cutting edge ideas four or five years ago are no longer novel, and are likely to be competing with commercially produced resources. The screening process should use the ValNet framework and assessors should include potential end users, e.g. ENIS teachers. Projects could be championed by an education ministry. However, validation in partner countries is reliant upon face-to-face meetings and personal support. It therefore incurs costs and provision should be made to ensure that these are met.

- Future calls should make it compulsory for proposals to include information about the distribution and marketing of products upon completion. In addition the intellectual property rights must be clarified and tools/resources that are intended to be freely available should be placed in a public repository.

Key recommendations for consortia preparing future project proposals

- Commercial producers of innovative tools for education provide support for training, installation and maintenance. The marketing processes for such companies are often very well developed. The same principles need to be applied to products produced through commission-funded projects or those funded through other sources within academic institutions.

- Teachers involved in the five project validations would have valued the opportunity to share their experiences and achievements with the original project teams, but were unable to do so because of lack of funds and interest. Financial provision to allow for this in future project proposals and validations would be welcomed and motivate teachers to participate fully.

- A number of cultural barriers need to be overcome such as language, curriculum differences, term dates (when international collaboration is required), and the sceptical attitude of some teachers towards materials created by teachers in other countries. Project proposals that investigate such issues would be beneficial.

- The projects underpinned with sound pedagogical models have proven to be most successful through the validation. Support should be given to facilitate more exploration of pedagogical models.

- Schools do not have sufficient finances to investigate and experiment with tools and resources. Schools are not market environments. The best means of disseminating and promoting good tools/resources to schools should be identified. This should be identified in future proposals as should information regarding how hi-tech products can be introduced into schools and the potential impact.

Recommendations for policy makers:

- National policy makers need to ensure that there is flexibility within the curriculum, and other inhibiting factors such as a reliance on ‘high-stakes’ testing or rigid structure of the school day, to support innovation and change; centrally controlled curricula will constrain ICT innovation in educational institutions.
• Successful innovation projects such as Fle3 and 5D should be promoted and supported at national levels both in relation to usage and research. Both these projects, for example, have not been expensive to implement and have achieved change through research and reflection. Fle3 facilitating computer supported collaborative learning with progressive inquiry methods has challenged students to hypothesise, investigate and evaluate. These students have been learning to learn, a major competence required to support life-long learning. 5D has enabled learners to interact with older and younger peers, as well as members of their local communities and experts in the field. Both projects have resulted in positive and welcomed changes in the roles of teachers and learners.

• The development of national ENIS networks should be supported and developed further to act as a cost-effective sounding board for innovation and new ideas.

• Involving schools in validation can stimulate a lot of thinking, reflection and innovation. Providing support such as additional funding and recognition for teachers would be valuable, and reap rewards. Providing training and support for teachers on ICT usage, evaluation and action research may also be beneficial.

• It may be beneficial to appoint a champion to address all cultural and organisational issues through consultation with potential actors, identifying barriers and means to overcome them. This would overcome the fallacy that innovation only works with certain people in certain situations and is not transferable or reproducible.

Recommendations for schools and teachers:

• Support from leadership and senior management contributes to the success of ICT innovation. The success of any project depends upon how it is perceived by leadership and senior management. There needs to be clear guidance about what can be achieved and what contribution innovative tools and services could make. There needs to be an awareness of the commitment required. Teachers and other staff need to be provided with adequate training and technical support. Provision should be made for identifying problems and addressing them before they become major issues.

• ICT innovations should be embedded in well-formulated pedagogical policies on teaching and learning, underpinned by a clear vision on schooling. At the same time teachers should be empowered and trusted to experiment.

• Innovation and change is successful where it is perceived to be purposeful, flexible, collaborative, easy to manage (i.e. small, manageable steps), and develops a sense of ownership amongst those participating (for example, requiring teachers to adapt or create their own learning materials).

• Careful consideration should be give to the reorganisation of teacher workloads to ensure that sufficient time is allocated for the preparation of ICT resources and activities.

• Teachers not only need inducements to participate in research and development projects, they need to be reassured that their activity will complement local educational aims/objectives, and potentially have a positive impact on their students.

• Teachers should be made aware of how they can find and get support to use tools and resources that have been successfully validated.
References


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