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Author(s): **Henk Sligte, Bruno Emans, Fieke Roozen, University of Amsterdam**

Input by: **All partners**

Mail:	SCO Kohnstamm Instituut P.O. Box 94208 1090 GE Amsterdam The Netherlands
Phone:	+31 20 525 1374
Fax:	+31 20 525 1200
Email:	hsligte@fmg.uva.nl

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Abstract: In today's society schools are faced with the difficult task of not merely supporting the traditional acquisition of knowledge and skills of their pupils, but also of meeting the ever-higher demands of society to helping their pupils develop higher order cognitive competencies and social communication skills. The use of Information and Communication Technology increasingly forms the medium for schools to realize this endeavour, by creating new possibilities for communication, collaboration and knowledge building. Part of these possibilities involved the opening up of the school to the surrounding community.

The OASIS project is set up to meet this challenge by developing and introducing a wide variety of technological solutions. The main goal of the OASIS project is to keep the public school system the leader of young people's education, also when technology and Internet are involved. Therefore, all technological solutions are developed cheap and compatible. Among the technological solutions are schools servers and zone servers, school interoperability frameworks, and wireless technologies within the classrooms. These technological solutions are described in other deliverables of the OASIS project, and are shortly discussed in chapter 2, that describes the OASIS context.

But schools are not supported by technology alone. In order to make full use of the technology to meet the above-described challenge, proper pedagogical support has to be provided. In chapter 3, this deliverable introduces the relevant pedagogical models that, together with the technological solutions proposed within the project, prepare schools for introducing communication and collaboration in their educational programs. These models include various forms of computer supported collaborative learning, problem based learning, and ways of connecting the school with the outside world. In chapter 4, the models culminate in a generic scenario and a number of examples for specific projects that can support teachers to set up learning projects as appropriate to the situation at their own school. Furthermore, on the basis of the pedagogical models, a set of recommendations and restrictions for the technological solution is given to make the technology fully compatible with the modern pedagogical insights.

In chapter 5, the deliverable continues with an evaluation framework that will make it possible to assess both the value of the pedagogical models and the usefulness and effectiveness of the technological solutions. The deliverable ends with some general conclusions.

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1 Introduction

In today's society schools are faced with the difficult task not to merely support the development of traditional knowledge and practical skills of pupils and students. The working life and the complex society with ever-higher demands on all citizens create a need for the school to help their students to develop higher order cognitive competencies, and social and communication skills. Information and communication technology (ICT) forms increasingly the medium for schools to realise this endeavour, by creating new possibilities for communication, collaboration and knowledge building. Part of these possibilities involves the opening up of the school to the surrounding community, and vice versa. A development of this kind will have beneficial effects on both the school and the surrounding neighbourhood, in terms of learning, and in terms of social cohesion.

The goals of the OASIS project are to keep the public school educational system as the leader of the young people education also at the Internet, to pay in particular attention to the socialisation role of the traditional schooling as one of the main capacities of the traditional public system, and how this capacity can be transferred towards the Internet as a competitive advantage for the public system, and last but not least to look at the concept of small school virtual community around the school portal as the main tool to support this approach.

Some of the most pressing challenges to set up, operate and promote the use of the small school virtual community around the public school educational system are:

School Interoperability: how to enable different applications to share information data to promote interoperability between software applications from different vendors, and how enable the use at the school of different networks and communication services technologies, to promote interoperability between communication services and technologies from different operators (LAN, Cable networks, Radio networks, ADSL, FTH, etc.), in order to improve usability, accessibility, efficiency and reduce cost.

School Cost-effective Operation and Maintenance: how to define and implement administration procedures and tools driven to structured and effective service provisioning, in order to improve quality and reduce cost through specialised external hosting and service provisioning (Municipalities, etc.), with Cost-effective and User-friendly administration solutions. This will provide quality services at reduced cost without expensive users development, training and self administration costs, so reducing the teachers efforts addressed to fix HW&SW infrastructures, and allowing them to concentrate in learning and practice how to better use ICT in education. Today, the big amount of those cost, and the complexity to assure quality of service, are one the major factors against the integration of ICT in the school community, as well as to achieve location independence and widening remote access to resources from the school and at home, that are background major objectives for the school virtual community.

The OASIS project has been defined to meet (among others) those major challenges. The project has a strong and complex, but very innovative technological side to it. An interoperability framework will be created, together with zone servers and school servers. All will be done with a cost effective open architecture. (The technical details will be elaborated in chapter 2). Furthermore, in five validation sites, different technological set-ups will be evaluated in large-scale evaluation pilot experiments. At the end of the project, European schools will have access to the technical outcomes of the project, with several educational levels and different levels of integration of the technology in their curricula and different pedagogical models.

But technology as such is not enough to make improvements to the school system. Adequate and modern pedagogical models should accompany it, in order to make the technology effective. This deliverable will introduce, describe and develop collaborative learning models where the local community surrounding the school, as well as networking with other schools, will innovate traditional ways of learning towards more open and flexible learning environments, in which teachers and learners feel comfortable. Collaborative learning models will be developed and used to enhance and train higher order cognitive competencies and social and collaborative skills among pupils.

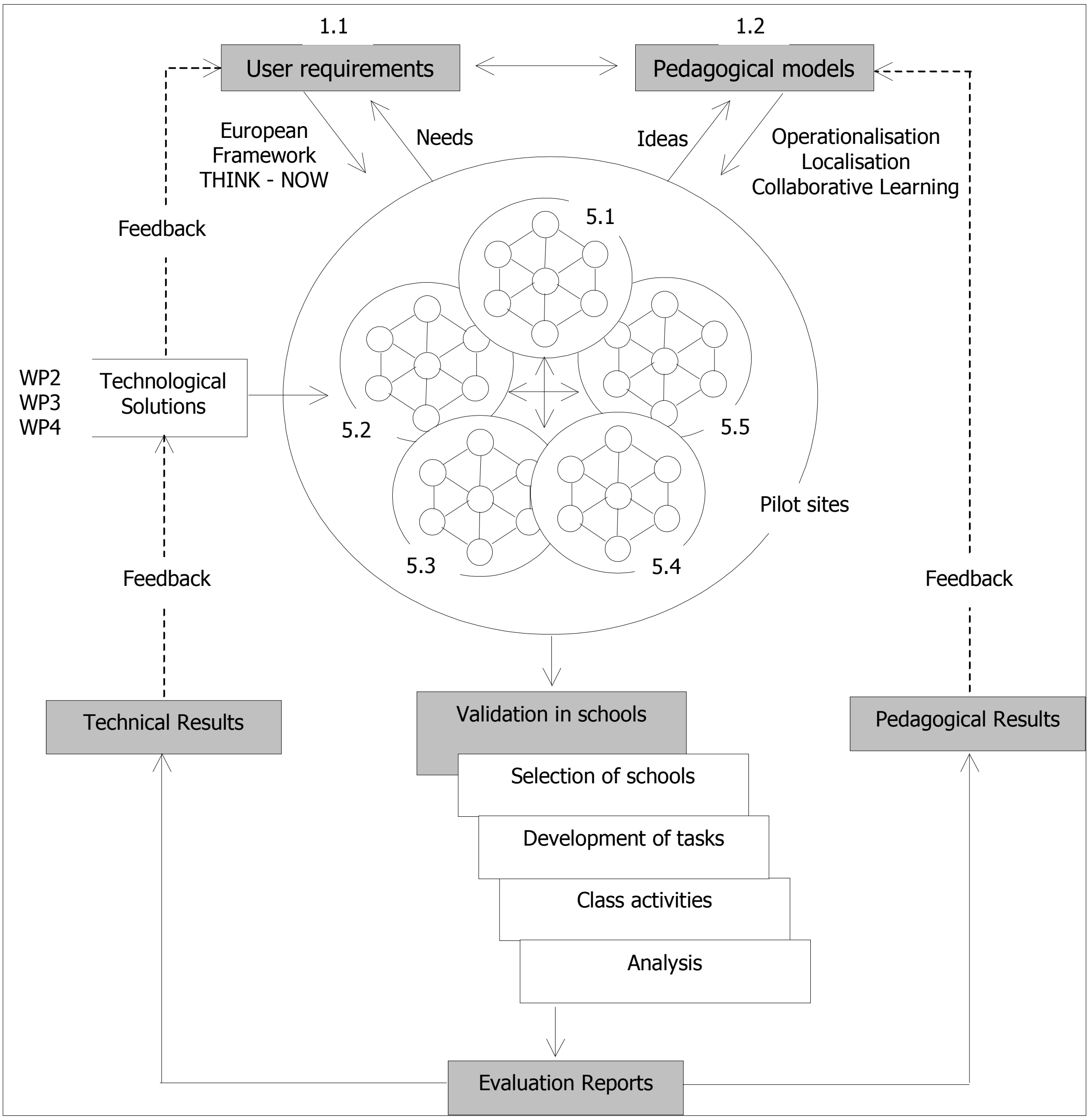


Figure 1: Overview of activities within the OASIS Project.

In figure 1 the interdependencies of the OASIS project are sketched. As can be observed from the figure, the description of the pedagogical models is dependent upon the user requirements, but also upon the technological solutions of the validation sites. The aim of this deliverable is to describe pedagogical models as they can be derived from the possibilities and constraints of the project (user requirements and technology), but also to describe the implication of the pedagogical models on the technology. Furthermore the deliverable will provide teachers and educational developers with learning scenario's and learning projects based on the proposed models.

In chapter 2, the constraints for the pedagogical models will be described. These constraints include input from the user requirements (described in deliverable

1.1), technological constraints from the OASIS context, and pedagogical and technical constraints derived from the projects that will be undertaken in the five validation sites.

Chapter 3 is the main chapter of the deliverable. It sketches various relevant pedagogical models, based upon the OASIS context of chapter 2. The description of these models will result in generic scenarios and concrete projects that are to be used by teachers as sources of inspiration to create and implement their own projects.

Chapter 4 will be concerned with the implications of the pedagogical models on technology. These implications can be divided into four fields in which technology plays a role:
- Communication
- Collaboration
- Usage of shared information resources
- Production of new resources

In chapter 5 a framework for the evaluation is sketched. Here, research questions on the two most important challenges of the OASIS-project are addressed:
- How does the technology proposed within the OASIS context function in order to improve the school system?
- How do the pedagogical models function in their support to the technical solutions? How effective are the pedagogical models?

2 The OASIS Context

2.1 Introduction

As depicted in Figure 1 within chapter 1, the pedagogical models that are described in this deliverable depend on several other work carried out within the Oasis project. Firstly user requirements described in deliverable 1.1 of work package 1.1 are related to the possible implementations of pedagogical models in schools. Furthermore the possibilities and constraints of the various technological solutions in the five test sites define the boundaries for actual implementation. This chapter describes the work that forms the basis of the development of the pedagogical models. First the user requirements are described and then the five test sites are described in detail.

2.2 User Requirements

The pace of technological developments is increasingly accelerating. PC's, multimedia tools, open and distance learning and the whole Internet have the potential of radically changing both learning and teaching activities within schools, and the organisational structure of schools. The position and function of schools within the emerging information- and knowledge society is a major challenge.

In this rapidly changing situation there is a need for democratic discussions, reflection and political guidelines. But the development goes on in such a rapid pace that most of the teachers and the citizens - but also the responsible ministries – feel that they have their hands full of problems just trying not to fall too much behind the technological development. There is a feeling that there is no time or space enough for democratic, political or professional initiatives to take the lead of the pedagogical development and educational policy in the Information Society.

Usually visions that are made by ministries are the same as political initiatives to point out the desirable future. This is an essential part of all Ministries' work. But when it comes to ICT it is very hard to make that kind of visions, due to the rapid development in the sector. In many countries there is a strong opinion that wants schools to use ICT to develop a more optimal learning situation. The Ministries as well as individual schools are struggling with this challenge. The key question is *how* to use technology to reach optimal pedagogical progress. ICT is not a goal in itself; it is a tool for learning.

The Ministries deal with the question of *what* is the best strategy to support and reach that pedagogical progress. There will never be one single answer to that question. But there is a extensive need to explore and examine different "possible futures" of the school of tomorrow - visions in which the public school system is advanced enough, good enough and interesting enough to successfully compete with other alternatives.

Deliverable WP1.1 forms a basis for a better understanding of the front-end development in Europe regarding 'schools of tomorrow' while at the same time establishing some future-looking scenarios marrying key educational functions and priorities with possibilities created by the further development of information and communication technologies. To do this, existing pilot ICT projects and innovative schools in contrasting environments have been identified and analysed on their strategies applied with regard to new learning environments. After that, consultations with policy makers and technology companies were carried out in order to identify long-term scenarios for new learning environments and policy issues that will emerge. The requirements cover key issues including learning, cost-effectiveness and use of technology. Besides, socially disadvantaged communities are identified.

2.2.1 Collecting user needs

For the pedagogical models, the most important outcomes are the list of user need specifications and the summary list of user requirements, in particular requirements on teacher training. The list of user needs was derived from a questionnaire among teachers, of which the important questions with their answers are listed in full here (figure 2).

Question 5: The educational tools of the future will include online learning environments. What features would you like to see included in such environments?

- Less drill and practice, more intelligent/constructivist learning supported
- Speed, self-assessment, interactivity, teacher intervention at all level
- Resources for teachers and students: chat, voice chat, forum, whiteboard, upload/download possibilities, friendly use of html, grading, lesson plans, mailing lists, email, videoconferencing
- Language of country where it is used, blackboard-tools, webcam tools, connection to mobilephone
- Exemplars of pupils' work, interactive multimedia, broadband permitting, research without copying
- Nice looking, easy to handle, helpdesk, easy interface
- Interactive features and with the possibility for intercommunication between different individuals or groups. Keep the environments simple, since not everyone has the ICT resources for using learning environments. If they are for everyone this is a point that is important to take into account, but not everyone takes this into consideration.
- Good collaboration tools
- On line translation, videoconferencing

Question 6: As an advanced user of ICT in education, list your priorities with regards to your training for future developments in ICT.

- Using and building learning platforms.
- Quick and handy connections, flexible tools, sharing software, friendly internet tools, convenient costs
- Developing digital courses, web-based courses, using 'good' tools, interface friendly for users
- Online authoring tools: Blackboard, Luvit etc.
- Tools to easy make the children take part in different European projects like platforms with Babelfish to easy translate the Swedish into English and have both languages in the work.
- Maybe how to make own platforms in the Internet, small easy training program to use and change digital photos,
- e-learning service
- Subsidised training, an issue that should be more greatly debated in the EU
- Networking

Question 7: What type of eLearning services will you need in the future in your work?

- High-speed connectivity. Services that take away nothing from the creativity of teaching.
- Learning environments, internet, voice chat and videoconferencing, sharing communities, streaming, video on demand
- Translation to different languages, tools to visualise courses
- Online authoring tools
- Possibility of quick, personal contact through email.
- Virtual classes, community, forum
- It depends on the group you are working with. School wise, it is a question of making and planning what the goals are for eLearning at the individual school. Services I need for eLearning would have to be relevant services that fit the needs of education, in particular subjects as well as in individual needs and in cross curricular activities.
- On line translation, videoconferencing

Question 10: In the future, what type of measures do you think will need in order to ensure safe use of the Internet by your pupils?

- Much more flexible firewalls and filtering of email.
- We have to guide them and teach them to choose and judge the materials in a proper way. I would say similar as we do in real world where there are also different temptations for them and us.
- I don't believe that restrictions and firewalls will help. We have to build strong and rich educational networks and sites with quality materials and interesting stuff for the youngsters to research.
- Login; hardware and software protection
- Intranet, legal block on unsuitable material
- I am convinced that the best is to talk and discuss the matter with the pupils to make them aware of the danger and so to speak: put up a fence against bad use inside the pupil himself.
- A control system in for student research website
- None actually. I think it is more important to teach them internet ethics as they would be in the 'Real World'.
- Training

Question 11: In the future, what kind of support do you think you will need from your school to help you to use ICT in your teaching?

- Time, hardware
- Continual financial investment in hardware and fasted available connectivity
- To update the hardware and provide the useful software constantly and of course to understand the educational value of this new device.
- Good hardware, good software; financial compensation for working and accommodation at home (internet connection); time
- It depends on the support the school gets from central government.
- Time for own practice and learning, I need the same version of the software in the whole school - Office for instance, I need a technician who is clever on wires and things, I need support in a principal who says I am doing a great job!
- Financial (providing instruments)
- I receive only positive support, but it would be nice that it was possible to get more financial support on a whole from local and state government.
- Money! right now I'm responsible for all the schools computers and I get paid only one hour / week
- Funding, hardware, software

Question 12: In the future, what kind of support do you think you will need from the national / local authority to help you to use ICT in your teaching?

- I work in private institution but ditto #11
- Financial support, educational seminars on brand new tools and software, co-operation with those that produce ICT software - testing for free for educational purposes
- Good hardware, good software; financial compensation for working and accommodation at home (internet connection); time
- Money
- I need support in plans of developing ICT in the schools and of course money for it in the budget.
- Advanced laptop for every teacher and e-learning courses, good instruments
- More financial support.
- Same as 11
- Funding

Question 13: In the future, what kind of support do you think you will need from parents/local community to help you to use ICT in your teaching?

- Understanding that revolution always has costs
- Some financial support, help, similar as said before.
- Support in attitudes.
- Support in local plans for developing ICT. The parents are welcomed to be with the groups when they visit the school and they are welcomed to tip about great web pages.
- Sharing of knowledge
- Parents and the local community need to be more aware of the results produced by their schools within ICT to be able to better understand its impact.
- Active taking part to the schools ICT projects e.g. as knowledge resources
- Funding

Question 14: In the future, what kind of support do you think you will need from your students to help you to use ICT in your teaching?

- Same as always
- Interest in use of ICT, co-learning habits, sharing knowledge and researching the materials...
- Enthusiasm.
- I need to be aware of the facts that many of the students/pupils know much more that me about ICT and to be open minded and learn from them.
- Collaboration
- None, because they are aware of its importance and because we have a school plan in which skills should be introduced for the different grades or levels, it is natural for students to see what is expected and they have a feeling that they are actually learning something relevant about ICT and how it is integrated in the different subject.

Question 15: What, in your opinion, will be the greatest challenge to using ICT in teaching in the future?

- Stopping teaching and helping people how to learn.
- I think it will be the something indispensable and will change the rigid forms into flexible ones, cross-curricular dealing with certain topics, no borders in learning, common curricula in most of the countries, sharing experts from different parts of the world
- Good web-based courses; the contact with the students (not too virtual...)
- Lack of funding
- Lack of support from Education departments.
- Attitude of teachers.
- The greatest challenge to using ICT in teaching in the future is to be a part of learning for life in the world. Through ICT the students can, if they are able to understand and write in English, learn from people in the whole world and to teach people in the whole world about issues they are experts in.
- Sharing knowledge and experience between young people with different cultures and to raise new generations' competences
- The greatest challenge is quality in teaching. I think there are too many people who rely on only using ICT to solve teaching practice, where I find that it is just as important to not use it. I think it is a tool that should be used if it creates some kind of quality in education, and not to be misused as a resource in general. If we do not know how to do things the old fashioned way as well, ICT has no meaning. ICT must be understood as a tool and it should also be understandable for everyone when it is a good idea to use and when it is not. It is a question of not being dependent on it as the only resource in teaching.

- To get the technology run properly in everyday work, now it takes far too much time to struggle with all the technical problems
- Worldwide communication and on line translation

FIGURE 2: Most important questions and answers of a teacher questionnaire on user needs (adapted from WPd1.1)

Different answers are given to the 9 questions. However, in addition to the obvious answers (need for more time, more and better hardware and software, training) some common answers are given that are important for the description and development of pedagogical models. These issues are:

- The need for communication tools
- The need for collaboration tools and possibilities
- The need for possibilities of the sharing of resources
- Authoring tools
- Contacts with the “environment outside the schools”

The answers reflect the change ICT-usage in schools underwent during the last couple of years: a shift from the single computer with learning and teaching possibilities to multiple interconnected computers with possibilities for communication, collaboration, and sharing of resources, both within the individual schools and between schools and other persons and institutes. Computer Supported Collaborative Learning (CSCL) is a pedagogical model that encompasses these possibilities. CSCL is therefore one of the main models within OASIS, extensively described in chapter 3.

2.2.2 Computers in the classroom

An issue that deliverable 1.1 touches upon is the arrangement of computers within the classroom. The position of the computers within the classroom, their position relative to the teacher or to the blackboard makes much difference when using the computers for educational purposes.

A first thing to consider is the number of computers. When every pupil can have his/her own computer, one can work in one’s own pace, and to feel free to interact with the computer without feeling embarrassed. On the other hand, when pupils work together behind one computer, interaction among pupils is promoted. An interesting set-up of a classroom, described in this report, is “working in corners”. In each corner of the classroom different activities related to the same topic are undertaken. Examples are computer work, role-playing, writing, and speaking/listening. Pupils rotate their activities, assuming other roles in turn.

The next thing to consider is the set-up of computers within the classroom. Possibilities described in the deliverable are a “U”-arrangement, with computers facing the wall, or a central space, with the computers arranged around a big table. The latter makes communication between pupils easier.

A possibility not described in the deliverable is the “studio Classroom”-concept (see for example http://www2.ic.uva.nl/uvalink/uvalink29/STUDIO.htm). This high-tech set-up originated from the idea: “Improve education, start with the classroom. And make optimal use of ICT to do so.” The classroom is a combination of a computer lab and a normal classroom. Each pupil has two desks: one facing the blackboard and the teacher, and one desk, rotated 180 degrees from the first desk, with a computer and other experimental equipment. In this classroom arrangement, the teacher does not have to compete with the computer while attracting attention from the pupil. Other arrangements are possible, but cost is an issue here for schools. Some governments start to rethink the spatial arrangements within school and classrooms from a pedagogical-didactic point of view, and reserve budgets to introduce these arrangements. Singapore offers a good example for this type of initiatives (see http://www1.moe.edu.sg/prime/ for the Programme For Rebuilding and Improving Existing schools). Also in the Netherlands initiatives start to emerge (see http://www.slash21.nl/).

To conclude the issue of classroom arrangement, it is clear that the set-up of computers within a classroom has impact on the kind of activities that can be undertaken with pupils, and on the educational effectiveness thereof. Making use of laptop computers and a wireless network, as is done in one of the validation sites of the OASIS project, makes classroom arrangements very flexible. In the Spanish test site, the issue of classroom arrangements is also discussed, and teachers gave feedback on this topic.

2.2.3 Summary of user needs

Deliverable 1.1 ends with a summary of 27 user needs that are relevant for OASIS. This summary is given in figure 3.

SUMMARY OF 27 USER NEEDS

National differences

1. ICT in schools varies between countries in terms of, for example, educational culture, attitude to change, ICT development stage and spending, curricular requirements, pedagogy, teacher ICT confidence and technology deployment. It follows that there may not be one single OASIS solution and that it has to be adapted to suit local circumstances.
2. Solutions should be scalable across regional and national networks and run alongside existing provision if necessary.

Product design

3. Learning environments should:

- Be flexible and open, allowing for a full range of interactions between participants and resources, teacher intervention at all levels
- Have good collaboration tools
- Have less drill and practice and support more intelligent/constructivist learning
- Should provide rapid feedback to users, appropriate incentives and approvers built in - feedback on progress.

- Provide chat, voice chat, forum, whiteboard, upload/download possibilities, friendly use of html, grading, lesson plans, mailing lists, email, videoconferencing
- Include exemplars of pupils' work, interactive multimedia, broadband permitting, research without copying
- Be nice looking, easy to handle, helpdesk, easy interface
- Work for both educational and administrative use, providing appropriate security and integration with other Management Information Systems for example

4. Products should be:

- In the language of the country where they are used - the blackboard-tools, webcam tools, connection to mobile-phone. They should provide on line translation, videoconferencing
- Able to interoperate, centred on the learner; implementation must enable different applications to exchange data efficiently, reliably, and securely regardless of what platforms are hosting the applications
- Adaptable to teachers' curriculum requirements and teaching style
- Adaptable to student's learning style
- Maximise the power to support communication and dissolving boundaries, for example audio and video as well as text – the more the technological is invisible the better

5. Tools should support educational aims, support collaboration and constructivist approaches; they should be suitable for the full range of abilities, ages and languages (not derived from business applications for example)
6. Users will expect television-style experiences once they have broadband to the home, i.e. rich multimedia
7. The user (or parent) should be empowered to set their Internet safety levels according to their personal values, for example knowing that a child can safely enter a chat room; this may imply identity validation – the work of the DotSafe project may help in this respect
8. The OASIS system should also allow for social use, for example parents can attend physically the course closing theatre session, but the far family can follow it over the net.
9. Provide a library of tools and applications to enable teachers and learners easily to create learning objects that can be shared, integrated and adapted by others.

Educational content

10. A modular approach to the curriculum and learning objects is needed to suit individual learner needs.

School level

11. The emphasis in OASIS should be on the learner and their learning communities rather than the school.
12. The system should aim for 1:1 PC:user; not so much one PC or terminal but an entitlement of the learner to appropriate ICT tools any time, anywhere.
13. School buildings, especially in primary school, do not have space for desktop computers in every classroom.
14. Access devices should be small in order not to disrupt learning processes and overcrowd classrooms
15. Access should be possible from the home, if not anywhere; everything the learner and teacher needs should be at hand wherever they are.
16. Consider the school as a learning hub connected to other hubs, portals and learning grids, perhaps under a 'super-portal' like the EUN; an example of how a learner might connect to the hub: a child, doing some reading in the school garden, should be able to connect its notepad or palmtop to the school portal. That means that the school portal should be designed to support traditional Web pages design, but also more advanced concepts that support downscaling of the information for mobile screens.

17. The school portal, intranet or web site is technical and educational nexus of tomorrow's school; enable schools to rethink their concept of the web site and intranet, making both open and central to achieving their educational aims:
- It has to be easy to use (for teachers as well as for pupils)
- It has to be cheap but reliable
- It has to talk and interoperate to thousands of other school portals
- It has to integrate in all the regional, national and international knowledge networking projects, programmes and portals

Teacher training

18. Take into account what the teacher or learning support person (classroom assistant, para-teacher) is expected to be able to do, their different attitudes towards change and their role and how they will be trained and supported; is a new breed of teacher – the online tutor – needed?
19. Solutions should take into account different attitudes to ICT, varying teaching and learning styles, for example the 'early adopters', 'laggards' and gender differences
20. Training needs:
- Collaborative and constructivist methodology
- Facilitation methodology (in view of changing control role)
- Learning to alternate activities between computer based activity and interaction
- Use of peer mentoring techniques (teach to teacher and pupil to pupil),
- Negotiating skills (teaching students the rules of behaviour in this type of teaching methodology).

Student training

21. Training needs:
- Rules of collaborative activities
- Techniques of autonomous learning

Installation and maintenance

22. It should be less expensive than existing solutions and operate without the need for an on-site technician. Support for schools is from help desks and other set ups and a general outsourcing approach. All available social resources, including industry and other public institutions, should be involved.
23. The use of tools should be self-explanatory and intuitive, so that they can be used independently 24/7
24. Solutions should free teachers to teach and learners to learn and not demand extra skills, training or time
25. Teachers: Adequate number of computers 1:2 based on class size of 20; adequate access and technical maintenance and support working networks; more flexible classroom design
26. Students: Adequate access to machines; well-maintained system.
27. There should be a help desk and FAQ for solutions developed for schools

Figure 3: Summary of user needs relevant for the OASIS project.

From figure 3 we can learn that technological solutions developed within the OASIS project must be very flexible, as they have to be able to adapt to all kind or schools within Europe, that differ in educational culture, attitude to change, teacher confidence and many more. Furthermore the technology must make communication and collaborative learning possible. And, very important, the solutions must be cheap. Efforts within the OASIS, to improve interoperability and foster open source policy address this issue.

2.3 Innovative Technology within the OASIS project

As described in the introduction chapter, the goal of the OASIS project is to keep the public school educational system as the leader of the young people education also at the internet, to pay in particular attention to the socialisation role of the traditional schooling as one of the main capacities of the traditional public system, and how this capacity can be transferred towards the Internet as a competitive advantage for the public system, and last but not least to look at the concept of small school virtual community around the school portal as the main tool to support this approach. In order to reach these goals, the paths of "school interoperability" and the path of "school cost-effective operation and maintenance" are followed. The school portal is conceptualised as a set of net applications covering different aspects of the school life, in which development three issues play a role at the level of interoperability.

1. There is a strong need of *technical interoperability* of the various applications. Schools do not have, as Universities or Companies, an informatics department that can, first customise applications, second, spend a lot of time installing them, third, repair and recover the system when it fails or breaks down. In most schools, there is a teacher supporting as a part time job the school LAN, and that has been trained for this purpose. Technical interoperability, together with other support measures, should guarantee low installation and maintenance costs.
2. There is in particular a strong need of a *system administration interoperability*. A pupil having this year mathematics level 5, should automatically have an open account or be referred in any application (a forum, a web area, a chat, a material, an announcement) dealing with mathematics level 5. A human based administration of complex systems pays off in large organisations. In a small organisation, system administration grows quicker than the number of people to be administered. However, the school community is very sensitive to system administration matters: examinations and protection against harmful content are just two examples.
3. But there is also a strong need of a *semantic interoperability*. In applications designed for large companies, there is a hidden common understanding of the semantics, guaranteed by a centralised informatics department. Customer means customer the same way over all the company and over all applications. But it's certainly not the same from company to company.

Work package 2 of the OASIS project concentrates on these interoperability issues. The SIF (Schools Interoperability Framework) has been chosen as the most promising platform to complement and round the ongoing school networks developments. Within SIF various data models are proposed that will be checked with a group of experts on:

- Its suitability for the European Schools scenario;
- Its compatibility with other developments for the European Schools like the European Treasury Browser metadata navigation structure;
- Its compatibility with other ongoing works like the PROMETEUS initiative.

Recommendations will be made for adoption for the School Networks of some or all the SIF proposals, and make comments, propose changes or adaptations or improvements where required. A main aspect is to agree on a school interoperability extension language at the service of an *open* and *cost effective* architecture with the following dimensions:

1) Metadata
2) Data Models for schools, and eventually on an XML extension for schools
3) Topology of the architecture
4) Data navigation model
5) Administration functions of the architecture
6) Educational Taxonomy

The OASIS implementation must enable different applications to exchange data efficiently, reliably, and securely regardless of what platforms are hosting the applications.

In addition to the goal of school interoperability, the goal of cost-effective operation and maintenance for schools will be reached by making an open code software library available, and by setting up a Zone Management Server Architecture to support school servers.

2.3.1 The Open Code Software Library

An *Open Code Software Library* (OCSL) will be made available as a web site to developers for schools, as a valuable tool for the ICT educational community, and as a good dissemination tool for the developments achieved in the OASIS project. Such a web site will include free and shareware Java based components to be used as components for the development of educational applications and will provide co-operative working tools to support the interaction between developers, teachers and users/providers. It will also include information about commercially available ones. A major function of this library will be to incorporate e-commerce facilities for both allowing the users to acquire them and allowing users to commercialise their own components. Finally, the web site will include a corner for small educational Java applets made by teachers, groups promoted by Ministries and university groups.

Within the OASIS project the following tasks are addressed: defining, developing, setting-up, operating and maintaining the OCS Library devoted to both software professionals and teachers/developers of educational applications and tools for ICT based education at schools.

The Open Code Software Library is defined as follows:

1. In a broad sense the term “Software Library” has similar meaning as the most used Digital Library. It is the opposite of Hardware Library when this is applied to the traditional libraries. Nevertheless, for computer scientists and software developers, collections of computer algorithms or software programme are Software Libraries.
1. “Code Software Library” emphasizes the nature of contents, which are software programmes (software components, software code) and not simply digital materials. Software components to be used by the developers of applications, not digital materials to be directly used by final users (teachers or pupils).
2. Additionally “Open Code” means: “software developed in the public interest, by definition flexible, generally strong and smooth-running, and low-priced or free” (see http://cyber.law.harvard.edu/projects/opencode.html). Open Code

generally implies that the source code of the software is available or easily available. So it can be further integrated as a component in other application under development, or modified to be adapted to a different scenario. This “reusability” is of course very powerful, and the possibility of having an easy access to those software components is of very high interest.

The OCSL is especially focused to help in the development of educational applications providing software components, and it is mainly addressed to application developers, both professional software developers and teachers in their role of educational designer, in the preparation of applications and supporting tools for schools (educational, administrative and management activities).

2.3.2 The Zone Management Server

One of the most pressing challenges to promote the use of the *school virtual community* around the public school educational system is to find *cost-effective solutions with guarantee of service quality*. OASIS will establish this by the creation of a zone management server.

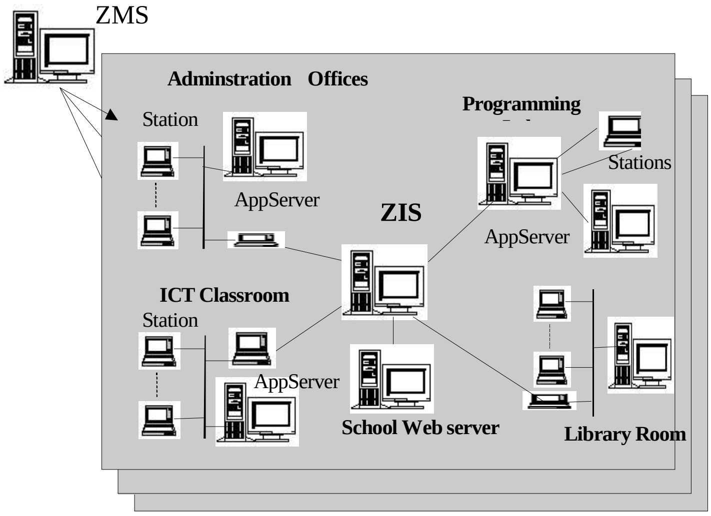


Figure 4: The Zone Management Server

OASIS understands the Networked School Community as a distributed networking system. Within this framework the network management and administration system is a distributed networking system, that consists of a Zone Management Server (ZMS) and one or more components organised into a zone. The size of the zone is flexible and can consist of a single building, school, a small group of schools, a district, etc. It is a scalable solution and supports multiple ZMS implementations or zones with ZMS interconnections. The components are the hardware and software components of the networked schools (PCs, servers, routers, OS, SW tools and applications, etc.).

The zone management server will be integrated with the development of a school sever architecture and the creation of the Virtual Workspace Environment (see http://www.vwe.nu), which is a “Java Based Kernel for Supporting Applications”. The Virtual Workspace Environment and further information on the technologies developed within the OASIS project are included in the deliverables of the work packages 2, 3 and 4.

2.4 Technological and pedagogical possibilities and constraints

The technological solutions and the generic pedagogical models of the OASIS project will be validated in five test sites. These test sites have an extensive variation in the technology used, the kind of activities undertaken, and the pedagogical approach. This paragraph will describe the five validation sites. In the Spanish sites some experience with projects was already collected. Therefore, these projects are described more extensively, as they contain valuable feedback from teachers, and will structure the necessary professional development of teachers who actually participate in the validation of both pedagogy and technology. All descriptions included here are contributed by the coordinators of the various test sites.

2.4.1 The Spanish validation sites

In Spain, two different projects will be undertaken. The first one is the Descartes project within the field of mathematics education. The second is the Malted project on teaching modern languages. Both projects have already been running, and from both projects teacher feedback is reported. Both projects will be developed into more detail before and during the validation phase. Characteristic is the focus on educational design and development from the side of teachers, and its collaborative features by teachers being part of a community of practitioners. It will be a challenge to also introduce pedagogically innovative aspects for pupils learning mathematics and English language, by for example introducing forums for pupils to discuss their experiences with the projects, creating authentic contexts in which the knowledge can be used, e.g. in problem-based cases, or to involve parents in the school work.

2.4.1.1 Mathematics for the school curriculum (the Descartes project)

The Descartes project (see http://descartes.cnice.mecd.es) was initiated by the Spanish Ministry for Education, Culture and Sport and arose from the need to develop interactive material to cover a significant part of the compulsory and post-compulsory secondary curriculum stipulated by the government. The material has been produced in a collaborative environment and has included the participation of teachers from all Spanish Autonomous Regions. The results of earlier projects and previous experience were all taken into account to help with the design of this project.

The leading idea of Descartes is that computer programmes should be open: they should offer the teachers the possibility of interacting with the educational activities presented, allowing them to adapt these activities in order for them to use the most suitable type of methodology for their particular group of pupils.
One drawback to using these types of programmes is that both teachers and pupils must learn how to use them themselves, and that they may only be used to cover a small part of the national curriculum. The programmes usually require the preparation of new material together with activities for pupils or at the very least material adapted by other teachers, which can be difficult to coordinate when different formats have been used.

This project aims to overcome some of these difficulties by offering:

- A large amount of teaching material covering a high percentage of the mathematics syllabus of each academic year.
- An efficient, inexpensive publication and distribution system (Internet).
- The possibility for teachers to adjust the content of the published material using a basic web-page editing programme.
- The possibility of publishing material designed by teachers on the Internet.
- A setting in which the teaching material can be developed (The Descartes applet).

The project aims to break new strategic ground in the learning and teaching of mathematics. The belief is that the existence of powerful tools like the computer and communication through the Internet should play a role in changing the way we learn, the methodology we use, the way we acquire knowledge and the content of what we teach. Of course this change will be more gradual, instead of being very sudden, but nevertheless inevitable. As new technology is becoming more commonplace in schools and teachers feel the need to incorporate it into their teaching, the need arises for specific tools which meet both teachers' and pupils' requirements. This project aims to help this situation by offering solutions to these demands. The observations of the use of computers in the classroom showed that pupil participation in computer-based activities is active, thus creating a constructive learning environment in which both pupil interest and motivation is high.

The project started with designing and implementing a configurable applet in Java, included in an HTML document, thus forming interactive maths lessons, in which the teacher could include whichever textual or graphical information they felt was relevant to the teaching unit, together with recommended activities for the pupils. Then it was realized that a significant collection of material had to be available. Teachers who begin to take part in the project need access to a collection of material which can be used in the classroom and which has been developed using the same programme offered to them. They are also presented with activities to help them learn how to use this tool effectively. This collection of material should cover a large percentage of the subject's syllabus, not just for one particular academic year but also for different levels or stages of education. Therefore, a teacher beginning to learn how to use this kind of material is especially motivated to do so, especially if they know that the material they can work with after the training period, to help their classroom teaching, can be used again and again and is not limited to just a one-off class or set of classes.
Once the applet had been created a team of collaborators was selected in 1999 to design the teaching units, which cannot only be used as classroom teaching material but also as basic models from which other units can be developed. Designing, adapting and improving these teaching units has been an ongoing process. By June 2002, 85% of the maths curriculum was covered for the first term of the 2002-2003 academic year.

A collaborative environment for teachers was created including elements that attract the attention of a large number of teachers and encourage them to use the material. This collaborative environment consists of:

– a special web site with teaching materials;

- a programme of distance-training courses to help teachers design and create teaching units;
- tools for adapting available materials to suit their specific classroom needs and to be able to create their own teaching units;
- a communication site, with a forum for teachers with similar interests to get in touch with each other, and FAQs and their answers covering the most important areas mentioned in the forum will be set up in order to make it easier to search for the most relevant information.

The OASIS project will be validated by schools that are involved in the Descartes project. It will demonstrated that the OASIS technology will lead to better maintenance of school networks, so that technical problems of teachers will decrease. In addition different ways of using the system, both inside and outside the classroom, will be explored, including the online collaboration between groups of teachers working with Descartes in different school communities, using different computer systems and with different educational backgrounds.

Descartes is a mathematical web-based project including content (lessons) and tools (applet authoring software). For mathematics it seems not to be easy to design projects that include other subjects or collaboration with other actors. Up to now the pilot experiments conducted by the teachers basically consisted of taking the pupils to a computer lab to cover a certain part of the curriculum. The pupils worked in pairs. The teachers were not able to picture more ambitious scenarios beyond the school walls (e.g. projects involving companies or the local community, etc.) or thoroughly implement well-designed collaborative learning schemes; they sometimes simply seemed happy to have the computers working properly.

2.4.1.1.1

For the validation it will be a challenge to stimulate teachers to introduce pedagogical innovative features around the pupils' usage of Descartes. The pedagogical models, scenarios and examples of projects that are presented in this deliverable are a starting point for this.

One innovative feature is already part of the Descartes-project: by creating and sharing content on mathematics in different forms with colleagues, thus learning from and with each other, a learning community of teachers has emerged. Part of the validation will be around the question in what way the OASIS technological infrastructure will improve upon the qualitative and quantitative enhancement of this virtual community of practitioners, and its sustainability.

Other possibilities for the further qualitative and innovative character of Descartes are:

- Teachers present the digital resources that their children use in the classroom and at home to parents. It may give parents a better vision on how teachers do the effort of accommodating to the new technologies in the school. Parents can afterwards access from home the web page with their children activities and contact by electronic means with their teachers.
- Involving pupils in 'The problem of the week' in which the Descartes-context is used to present more complex problems, that are not directly related to the lessons explained recently, but that require more logical resources to get to the solution. The problem can be open to the whole school, not only to one classroom. Pupils might propose and explain to peers the solution, presenting it in a web page, on the school portal,

maybe with the help of the Descartes applet. Or pupils might propose, by groups, creative problems for some weeks, and not only inside school, but also open to twin schools, possibly with schools involved in other OASIS validations in other countries.

2.4.1.2 MALTED

The MALTED project started in 1998, as part of a project funded by the Multimedia Joint Call. The general aim of the project was the development and validation, on a large educational scale, of an authoring system designed for the teaching of foreign languages, using a standard technical environment. Java and XML were selected for the technical framework.

The basis was a collection of 9 CD-ROMs that was put online. Material as far as the 4th year of Compulsory Secondary education is now complete. Distance training of foreign language teachers in the use of the tools has been carried out.

The development of the project is similar to that of the Descartes project, encompassing the development of:

- an authoring tool simple enough to attract foreign language teachers;
- a set of materials adapted to the curriculum to make the effort of getting trained in how to use the system worthwhile, as well as providing examples of how to use the tools effectively;
- materials for distance training of foreign language teachers. To promote the use of the system in the classroom, one of the compulsory activities on the course is classroom research together with a description of the pupils' performance;
- a forum on a website, so that teachers can communicate their development and classroom experience with one another and share their own materials with peers. An Asset Base to access through a metadata template is one of the tools of the system, allowing easy and effective sharing of pedagogical applications;
- pedagogical models of use in the classroom and the dissemination of concrete best practice examples.

There are three important differences with Descartes:

- The ICT expertise of teachers of English in Spain is generally far less than that of Maths teachers. It implies that distance technical support in the school network for computer maintenance and the connection of the server to the Internet is more greatly appreciated here than with Descartes. Indeed, in previous workshops with teachers using MALTED, technical problems were presented as critical.
- With Descartes the tools consist of an applet, which occupies 200 KB. The MALTED system occupies 10 MB alone just to install the java set needed to access contents online. Furthermore, the language applications are based on rich multimedia assets, thus requiring local use or access through high-band connections.
- With regards to accessing resources online, teachers of Maths in Spain have little knowledge of the English language. Since most of the content on the Internet is in English, this is an important drawback.

To start the development of pedagogical innovative approaches to English language learning, teachers were asked to give their opinions on a pedagogical model to follow. As an outcome teachers are interested in guidelines for working with new technology. In order to create a pedagogical model that suits them, a global model needs to be developed as a guideline. The following elements are to be part of this model:

- A multimedia definition document (e.g. how to combine and arrange the media files, interactivity between the user and the system, pedagogical arrangement of the contents)
- Arrangement of pedagogical principles (pedagogical model to be followed in language teaching); role of the teacher; role of the pupil
- Maximum exploitation of ICT resources in schools (e.g. contextualisation, interconnectivity, interactivity); examples of best practice

In addition the teachers discussed several ideas according to different types of classroom arrangements, giving the advantages and disadvantages of each and stating which type would be better depending on the activity. These types include:

- A classroom with 20 computers, one for each pupil

This arrangement is typically suitable for independent work of individual pupils. When entering a collaborative learning environment, or using collaborative tools, pedagogically more innovative projects can be implemented. One example of collaborating with pupils of other schools is provided on http://www.europeanschoolsproject.org/image/. Its focus is on Internet-based written English language skills.

- Working in corners

Four corners with different activities could be set up in the classroom, like computer, role-play, writing and listening activities. The pupils rotate in groups, doing a different activity every lesson. An instruction sheet is prepared for each activity and the pupils are to follow the instructions, thereby encouraging autonomous learning, and to hand in the product at the end of the lesson. This product could vary from a tape recording to a written assignment. This method would mean that pupils would not have to share computers. Also in this arrangement pedagogical innovative features can be introduced.

- Working in pairs

This type of arrangement facilitates communication and collaboration between the pupils and they support each other. This kind of arrangement in foreign language teaching gives the possibility of:

- working on role-play activities in which pupils have to record themselves, compare their performance to the original and create different contexts using the computer.
- creating different contexts which are not related to classroom activities.
- promoting communication.

In all, this second Spanish validation site offers more possibilities for introducing collaborative learning models in the classroom, in addition to the support of teachers as part of a virtual community of practitioners. A further scenario is the actual interaction between Spanish pupils and pupils within other validation sites, using English as a second language, on topics of common interest. Diverse communication modes can be used, from e-mail to exchanging audio-files with voices, voice net meetings, or video conferencing. Groups of learners composed by pupils of different schools might produce together web pages with tasks designed by them, with support of teachers.

2.4.2 The French validation

In the French validation site, the Académie de Grenoble will support French schools in setting up an infrastructure for collaborative learning. Each school has to define, first, a School Project. Thus, all pedagogical projects can then be developed and coordinated in a more easy way in the framework of one's own School Project, so that a clear overall structure can be shared everywhere and will give the opportunity of more pedagogically oriented interactions and exchanges.
The following examples of different pedagogical projects will act as an advance organiser for schools that start creating their projects.

1. Democracy and Citizenship

This generic project involved many pupils of different schools in Grenoble, teachers of history, geography, English and Italian language, and the school's Global ICT assistance platform. In less than one year a 23 minutes movie was realised, called "Major Social Risk" within the theme "Violence and Language". This movie has become a national document for pedagogical approach of this area of problems, as well in primary and in secondary levels. Furthermore it was translated in Italian, while an English version is scheduled. Last but not least pupils and teachers who worked on it are invited to speak of it: how to realise such a quality pedagogical document, what about partners, method, difficulties with pupils actors which were themselves “difficult" pupils and have been become exemplary after this great experience, etc. (see http://www.ac-grenoble.fr/CARMI-Pedagogie/RisqueSocialMajeur.htm)

2. Transnational Storm Inventory

Two years ago, with the help of Environment Ministry, an "Interacademic" Pedagogical Project was created, in collaboration with many classrooms in the whole of France. It became a real School-Citizen-Network in which very different presentations and reports are included on national and international Natural or Technological Major Risks. (See http://www.ac-grenoble.fr/CARMI-Pedagogie/Tempete.htm)

The main starting point for the Grenoble schools is the setting up of School Information and Communication Systems, which forms the condition for efficiency and lightweight work. The ICT department of the French Education Ministry has developed a national scheme called S3IT ("Telecommunication & Information System Strategic Scheme"). In this framework and starting from the OASIS project, we propose to customize a tool, based on four recommendations of the ATICA (French State ‘Administration ICT Agency’) dedicated to harmonize exchanges between all administrations and with all partners and conform to the European IAP: Internet and Web Standards of W3C and IETF for

interconnectivity, Norms or/and Open Standards for interoperability (XML, XML Schema, XSL), QoS and Security for users.
The following external aspects of this tool apply. The regional "Schools Information System" (SIS) is dedicated both to primary and secondary schools and will be the tool of all actors (pupils, parents, teachers, school director, school administrator, city, academy, minister). Elements of content that are all projects developed in the Academy of Grenoble: SLIS for regional and local architecture, CYBERSCHOOLS for primary, ELECTRONIC-PORTFOLIO for middle school, LOG (Open Highschool of Grenoble) to complete secondary, and PARC for adults training.
The following internal aspects have to be taken into account. All data of this SIS should be XML Structured Data presenting a tag glossary and a SIS.XMLScheme that should allow school interoperability on both administrative and pedagogical levels (this structured data model is dedicated to communication between European schools and with their environment: Ministry, Community, City, Parents, Companies, Editors and other partners).
The experimentation and demonstration in the Grenoble area will be done with 12 primary and secondary schools.

2.4.3 The Apple set of schools

Apple plans to select approximately 20 schools throughout Europe (France, UK, Switzerland, Germany, Belgium etc) using wireless technology in the classroom, from which 4 pilots are directly involved in OASIS as they benefit from equipment through the budget. The 4 OASIS schools participate in all aspects of the OASIS project. These schools are based in

- Madrid (Spain)
- Grenoble (France)
- Tübingen (Germany)
- Limburg (Belgium)

All schools will have experience with mobility (using wireless technology) and will demonstrate the pedagogical and financial added value of using wireless technology as well as prove how this wireless environment works in an open architecture (example SUN for Spain and SLIS for Grenoble). Schools are a mixture of primary and secondary schools. All use their portables in a media rich learning environment.
The sights, sounds, and interactive media that engage and motivate today’s digital generation are often missing from the classroom. Digital media can truly enhance learning and fun, providing a more compelling and effective learning environment for today’s pupils. Technology today is giving pupils more ways than ever before to research, collaborate, communicate, express their ideas, and share what they have learned. Even children who may not be as articulate in the written word find new ways for effective communication with digital media technology and easy-to-use applications
Integrating digital media can increase the relevance of school for pupils living in today’s media-rich environment. It also gives pupils of all backgrounds, experiences, and capabilities, new ways of communicating and expressing themselves. Imagine a classroom of pupils who can’t wait to work on their projects because each assignment gives them a voice and a means of self-expression.

With the Wireless Mobile Classroom, all the necessary technology is stored on a portable cart. An AirPort Base Station keeps the lab's iBook computers connected wirelessly up to 150 feet away and when the base station is connected to an existing Ethernet port, pupils have instant access to the school's network and the Internet. Another great advantage is that all portables can be charged at the same time, simply by plugging a single electrical unit into the wall.
To integrate Media rich Learning in the classroom, a mixture of DV camcorders, a digital camera, a scanner, headphones and microphones enables teachers and pupils to integrate images and sounds from virtually any source into projects, presentations, and lesson plans and easily integrate digital media content into the classroom.

The relation between technology, learning and interaction spaces, like the portal, and the educational vision can be seen as follows.
Pupil access to technology is no longer limited to a single computer lab or classroom. Now teachers have the flexibility to turn any corner of the building into a powerful learning centre. And because the portable iBooks are on a mobile cart, they can be shared by teachers and pupils in different classrooms to maximise use and limit costs. What's more, security is not an issue — the solid construction of the lab and the locking doors ensure that the iBooks will be perfectly safe when they are not used. Best of all, the Wireless Mobile Classroom reduces wiring costs and installation time. You don't need to tear down walls and reconfigure buildings. You don't need to invest in a dedicated computer lab. You have a cost-effective solution for placing multiple computers in a classroom.
The following relationships between the schools and the local community can be realised.
School projects and results can easily be shared with parents, other schools or members of the local community by through iDisk, a server space with pre-designed features that allows pupils and teachers to store their projects on a server. Teachers can also benefit from the interactive platform ALI (Apple Learning Interchange) to exchange and store lesson plans.
It is also possible to create relationships between schools, teachers and learners at European scale. School projects can easily be shared with other schools in Europe, either in an open and structured way through portals such as EUN (European Schoolnet) or between 2 schools directly. To benefit from real broadband Media Rich Learning across the border, servers allowing for streaming video, on top of the standard server features are a must.

2.4.4 The SUN schools

SUN will select in the first place a number of schools to act as test schools for the implementation of the first release of the technological architecture for the school server. These initial test sites will assess on the later implementation of the school server in some of the pilots of the Spanish Ministry. The teachers of these schools will provide a first in-site impression on the solution and its pedagogical applicability. Sun will select the test schools, but even more important, it will evaluate what criteria should be applied for those sites to be selected. The initial test sites will be composed by four schools in the area of Madrid and two laboratories, one in UPM and one in the headquarters of the Ministry. The solutions adopted in the Spanish pilots for the school server will be varied Some will adopt the SUN Cobalt, some Microsoft servers, and some Linux distributions prepared specifically in the Ministry for this purpose, with the idea to be able to offer an open source code solution to be extended at the end of the

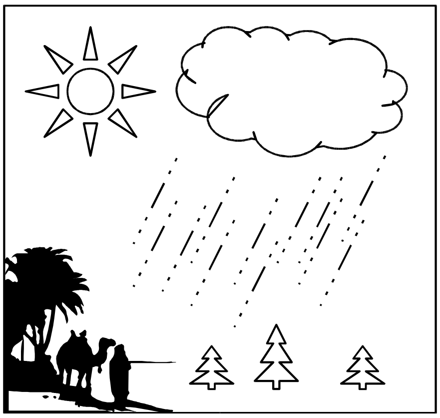


Figure 5: Metaphor of Natural growth

project, besides commercial ones.

For the SUN pilots, the more likely candidates are schools belonging to the Catalonia region, using Sun thin clients architecture for their pedagogical applications. The SUN pilots contrast with most of the other pilot schools in the project in the use of the pedagogical application server as a general solution. Though this is beginning to be essayed in some other Spanish regions, not yet in Madrid and Castilla y Leon Communities, where Spanish pilots are to be installed.

2.4.5 The EUN ENIS Schools

A preliminary version of collaborative learning models is developed in this deliverable and will be tested out together with a significant number of ENIS schools (European Network of Innovative Schools). This will be done in community oriented projects were learning should take place at different places (not only in schools), at different times (not only during school hours) and on different levels (not only by pupils). The goal must be to establish a relationship of mutual respect and advantage for all partners involved. This is both to practice "learning by doing" in projects related to issues like democratic participation and human rights, but also to establish a sustainable relation.

The collaborative learning activities should be developed together with partners such as neighbourhood work places, local political parties, parents associations, or pensioners. The projects will be centred around topics like participation of pupils and parents in the management of the schools, participation in local democracy, comparative studies on citizenship in the society of yesterday, today and tomorrow, etc. They would run through three phases: introduction, implementation and evaluation of the developments of the project. The technological solutions provided by the project will be validated in these pedagogical models.

2.5 Conclusions on the OASIS context

As described in the previous paragraphs, OASIS is a complex project, with a broad scope of technologies and five test sites that differ more than they have in common. Thus pedagogical models that will be described in the next chapter are to be very flexible in order to be able to support teachers in all validation sites. In addition to flexibility, the models have to focus on issues that the findings from the OASIS context have in common. The following five topics are not shared among all validation sides, but are issues that arise often in the previous paragraph:

- Communication
- Collaboration
- Contacts with actors outside school
- Usage of shared information resources
- Production of new resources

In the next chapter various pedagogical models and their backgrounds are described. Suggestions are offered for better understanding pedagogical models in order for their underlying innovative features to be introduced in schools. In chapter 4 the generic models are connected to the validation aims of the OASIS-project and suggestions for projects are described. In addition these five topics mentioned above with be connected to the pedagogical models.

3 Pedagogical Models

3.1 Introduction

This chapter is concerned with the description of pedagogical models that are the basis of the educational activities which various schools in various contexts will undertake using different ICT-architectures and – infrastructures within the framework of the OASIS project. One central model in this chapter is Computer Supported Collaborative Learning (CSCL). This model is based on constructivist ideas on learning, encompassing the concept of learners constructing their knowledge in interaction with the world around them and in collaboration with others. CSCL argues that students, while constructing their own knowledge, can be supported not only by communication and collaboration with the teacher, but by communication and collaboration with their peers as well, and even by anyone outside the classroom.

Both constructivism and CSCL will be described in detail in this chapter. A model related to CSCL is problem-based learning. The main idea behind problem-based learning is the notion that students learn the content of a certain area by working with cases and problems that represent authentic real life situations. The progressive inquiry model (PIM) is a model, based on both CSCL and problem-based learning.
Problem-based learning and the progressive inquiry model are practical models that fit the OASIS situation, as within the test sites projects on real issues will be undertaken in the local neighbourhood. This leads to another set of ideas that will be discussed. These ideas are on the topic of the school being part of the neighbourhood, and ways to establish relationships with this neighbourhood.

When these models have been discussed, implementations and scenarios are described that teachers can use to set up their own learning projects within the OASIS project. Teachers are encouraged to come up with projects themselves, but these scenarios can support them to organize their own projects in order to be in compliance with the proposed generic pedagogical models described.

The basis of the approach used within the OASIS project to implement pedagogical models is complementary; a top-down approach is combined with a bottom-up approach. Especially teachers can see pedagogical models as rather abstract sets of ideas in which practical implications for designing and implementing learning environments and learning activities are not necessarily present. So pedagogical models should be connected to the provision of a set of different scenario’s, which can be used to create learning projects. Teachers, as designers and facilitators, are to localise the models, by taking into account the local conditions, constraints and possibilities and combining them with one of the possible scenario’s provided by the pedagogical models.

This approach within this project is best described by using the *metaphor of natural growth* (see figure 5). From the sun and the cloud, being the pedagogical models, sunbeams and rain come down: different scenarios for local implementation. On various locations, learning projects (trees or flowers) can grow. The weather is conditional to let the trees grow, but so are local factors (like the fertility of the soil). Adding 'just-enough' fertiliser leads to improving these local factors (by providing different kinds of support to local teachers and other local actors). In the ideal case even an oasis can emerge, places that support a variety of life in a desolate context. Using this approach has a clear advantage. Teachers are responsible for their own work, and therefore will be able to accept ownership of the learning activities and environment, thus increasing their commitment.

3.2 Pedagogy as set of inter-related dimensions

The localisation of generic pedagogical models, as they are sketched in this chapter, within one's context is to be supported by including its specific descriptions in professional development for the teachers of the test and validation sites. But a more general framework is necessary to analyse the present pedagogic context, and to derive scenarios for action when introducing and implementing ICT in a pedagogical innovative way. This paragraph describes several inter-related dimensions according to which pedagogy is to be seen. They are based on McCormick and Scrimshaw (2001) who adapted them from Leach and Moon (1999, p. 268). These dimensions are listed in figure 6.

Educational goals and purposes	The goals both general, e.g. for a subject and for particular activities
A view of learning	This is the view that the teacher has on learning: what learning consists of, and how this is best achieved.
A view of knowledge	This is the view that the teacher has on knowledge; this view is related to the view on learning. The questions here are whether knowledge is located in the head, or can reside outside the head, and whether knowledge is objective and given, or subjective and constructed.
The learning and assessment activities required	This defines and structures the classroom activity (and that outside it)
The roles and relationship among learners and between the teacher and the learner	Who controls learning and extent of collaboration among learners
The classroom discourse	This includes not only what is said in the classroom, but also which other actions take place and which norms govern the discourse

Figure 6: Dimensions in pedagogical models (adapted from McCormick and Scrimshaw, 2001)

Each of these dimensions is complex, but they offer a good way for teachers' reflection on their present classroom practice, and for their anticipation upon the future situation when ICT-usages are introduced in combination with 'new' pedagogy. Below part of the McCormick and Scrimshaw work is cited in more detail in combination with effects for OASIS.

3.2.1 Educational goals and purposes

This dimension states the intentions and rationale of the educational encounter, both in general terms (e.g. for a subject) and for particular activities. Curriculum designers, teachers and learners might all vary in what they see as goals and interpret those specified by the curriculum in different ways.

Within OASIS, it is acknowledged that, when possible, projects are to be undertaken in which relationships with actors outside the school are involved. Furthermore, projects may focus on subjects like democracy and citizenship, democratic participation and human rights, participation of pupils and parents in the management of schools, participation in local democracy, comparative studies on citizenship in the society of yesterday, today and tomorrow. Some of these topics are not applicable to all test sites, but they are an important idea of the OASIS project.
The goals are also related to a transition from instructivist approaches to education towards more constructivist and collaborative approaches. The pedagogical models presented in this chapter do encompass the latter. Support has to be given to the validation sites to enable and empower teachers to start and try out these new approaches, and setting out new educational goals and purposes.

3.2.2 Views of learning

How teachers act in the classroom will depend upon how they think learning takes place. If they take the view that learning is the individual construction of knowledge (cognitive constructivism), then their focus will be on individual learners. However, there are ranges of views of learning that are eligible for consideration. While notions of information processing or constructivism are well known, the ICT community has not kept up to date with those views that emphasise the social dimension of learning. Although socio-cultural aspects of learning, and the importance of peer and teacher-pupil interaction are acknowledged, more contemporary ideas of 'learning as participation', as represented by those who take a situated view of cognition, are neglected. At the peer or teacher-pupil level of interaction, the idea of joint construction of knowledge is important, but this also needs to be considered at the community level. At this level, learning is ‘learning to participate in a community’, and this community may be represented by a subject (e.g. a community of scientists), or an occupational group (e.g. health visitors). From this perspective, learning to be part of a community is not just the acquisition of concepts, but ways of behaving, values and hence identity. Schools, and classrooms within them, form special types of communities and learning in them is, in part, learning to be a student. Thus, classroom and school cultures are part of the ‘content’ of learning, in addition to the norms, values and practices of communities represented by school subjects (which are not in themselves the same as the subjects as represented in life outside school). Students have to learn about carrying out a science experiment as scientists do, whilst also learning that the way validity of outcomes is arrived that may not be the same as in religious studies. They also have to learn that the science laboratory has rules that are peculiar to schools, and that these may not be the same as those operating, for example, in the English or mathematics class.

In chapter 2 teachers often mention learning by communication and learning by collaboration. Computer supported collaborative learning has become a topic among teachers and other people in the field of education. Computer Supported Collaborative Learning is based on constructivist ideas of knowledge and knowledge building. Both constructivism and computer supported collaborative learning are later addressed in this chapter. If schools choose for ICT-based change, improvement or innovation of the primary process and the school organisation, directions for change are to be developed. One generic aspect is direction of the school from an institute for learning towards a learning organisation (Senge, 1990). As change within an organisation is to be supported by its members in order to be successful, especially teachers themselves are to develop a learning attitude as well. And also for teachers collaborative learning and work is a strong concept. So within the OASIS sites attention is paid to the development of communities of practitioners, in which knowledge, information and learning resources are contributed on a mutual basis, in order for learning from and with the other within a (virtual) community can emerge. Within the Spanish projects, for example, communications and collaboration between teachers is devoted to the development of new learning materials and didactical units that are made available to others, while having benefit from the work of each other.

3.2.3 Knowledge

McCormick and Srimshaw state that complexities also arise in relation to the dimension of knowledge, not least because views of knowledge are related to those of learning. Those who take a 'radical constructivist' view of learning see students as constructing an individual knowledge structure that is tested (for its validity), against its viability in making sense of the individual’s world. Such an approach sees the objectivity of knowledge as an untenable concept (‘viability’ individually tested is their focus). Those who take a mainstream cognitive constructivist view on the other hand, see knowledge as in the head, and matching reality outside the head; i.e. there is a form of objectivity. Those who emphasize the social dimension of learning, and hence knowledge, focus on the shared creation of knowledge (at the interpersonal or the community level), and consider subjective (or intersubjective) views of knowledge. From a situated perspective therefore, objectivity of knowledge is rejected. At the very least issues are to be considered such as whether we take knowledge to be:

- objective;
- reflecting reality;
- reflected in a reality, that is an individual’s reality or one which is socially shared.

Different views of learning take different stances towards each of these properties of knowledge (objectivity, match to reality, individual or social).

For the OASIS validation sites it is important for teachers to reflect upon their views of knowledge, as they may need to be changed in order to start innovative ICT-based pedagogical projects.

3.2.4 Learning and assessment activities

These activities define and structure the classroom activity (and that outside it). They will also be a manifestation of the other dimensions. For example, if activities are 'open', learners may be encouraged to define the goals of learning or what is learned (which will also demonstrate a particular view of knowledge and a particular relationship between the learner and teacher).

From the previous dimensions, it is clear that communication and collaboration are to be part of the learning activities. The pedagogical models described in this chapter will address these topics.
It is interesting to note, however, that communication and collaboration must not be restricted to pupils themselves, nor to communication between pupil and teachers. These forms will be dominant and important, but from the OASIS context sketched in chapter 2, communication with actors outside the school is important as well. A school may want to establish relationships with the neighbourhood surrounding the school.
For communication, collaboration, and sharing information resources both within schools and between schools and external actors and institutes the interoperable OASIS-infrastructures are particularly suitable to support these activities.

With regard to assessment it will be useful for the teachers to realise that usual forms of mostly summative assessment of outcomes of the learning process are to be complemented with forms of formative assessment, focussing on guiding and monitoring the learning processes of individual or groups of learners. Tools like digital portfolios are powerful instruments for implementing formative assessment.

3.2.5 Roles of learners and teacher

These roles include such aspects as who controls the learning and the extent of collaboration among learners.
In chapter 2, not many constraints are given for the relationships among learners and between teachers and learners. The view on these relationships will be derived from the models described in this chapter.

3.2.6 Discourse

The dimension of discourse is related to views of learning and knowledge. Discourse is usually seen in terms of the *language* of the classroom. However, the way subjects and classrooms are represented by both speech and action in the norms and behaviours of particular classrooms are to be included. A classroom can be represented as a microculture that contains a variety of levels of norms (Cobb et al, 1997). Some of these norms derive from the school level and some from particular classrooms. This dimension includes the way language is used, but also extends to the way students are expected to behave and the ways in which they carry out activities. Different school subjects may exhibit differences in the microculture of particular classrooms, like the science laboratory or the English or mathematics classroom. Similarly different subjects in the world outside school may have different cultures in the way they deal with activity and hence have different ways of working. In addition, different kinds of schools and classrooms (e.g. elementary compared to a high school) have their own varieties of discourse. For example, by the end of elementary school pupils may have a degree of independence of movement around the classroom, which disappears when they attend the first year of middle or high school. Thus we need to see discourse as a kind of microculture shaped by such factors as the school, teacher and subject.

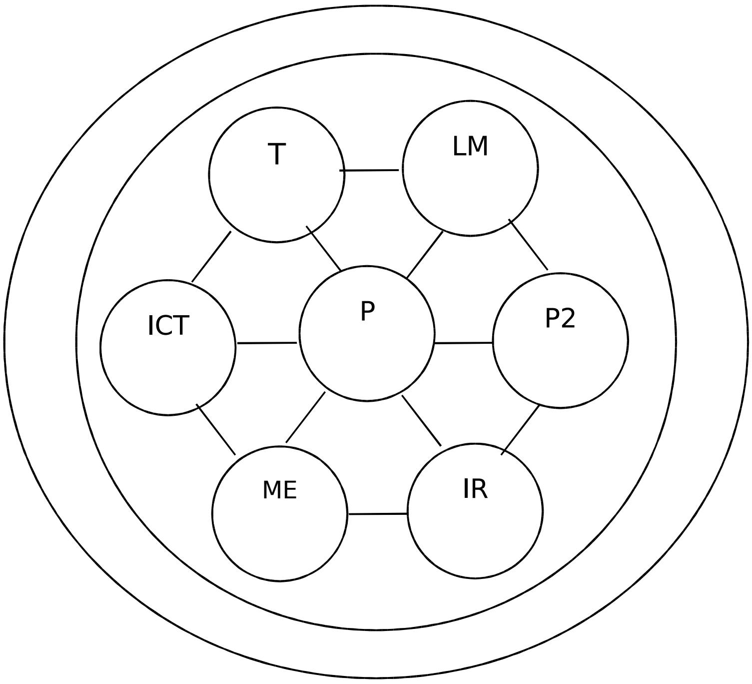
For OASIS it is important to see how the discourse, both with regard to the 'language' of the classroom, and at the level of representation of subjects, may change. By opening up the classroom for external actors, new 'languages', for example from grandparents, and new subject representations, for example social provisions within the local community, enter the classroom. Bridges to the normal or usual discourse have to be built to enable optimal learning and teaching.

3.3 Teacher knowledge and pedagogy

Teachers' knowledge is, in part, made up of the interrelated dimensions described. The figure below indicates a way of representing the different facets of teacher knowledge.

Figure 7: a model of teacher knowledge (Banks, Leach and Moon, 1999)

This model (Banks, Leach and Moon, 1999; described in McCormick and Scrimshaw) sees knowledge not as an objective and tries to take account of the situated nature of knowledge and learning. This representation of teacher knowledge acknowledges teachers' multiple identities: as subject expert (subject knowledge), as subject teacher (school knowledge) as teacher (pedagogical knowledge), and as individual (personal construct). The model also depicts



pedagogy as outlined above, indicating that a teacher's knowledge of pedagogy is made up of a series of dimensions that govern their views, decisions and practice in the classroom. Such representation enables us to see what the implications are for a teacher when ICT is introduced into schools. Teachers may have to change their views of the subject, what they count as school knowledge, and how they view (and implement) pedagogy. The element of personal identity in the model is a critical aspect of how teachers react to change that has the potential to be as threatening or as stimulating as that posed by ICT.

3.4 ICT-based change

Traditional approaches to the use of ICT are inadequate to deal with the complexities that the technologies bring, as well as with the requirements of a sophisticated view of pedagogy. Itzkan (1994) recognizes three phases in the process of integrating ICT in education: the substitution phase, the transition phase and the transformation phase (see also chapter 4). McCormick et al.

similarly state that the use of ICT may entail three levels of change to current practice:

- The first level aspires to provide a more effective means of doing what is already being done. The assumption is that *ICT replaces some conventional resource, but that the other elements in the situation remain largely unchanged*.
- The second level of change is to use ICT to provide a major extension to what can be achieved, one that goes well beyond the efficiency level. In this case *the ICT extends the reach of the teacher, the learners or both.*
- The third level is *transforming teachers' and learners' conceptions of the subject with ICT*.

Together with the dimensions of pedagogy these levels are represented by McCormick et al. in the table below. Of course we must realise that OASIS is an ambitious project already, and that it would unrealistic to expect that within the timeframe of the project all involved schools use ICT to transform all features of the primary process of learning and teaching, and the organisation of the school. But again, for teachers themselves the table offers a framework for assessing their current practices, and for deciding what aspects they focus on for ICT-based change, within the possibilities and constraints of their diverse contexts.

McCormick and Scrimshaw end their article by noting: "Changes in the use of ICT require engagement with teachers concerning their views of knowledge (subject, school and pedagogic), as well as with teachers' personal constructs. Views of change that imagine that all that is necessary is to demonstrate that ICT is effective, and show teachers how to use it (the rational-empirical view of change), under-estimate the amount of change in understanding and beliefs that teachers may have to undergo (requiring a normative-re-educative view of change). It follows that there is a need for clearer thinking about the nature of change in relation to the use of ICT (e.g. McCormick, 1992). One route to achieving greater clarity might be to engage teachers in discussion focused on the dimensions of pedagogy, thereby encouraging them to clarify their views and to re-examine them in the light of the use of ICT (as did Moseley *et al*, 1999). " […] "Sadly we see few signs of initial or in-service training of teachers, certainly in the UK, taking a perspective that emphasises understanding teaching and learning. In our view this may mean that changes in pedagogy will neither be effective nor in line with the goals of those who take initiatives that aim to bring about a more pervasive use of ICT in the classroom."

Dimensions of pedagogy	ICT as efficiency aid	ICT as extension device	ICT as transformative device
Educational goals and purposes	Stay the same, they are just easier to achieve.	Largely stay the same, but information skills or supporting learner independence become important.	These are transformed; e.g. the creation of knowledge becomes a goal.
A view of learning	- Constructivists would see more time for making sense of data etc. (making meaning). - Those who take an information processing view see that increased time on using ideas will allow better learning. - Those who take a situated cognition view may find the implied instructional approach inappropriate.	- Constructivists would see more time and perspectives for making sense of data etc. - Those who take an information processing view see that increased time on using ideas will allow better learning. - Those who take a situated cognition view would see the involvement of communities of practice, with focus on participation, as helpful.	Those with constructivist and information processing views would not see any change, but those who support a participatory approach (as in situated cognition) would see entering into communities of practice as central.
A view of knowledge	No new view of knowledge is required for this.	Extension to new areas may bring with it the need to be clear about who gives validity to knowledge.	Knowledge may become contested, and validation procedures unclear; hence a need for learners to have explicit criteria for what counts as valid knowledge, or processes to arrive at this knowledge.
The learning and assessment activities required	Activities remain largely the same, but may be delivered using electronic means. Dynamic assessment can be used (where the assessment interacts with student responses).	Additional activities required for working with others at a distance. Issues of collaborative learning and group assessment may be important, as well as new outcomes being involved.	New outcomes will require new learning activities and assessment methods. Additional activities required for working with others at a distance. Issues of collaborative learning and group assessment will be important; learners may have to develop self-assessment strategies and the ability to cope with non-teacher/non-school assessment.

The roles and relationship between learners and between the teacher and the learner.	Roles and relationships remain largely the same.	Roles and relationships changed by addition of new teachers and/or learners elsewhere. Teacher's role as source of knowledge displaced somewhat and learner independence may be important.	Distinction between teacher and learner may change, with community of learners and of practice being important. Teacher may be replaced on occasions by outside sources and agents.
Discourse	No change	As the classroom may be extended, there may be different non-school discourses involved.	The creation of a discourse may be part of the learning (e.g. for a community of learners).

Table 1: How different levels of change in the practice of ICT affect dimensions of pedagogy.

3.5 New metaphors for the school as learning organisation and as learning hub

Many classroom teaching is still based on teacher-centred instructivism. Knowledge in the head of the teacher and laid down in text-books devoted to compartments of fixed domains of subject matter is considered to be expert-knowledge to be consumed and reproduced by learners, and is mainly assessed summatively assigning numerical grades, thus allowing minimal grasp on and guiding possibilities of the diverse individual learning processes.
The whole system can still be characterised by the metaphor of a 'Didactic Triangle', depicting a situation where the teacher is at the top of the triangle, with the individual pupil (or student) in one of the lower corners and the subject matter in the remaining one. It is the dominant task of the teacher to instruct in such a way that the subject matter is represented as complete as possible in the brain and hands of the individual pupil. Complete correspondence produces the best grade. Interaction patterns are top-down, and most bottom-up initiatives are unwanted and sanctioned. This instructivist, cognition-oriented and teacher-centred approach fails increasingly, and especially when ICT in all its features is introduced in education.
With the advent of ICT and its resulting frameworks for thinking and acting in terms of networks, the metaphor of the didactic triangle slowly starts to loose its validity in schools. Of course instruction is still necessary, but different, more effective and efficient ways of supporting learning start to emerge. Insights around constructive learning, rather than reproductive learning, and collaborative learning, rather than individual learning are increasingly introduced and implemented. ICT provides support for these learning processes in the form of communication tools, cognitive tools, and electronic learning environments. Within OASIS technological infrastructures are implemented in which this support is offered.
The constructivist paradigm sees learning as an active process in which the learner constructs knowledge him/herself on the basis of prior knowledge. Information is not stored as offered, but actively rebuilt on the basis of personal and context-dependent insights. Social interactions during learning lead to explications of and reflections on insights, strategies, thinking paths, and solution methods. These activities promote both the creation of understanding and the acquisition of heuristic methods and metacognitive skills, the latter leading to the

abilities to learn how to learn. Development of knowledge is intertwined with application of knowledge.

In summary the differences between instructivist and constructivist approaches to learning and teaching are listed in the table 2 below (Eurelings, 2001)[1]

	Instructivist paradigms	**Constructivist paradigms**
Teacher	Judge, Narrator, Expert	Coach, guide, expert, learner
Learner	Passive, listener, reproductive	Active, do-er, constructive
Content matter	Monodisciplinary, abstract, comprehensive	Integrated, multi-disciplinary, authentic, learning objects
Assessment	Selective, summative	Diagnostic, formative, portfolio's
Learning environment	Large-scale, few interactions, few information sources, many directives	Small-scale, a lot of interactions
Didactics	Didactic Triangle Teacher-Student-Content Matter	Didactic Polyhedron Student-Teacher-Fellow student-Task-Media-Domain

Table 2: Comparison of instructivism and constructivism

A new metaphor, as opposed to the didactic triangle, is known as the learning polyhedron (Van den Dool et al., 1998). In a learning polyhedron the sources for learning (materials, information resources, tools), the teacher, the pupils and the fellow pupils form a learning environment that together with the organisation of learning influence the learning and teaching process. The environment transcends the boundaries of the physical classroom because of the communicative and collaborative potentialities of ICT. Thinking in terms of the learning polyhedron allows the inclusion of a larger number of actors, in different relations and roles.
In Danau et al. (Danau, Verbruggen & Sligte, 1998) the different relations and roles in the primary process of learning and teaching are elaborated in a preliminary model called 'pupil-centred ICT-rich learning environment' (cf. Barnard & Sandberg, 1996). The focus on the pupil (P) and the pupil-centred character of the learning environment is represented by the central position. Around the learner are the teacher (T), the learning materials (LM), the fellow-pupils (P2), the information resources (IR), the monitoring and evaluation instruments (ME), and the ICT-tools for the support of the learning process (ICT).

Figure 8: Learning polyhedron

The leading thought is that from the position of the learner meaningful connections can be created with other actors, sources and instruments 'around' the pupil, that show more variation because of the presence and usage of ICT. The didactic triangle is still part of the model (T-P-LM), but more, especially constructivist-oriented pedagogic-didactic learning arrangements become possible. Using the metaphor supports the imagination and realisation of extensive possibilities that ICT offers in the improvement and innovation of the primary educational process.

The representation depicted is to be seen as surrounded by two concentric shells, the one of the secondary processes and systems at the level of the school organisation, and the one of the tertiary societal processes and systems, like the local community and policy regulations. The interaction between the classroom and the school as a whole, and between the school and the surrounding social context are all enhanced by different usages of ICT.

For OASIS it is useful to use the metaphor into more detail, as it sheds light on the nature of the various types of interoperability that will implemented in the project.

First we can see that various actors are present in the model: teachers, pupils, other school staff, and actors outside the school. All these actors can vary in their roles, which affects the type of knowledge and information to be learned, to be produced and to be exchanged, and the skills needed for the learning and teaching activities.

The teacher will still have traditional roles, derived from the instructivist paradigm, but the challenge is to enhance the pedagogic-didactic repertoire of teaching activities and skills towards different roles like coach and guide, but also to invite the teacher to become an educational designer of the learning space, and its constituting elements, and to get involved in communities of teachers and other practitioners in order to share ideas and resources and to collaboratively learn from each other.

The pupil will be supported in not only be a consumer of knowledge and skills, but also to start meaningful collaborative knowledge building activities, in which peers, both within and outside the classroom are partners in learning. These activities can lead to the creation and development of products or half products to be shared within communities of learners.

In the physical classroom many natural communication lines and information streams exist between actors. In the extended classroom these lines and streams are mediated by technology, and come in the form of synchronic or asynchronic communication and collaboration tools.

In addition many educational resources and tools are available within physical classroom and school. With the OASIS interoperable systems additional resources and tools become available to the actors within the classroom. These can come in the form of learning materials close to (national) curriculum, with which pupils learn individually, but also enhanced by multimedia and made dynamic by e.g. simulations, and in the form of a multitude of information resources for learning.

Secondly the school is depicted as an organisation in which the primary task is to organise the primary processes of learning and teaching. As sketched before the introduction of ICT leads to a multitude of changes that may be based on the development of the school as a learning organisation. In addition to the human actors, having to support the changes, the school organisation profits from central repositories with diverse information, residing in school and zone servers, and offering tools for communication and collaboration within the school, including e.g. safe e-mail facilities for pupils under the age of 16.

Thirdly the school is part of larger contexts, like the local community or the complete national educational system. As stated in OASIS-deliverable 1.1 the school of the future will be part of a larger entity of dissolved boundaries. Teachers and learners will be surrounded by ‘ambient learning’, as will the school buildings, support agencies, the home and public buildings. They will be able to connect to resources, support and peers ‘anytime, anywhere, and on anything’. The evidence is pointing towards the school of the future as part of a learning environment, a ‘learning cloud’, part of a larger e-cloud encompassing home, local community, region and nation state: the school as part of a powerful and seamless communication infrastructure connecting citizens, businesses, public services and other organisations. The OASIS infrastructure supports the emergence of schools as core nodes or hubs of knowledge dissemination in their local communities extending learning beyond the physical limits of classroom.

The learning polyhedron is a metaphor depicting an increasing variety of communication lines and information streams when introducing advanced technology. In the sequel more concrete pedagogical models are presented for localisation in the different validation sites, focussing on activities from the side of teachers and learners, and the supporting role of technology for these activities.

3.6 Constructivism

In the previous paragraphs the notion of constructivism has passed in review. Learning is perceived as an *active*, *constructive* process by which the learner builds new knowledge from previous knowledge. Understanding new knowledge is a transformation process of the learner’s mental representation. The learner is not only the actor of his learning; he is also the author of what he learns. Anyone learns by himself but this doesn’t imply that he learns alone. Learning is situated in a given space, time, and social environment. Knowledge is built from various – intended of unintended- educational situations. In these situations, the cognitive confrontation, in other words getting over the difficulties and contradiction between the new knowledge and existing believes, are important learning sources. The environment includes material components (documents, tools but also the classroom, resource centre or a pupil’s home) and human components (for instance other learners, fellows, teachers, educators, parents, etc).
According to the constructivist view, the learner controls the learning process. The learner is totally responsible for his own learning process. However, this does not imply that the teacher’s role is decreased. On the contrary, the teacher is responsible for organising the conditions for effective learning to take place. In this sense, teaching is creating, designing and organising learning situations.
Therefore, the teacher:

- Makes the academic knowledge available and comprehensible for the learners (a so-called didactical transposition process);
- Puts learners in a context in which social interactions and collaborations can take place;
- Designs and delivers learning activities for learners;
- Leads and adjusts the whole learning process for each one of his pupils;
- Makes sure that learning takes place for each one of his pupils and that the acquired knowledge is correct according to the academic standard.

So if educators are to adopt a constructivist approach, they are challenged to adapt and change instructional design strategies to actively engage learners in meaningful projects and activities that promote exploration, experimentation, construction, collaboration, and reflection of what these learners are studying.

It means too, that constructive learning environments are to be created that support a project-based curriculum as an alternative to traditional teaching practices. Learners should be presented with interesting, relevant, and meaningful problems to solve. These real world problems should not be overly defined, but rather ill-structured, in order to allow pupils to seek out a solution to the problem. There is no single right answer or single solution for a problem using this approach. Constructivist learning environments must be designed to engage the learner in complex thinking exercises that require reasoning and investigation of the problem to be undertaken. Pupils must construct their own ideas to make sense out of the situation.
Design of constructivist learning environments is important in enabling the effective use of collaboration. Learners share information to collaboratively construct socially shared knowledge. Applications such as computer conferencing, chat lines, newsgroups, and bulletin boards promote conversation and collaboration and assist meaningful learning. The use of these tools helps facilitate discussion and sharing of ideas amongst learners when they are addressing the same goals. In this way peers are identified as resources rather than competitors.

In the next paragraphs different pedagogical models are presented that are based on the constructivist approach. They lean heavily on the work done within the IST-projects ITCOLE and Celebrate, and are especially inspired by the important work of the University of Helsinki (Hakkarainen, Ilomaki, Rahikainen, Lipponen et al) that we have gratefully cited and used.

3.7 Computer Supported Collaborative Learning

3.7.1 Introduction

Computer Supported Collaborative Learning (CSCL) as a domain for study and investigation has emerged from several theories. The first is constructivism as discussed in the previous paragraphs. Communication and collaboration are essential elements when introducing a constructivist approach to learning, and computers and computer networks provide tools for extended communication and collaboration of learners. Extensive research has been performed to extend Computer Mediated Communication to collaborative learning in which co-construction of knowledge is central to the mutual learning processes of the different participants in interaction with each other. Theoretical references include the “community of learners” model (Brown, et al. 1993), in particular the notions of constructionism, as defined by Papert (1991), and of “distributed” and “situated” cognition (Lave, 1991). The communication theory applied to the mediation of computer software (Clark & Brennan, 1991) integrates this model. The “community of learners” model links theory to practice and is suitable to investigate into the development of higher order thinking skills. Within such communities students act as cognitive apprentices (Collins et al. 1991) both towards adults/experts present and towards each other. Teachers adopt the model of "how to find out" and they coach the students through the scaffolding and the "guided discovery" strategies. When such a community extends the borders of the classroom-walls, computer mediated communication becomes essential and new theoretical aspects are brought in the picture. Since its definition as process through which meanings are collaboratively constructed and re-constructed (Bachtin 1981; Dickerson 1996) communication has been put central in many studies. Hence communication is not thought to merely express thoughts but also as a way to shape thinking and cognition. A reciprocal influence between individual thinking and cognition and collaborative knowledge building and social relationships is thus established through communication. A constant process of introducing the individual meanings in the social sphere and re-integrating the social knowledge in the individual cognitive processes is necessary. This process is called "grounding" (Clark & Brennan 1991) and it is differently shaped according to the features of the communication means used. Especially the support of the emergence of grounding is vital for learners to develop responsive and responsible attitude with regard to the interaction and collaboration with their partners.

3.7.2 Types of CSCL

In general, five different categories of CSCL can be distinguished:

The first type of CSCL occurs in small groups, behind the computer screen. The communication is face-to-face, and the computer serves only as the tool where the pupils are working on.

The second type of CSCL is face-to-face collaboration within the classroom, together with the help of a networked computer environment. Often a shared workspace, or a networked knowledge-building environment is an element of this type of CSCL.

The third type of CSCL is where pairs (or groups) of learners in one classroom collaborate with pairs (or groups) in another classroom over the web.

The fourth type of CSCL is when most of the communication and collaboration is done through the web, but there is also a substantial part of face-to-face communication. This is seen often in higher education.

The fifth type of CSCL is the type where all the communication is done through the web, and there is (practically) no face-to-face communication and collaboration.

A concrete and simple approach for applying CSCL in the classroom is the jigsaw-model. (Aronson et.al., 1978, Clarke, 1994, Slavin, 1995). Within the schools, pupils will work in a peer-to-peer fashion, using the collaborative learning techniques described in this chapter. The jigsaw-model is based on shared responsibilities in a group. In this model a classroom of pupils is devised into smaller groups, and each group has to learn a specific part of a bigger task. Each individual has to become an expert in the task at hand. After learning this expert task, the groups mix in such a way that each group now has one expert of all the different tasks. These groups now will have to learn the whole big picture. Thus the goal of each pupil now is to teach the other members of his new group the task he is an expert in. More detail this would work out as follows:

- A group of 25 pupils is divided in 5 groups. Each group learns a task, say A,B,C,D,E. Thus we have the pupil groups AAAAA, BBBBB, CCCCC, DDDDD, EEEEE.
- After this has been accomplished, the groups mix, and there will be five new groups. Each group will have one pupil from each previous group, thus creating the groups ABCDE, ABCDE, ABCDE, ABCDE, ABCDE.
- Now each group can do the entire task while each pupil can teach his group-members his specialisation.

The model invites the pupil to be a teacher. Learning a certain task may not be that difficult. But to learn something with the goal of being able to teach it to others requires some higher order skills, and a better mastering of the task or learning subject. This model also enables group discussion and practice by doing, which are (together with teaching others) the best ways for retention of knowledge. In addition pupils learn how to switch between different roles.

3.8 Problem-based Learning

3.8.1 Introduction

Problem-based learning is a practice-oriented pedagogical model, in which students develop their expertise on the content area in question by working with cases and problems that represent real life situations (authentic problems) (Savin-Baden, 2000). Barrows & Tamblyn (1980), the pioneers and developers of the model, define problem-based learning as "the learning that results from the process of working towards the understanding or resolution of a problem. The problem is first encountered in the learning process, and it serves as a focus or stimulus for the application of problem-solving or reasoning skills, as well as for the search for or study of information or knowledge needed to understand the mechanisms responsible for the problem and how it might be resolved." The goal of learning is to acquire a pre-defined, integrated body of knowledge related to the problem(s), and this knowledge includes declarative knowledge ("what"), procedural knowledge ("how") and contextual knowledge ("why, when and where") (Barrows and Tamblyn, 1980).

As Barrows and Tamblyn (1980) note, the concept *problem-solving* is a bit misleading. For many *problems* there is no solution or, alternatively, there are several solutions and to solve the basic problem is not essential. *Problems* are as a matter of fact quite close to *cases.* The difference is that a case is a description of a certain situation that is used for training students to apply what they have learned from a textbook. Anyhow, *problem* and *problem-solving* are the commonly used concepts.

Learning by problem-solving can be applied on two levels:

1) As an overall method of learning and as a distinctive, well-documented instructional approach (Bereiter & Scardamalia, 2000) applied especially in several areas of higher education, typically in medical education for which it was first developed. In these approaches, all learning of academic professions is constructed around problem-solving. The educational organisation is then constructed to support the problem-solving approach and the educational settings are well-designed and stable. Typically the problem solving process takes some weeks (e.g. 6 weeks) and then it might include only one large problem. *A problem* is a large, cross-curriculum content, without an exact question but rather an area of several problems to be found, defined and solved. The process of solving the problems includes also group work, the division of labour for finding relevant information, the tutor, etc.

2) As a learning method for one content area, sometimes connected with other teaching methods; in that case, problem-based learning is used only occasionally, and it is one alternative among other methods. The difference in these two approaches is mainly the educational setting, not the method of problem-solving. When problem-solving is used as one element of a course or a curriculum, *a problem* might be an independent problem, not a part of a larger group of problems. Still, it might consist of a cross-curriculum content area, where the problems are complex and students must to define the problems and find the possible solutions. The process takes, however, less time and effort.

It is important to notice that problems are not "exercises" or ready-made questions, as problems are sometimes thought in e.g. mathematics.
Savin-Baden (2000) defines three essential conditions for problem-based learning
1) It concentrates on constructing a curriculum based on problems, to support a broad, cross-curriculum approach, and to support learning of cognitive skills instead of specific subjects
2) It is supported by a tutor's guidance, work in small groups, and active learning
3) The outcomes are the development of skills and motivation, and the ability to life-long learning.

The outcomes of problem-based learning are anticipated to be 1) the increasing expertise of the content area, 2) problem solving skills and the ability to solve new and challenging problems, 3) good metacognitive skills, like ability to self-reflection, 4) higher order cognitive skills, like decision making, critical and creative thinking, 5) the ability to connect declarative and procedural knowledge.

3.8.2 Essential elements of the model

3.8.2.1 Problem descriptions

Problems form the starting point for the studies. A problem might be for example a statement, a simulated patient complaining something, or a description of a phenomenon. It might also be an open question without one single answer; typically a why- or a how -question. Problems consist of authentic descriptions, which include all essential information of the situation/case, as in real life, e.g. not just ready-made summaries or exact references to textbooks. A problem description e.g. in medical studies might include a patient simulation, descriptions of symptoms, results of laboratory tests and background information of the patient.

The descriptions can vary from short and simple to large entities with detailed background information and a demanding content. Typically problem descriptions form a hierarchical structure from easier ones to more difficult and complex ones. The problem descriptions are designed by educators and experts; and, as in the case of many higher education applications, these form the whole curriculum, and the traditional "subjects", traditional contents of learning, are integrated in the problems.

Students are organised to work in study groups. In the group discussion, they define the study problem based on the description of phenomena, events or cases that have a relationship with each other. The description is the basis for students' collaborative discussion and inquiry; it is essential that they formulate the study questions themselves instead of getting ready-formulated questions. Because students have these complex and authentic descriptions, they choose themselves what they regard essential for defining their study problem.

3.8.2.2 Problem solving process in study groups

Problem solving is the key activity for learning in the problem-based learning approach. In educational institutes where problem-solving is applied throughout the curriculum, students are supported and guided thoroughly. Students always go through the same process, and it is explained thoroughly to them in "a problem-solving guide" with a clear model of the process steps, the needed activities, the problems they should be able to solve, and even the assessment questions they should manage in the end of the studies. The steps of the process become thus familiar to the students; therefore, they can direct their cognitive effort in content, not in the problem-solving method. Working in groups help the students to share understanding and thus construct a common knowledge base. They get also guidance in their study meetings from a real tutor, who supports their study activities in different phases.

The problem-solving is group work. The students learn in a group to divide the problem into sub-problems, to formulate hypotheses, to activate the previous knowledge and to reflect on their work (Moust, Bouhuijs & Schmidt, 2001). The group work is helped by organising it with formal roles of a chairman and a secretary.

The process has five different phases: problem identification, data collection, assessment, recommendation and evaluation of the solution (Savin-Baden, 2000). These phases have some minor variations depending on the educational institute. The cycles can be used several times to solve the original problem.

Additional information for solving the problem is also often required. It should also be authentic (or simulate authenticity) and it can include all types of information, like printed material, audio-visual material, models, even people (e.g. to be interviewed), or places to visit. Students do not get all the information needed in the problem descriptions. They have to do some information search and e.g. read additional literature or do some simulation before they can answer the formulated study questions to solve their problem.

Furthermore, a tutor is needed for guiding the study group. The tutor helps the study group to construct the problem so that the students learn the relevant concepts, principles and skills. The tutor has a facilitating role; she/he is not a teacher or a lecturer. The tutor also helps the group to get rid of misconceptions, false assumptions and thinking models (Barrows & Tamblyn, 1980, Moust, Bouhuijs & Schmidt, 2001).

3.9 Progressive Inquiry Model

One of the basic requirements for education is to prepare students for society, in which knowledge is the most critical resource for social and economic growth. Knowledge work is characterized by systematic knowledge advancement, sharing

of expertise, and collaborative elaboration of knowledge products. In order to obtain skills required in this kind of activity, it is important that students learn to work with knowledge in the same transformative way that experts do.
New pedagogical models are required that would support these kind of practices in education. In the literature on educational research, there are several models for *inquiry learning* in primary and secondary level education. A number of them have been developed to model and facilitate inquiry in natural sciences, e.g., scientific visualization technologies to support inquiry-based learning in the geosciences (Edelson, Gordin & Pea, 1999), or project-based science and laboratory work (Krajcik, Blumenfeld, Marx, Bass, Fredricks & Soloway, 1998). The ideas of discovery learning in general can also be considered to belong to this background. But, it may be argued that in *ill-defined* domains the process of inquiry has different emphases than in well-defined scientific fields. In the latter, the problem-setting, hypothesis testing, systematic data collection, and analysis demand more attention; whereas in ill-defined domains – such as social sciences or philosophy – efforts at theory building, conceptual clarification, argumentation, and critical evaluation are more often the focus of activity – although the overall structure of the inquiry cycle is rather similar.

Several researchers have proposed that in order to facilitate higher-level processes of inquiry in education, cultures of schooling should more closely correspond to cultures of scientific inquiry (e.g. Brown, Collins, & Duguid, 1989; Carey & Smith, 1995; Collins, Brown, & Newman, 1989; Perkins et al., 1995). This includes contributing to collaborative processes of asking questions, producing theories and explanations, and using information sources critically to deepen one's own conceptual understanding. In this way, students can adopt scientific ways of thinking, and practices of producing new knowledge, not just exploitation and assimilation of given knowledge. Scardamalia and Bereiter (1994, 1999) have proposed in their *knowledge building* theory that schools should be restructured towards knowledge-building organizations, in which students and teachers participate in the construction of collective knowledge as in professional research groups where the object of activity is solving knowledge-problems.

By synthesizing these demands, Hakkarainen and his colleagues in the University of Helsinki (see Hakkarainen & al., 2001) have developed a model of *progressive inquiry* as a pedagogical and epistemological framework that is designed to facilitate expert-like working with knowledge in the context of computer-supported collaborative learning (CSCL). It is primarily based on Carl Bereiter's and Marlene Scardamalia's (1994) theory of knowledge building, on the interrogative model of scientific inquiry (Hintikka, 1985; Hakkarainen & Sintonen, 2002), and on the idea of distributed expertise in a community of learners (Brown & Campione, 1994). The model have been implemented and studied in various educational settings (see e.g. Hakkarainen & al., 1998; Lipponen, 2002, Rahikainen, Lallimo, & Hakkarainen, 2001; Lakkala, Ilomäki, Lallimo, & Hakkarainen, 2002).

In progressive inquiry, students' own, genuine questions and their previous knowledge of the phenomena in question are a starting point for the process, and attention is drawn to the main concepts and deep principles of the domain. Although students are learning already existing knowledge, they may be engaged in the same kind of extended knowledge-seeking processes as scientists and scholars. From a cognitive point of view, inquiry can be characterized as a question-driven process of understanding. Without research questions there cannot be a genuine process of inquiry, although nowadays at schools information is frequently produced without any guiding questions. The aim is to explain the phenomena in a deepening question-answer process, in which students and teachers share their expertise and build new knowledge collaboratively with the support of information sources and technology.

The progressive inquiry model specifies certain epistemologically essential elements that a learning community needs to go through, while the relative importance of these elements, their order, and actual contents may involve a great deal of variation from one setting to another. In the following, a general framework of progressive inquiry is outlined and each aspect of inquiry shortly discussed (see Figure 9).

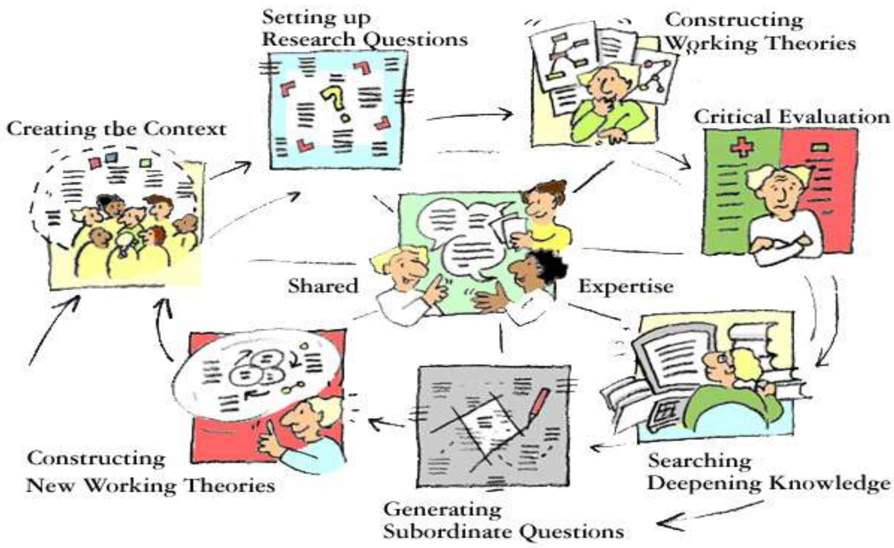


Figure 9: The Progressive Inquiry Model

Although scientific inquiry is a prototypical example of progressive inquiry, corresponding process are frequently observed in humanities and many kinds of cultural activities. One has to engage in a process of inquiry whenever there is a problem that cannot be solved with available knowledge. The process of progressive inquiry is similar in a wide variety of cultural activities. In this model, a group of learners goes through a cycle of 7 stages, thus building a distributed expertise in their group. The cycle consists of:

1) *Creating the Context*: In the beginning of the process the context for the project is jointly created in order to anchor the problems being investigated to central conceptual principles of the domain or complex real-world problems. The learning community is established by joint planning and setting up common goals. It is important to create a culture of learning that supports collaborative sharing of knowledge.

2) *Setting up research questions*: An essential aspect of progressive inquiry is to generate students' own problems and questions to direct the inquiry. Explanation-seeking questions (Why? How? What?) are especially valuable. In progressive inquiry, all the phases of the learning cycle are part of the problem solving process.

3) *Constructing working theories*: A critical condition for developing conceptual understanding is the generation of students' own hypotheses, theories, or interpretations of the phenomena being investigated. It is important that students explain phenomena with their own existing background knowledge before using other information sources, and openly share these explanations in the learning community.

4) *Critical evaluation*: Critical evaluation addresses the need to assess strengths and weaknesses of different theories and explanations produced, in order to direct and regulate the learning community's joint cognitive efforts and the evaluation of the process itself. Critical evaluation is a way of helping the community to rise above its achievements by creating a higher-level synthesis of the earlier results of inquiry processes.

5) *Searching deepening knowledge*: The students are supposed to explore diverse sources of information to find answers to their questions. A comparison of intuitively produced working theories with well-established expert knowledge or scientific theories tends to make weaknesses of the community's conceptions explicit. The information sources should be used in an elaborative and evaluative way instead of copying information as such. The teacher must decide how much of the materials should be offered to the students, and how much the students themselves should actually search out for the materials. Questions stemming from true wonderment on the part of the students can easily extend the scope of materials beyond what the teacher has foreseen or suggested. On the other hand, the search for relevant materials provides an excellent opportunity for self-directed inquiry and hands-on practice when struggling to grasp the differences between various concepts and theories.

6) *Generating subordinate questions*: The process of inquiry advances through transforming the initial big and unspecified questions into subordinate and, frequently, more specific questions, on the basis of the evaluation of knowledge produced. Formulation of subordinate questions refocuses inquiry.

7) *Developing new working theories*: New questions and the scientific and/or expert knowledge that the participants come about give then arise for new theories and explanations. The process also includes publishing of the summaries and conclusions of a community's inquiry.

8) *Distributed expertise*: All phases of the process should be shared among participants, usually by using collaborative technology. Diversity in expertise among participants, and interaction with the information sources and/or expert cultures, promotes knowledge advancement. It includes shared cognitive responsibility of the success of the inquiry.

When the stage of new theory is reached the cycle starts all over again. Within the group of learners this model leads to shared expertise.
Within the project, schools can create their own learning project. Important is that the programme fits into the framework of CSCL. The use of PIM has to be localised to the conditions and circumstances of the school. A typical progressive inquiry project in school can last 4-6 weeks, if about 5-6 hours is spent to it weekly, but the elements of progressive inquiry can also be applied in shorter learning periods. Usually, pupils in a classroom work mainly in the groups of 2-4 pupils having a common research question, but the whole classroom also have common discourse sessions face-to-face or on-line. Teachers' role in progressive inquiry is to organize the whole educational setting, which includes, for instance, scheduling the process, planning the use of technology and learning materials, and organizing pupils' collaboration and group work. It is usually necessary for the teacher to structure and scaffold the process, keep it active and in focus during the progression of the course, and to help pupils gradually to take upon themselves the responsibility of the higher-level cognitive processes.

3.10 The school in society

An important issue in the OASIS project is the notion that a school is a part of its environment. A school is a member of a local community. All too often, the school does not have a productive relationship with the community. The school is located in the neighbourhood, receives children every morning, let them out again in the afternoon, and that's it. No real connection to the community has been made. But a well-known saying is "It takes a village to raise a child". This last paragraph before going to the scenario's and projects-section describes initiatives made to increase the ties between the school and the world outside the school, and more specific to the direct neighbourhood of the school.

3.10.1 The broad school

In the Netherlands, initiatives have been made to create a social context around schools. This initiative is called "De Brede School" (the 'broad school'). Before, but especially after school hours, the school is turned into a kind of community centre, in which various activities take place, partly under the responsibility of other institutes in the local community. These activities are open for the pupils, but also for others. Initially, the initiative came from problem areas, in which schools and social organisations within the neighbourhood started to co-operate. But nowadays, the approach is recognized as a valuable initiative to establish more context around schools, also for areas and schools without social problems.
This approach has many advantages, like:
1) The school building hosts all kinds of activities. After school time, children can engage in these activities, thus learning all kinds of skills (sports, cultural skills, etc.) in addition to their school education.
2) These activities make it easier for parents to collect the children at a later time (when convenient).
3) More money can be invested in the school building, as the building is multi-purpose, and is used during an extended period (not only school hours).
4) The same applies for equipment. For example of a classroom with 15 computers can be used for computer education during classroom hours, and for computer education after school hours for people from the neighbourhood. Or an Internet-café might be opened after classroom hours.

5) After school time, people from the school environment might come to the school for sports, cultural activities, and courses. This creates communication between the school en the neighbourhood, leading to an increase in social cohesion and security.

In the Netherlands, the concept of the broad school is implemented increasingly, with many new broad schools emerging (see for example www.bredeschool.net).

3.10.2 Contact with experts

Internet makes it possible to communicate with persons outside the classroom. So when pupils need information on a subject, they can go to the library and read books about it, they can search on Internet, but they can also contact experts on the subject, which provides a more interactive approach to the subject and enhances the deepening of knowledge.
Making contact with experts can be done on an individual basis. The teacher or a pupil knows an expert personally, or incidental appointments are made to make contact with an expert. It is also possible to incorporate the contact with experts into the learning programme on a more regular basis.
In the Netherlands, a project has been set up to create an environment where pupils have contact with experts on a regular basis. The project is called Ontdeknet (Discovery Net; see www.ontdeknet.nl). The idea of this environment is that pupils can choose from a long list of professionals (from sports people to firemen, from farmers to ministers). These professionals volunteer to take part in the project and invest one or two hours of work every week in the project. First they will write an introduction on themselves and their jobs. The pupils will read this introduction on the Internet, and discuss in their group which questions will be asked to the expert. Then, every week the expert will address one of the questions. In the end, the pupils will have to make a presentation on the subject of their expert. All interactions are supported by the web-based environment developed in the project.
In the period this project has been running, it is demonstrated that both inspiring learning experience for the pupils are achieved, and rewarding experiences for the experts.

3.10.3 Contact with parents

Parents bring their children to school in the morning and pick them up again in the afternoon. Between these two moments, there is not much contact between the parents and their children. In some cases, parents can get involved in school tasks. Most of these tasks are not directly related to the learning process, but are related to school management and logistics (like preparing lunches etc.).
Many parents have busy jobs, with tight schedules. For these parents, getting involved in school activities is not an option, as it much too time consuming and it cannot be arranged within the working schedule.
From the viewpoint of the school, the idea of having parents around is not always welcome. A parent in the classroom might have a strong emotional impact on the child. Furthermore, it might be confusing for children when some parents do come to the school, where other children do not see their parents coming to the school. Thus, getting parents too involved in classroom activities might lead to confusing and emotional situations.

Nowadays, Internet communication makes it possible that parents can communicate with the classroom in a similar way as the experts described in the paragraph above, without too much time investment, and without the emotional impact of a physical present parent in the classroom. This might lead to a situation in which parents can contribute to the learning process. One can think of several learning projects in which parents of the children can play a role.

Another possibility arises when parents are offered access to content that their children use, both in school and at home for homework. In case of unfamiliarity with the content, forums may be created in which teachers get into interaction with parents to support them in supporting their children.

3.10.4 Contact with other schools

Many examples are available on the ways that contacts between pupils and teachers from one school and pupils and teachers from other schools have positive effects on both the learning process and the development of learning communities that extend the boundaries of individual classrooms and schools.

One of the examples is given by the CIAO-project.

The CIAO-project (Computers in Amsterdam Education) is now composed of 75 schools for primary education in Amsterdam. Among the many applications of ICT are the communication projects via e-mail, in which two or more schools collaborate with each other on certain subjects.

An example of such a project is ‘The Bear project’ (originating from I*EARN, one of the larger International school networks, see also: http://www.iearn.org) that facilitates communication between younger children using e-mail. A classroom teddy bear visits another class in another school and stays there for a couple of weeks. Every day the bear goes home with one of the children and the next day the child that has hosted the bear takes the role of the teddy bear and sends an e-mail ‘home’ to tell about ‘his’ (the bear’s) adventures while staying overnight in the home of the hosting family. Conclusions of a research project show that “the Bear project exposes young children from grades 4 to 6 to the computer. Girls as well as boys, from different ethnic groups, are given the opportunity to learn to communicate through e-mail in their own classroom. The project offers lots of possibilities to work specifically and interactively on language skills, in which a clear connection is made between the written language and the spoken language.” (van Daalen and van Gelderen, 2000).

Another good example is the communication project ‘Playing in Amsterdam’. This project facilitates communication using e-mail to discuss neighbourhood issues between pupils from different schools. Five to eight schools are grouped together. During art lessons pupils create paintings around the topic ‘playing and playgrounds’. They also add hand written information about themselves and their piece of work to the paintings. The classroom material is distributed among the grouped schools so each school receives material from all the other participating schools. The material is exhibited in the school and pupils are assigned to a particular piece of work and the hand written extra information. During a couple of weeks intensive e-mail exchange is organized between the pupils using the artwork as main topic of communication. This creates a framework for a broader exchange in which neighbourhood topics can be included. As a concluding activity all pupils of the participating classes meet in one school to get to know their e-mail partner face to face and to exchange cultural festivities. The research reports: “In this project most of the children enjoy writing messages about their own experiences. The theme ‘playing’ is the starting point of these messages. They are clearly focused on their peers who, in their turn, react on these messages. The set-up of the project is motivating and structures the writing activities." (van Daalen and van Gelderen, 2000). Many other especially international examples can be found on the websites of the European Schools Project (http://www.esp.uva.nl), the Comenius3 European Collaborative Learning Network (http://www.ecolenet.nl) and the EUN (http://www.eun.org).

3.10.5 The school in the neighbourhood

The school as part of the neighbourhood can mean interactions with other schools and parents. But also other institutions like a community centre, a police station, a fire department, an elderly people's home, a library, and many more can be involved. In a broader context, one can find many experts, which are willing to share their expertise with pupils, according to an apprenticeship-model.

The leading idea of the preliminary collaborative learning models proposed for the OASIS-project is to establish mutual contacts between the school and the various other actors in the neighbourhood of the school, thus taking the school in a broader context, and involving the local community in activities beneficial for the school and the community itself. Some information resources and training opportunities will have to be put at the disposal of local community members. The Zone Management Server for usage by the school and the local community fulfils this function.

When schools situate themselves in a broader context of the local community projects become possible in which pupils gather information about other actors in the community. For example collecting stories of elderly people in the elderly people's house, write a report on the local fire department etc. This will however not necessarily result in the establishment of a sound relationship between the schools and the other actors in the neighbourhood. On the long run, other actors will keep investing time and money only when these actors receive something back. Therefore, the concept of *reciprocity* is to be kept in mind. When the schools want something from other actors in the local community, they will have to provide them with something that is useful to them in return. The Zone Management Server can be the starting point for the interaction, and the first place to look for members of the local community to find something of their interest. The school portals thus will play an important role within the OASIS project, as these are the places where various actors in the neighbourhood (the school itself, other schools, members of the local community, etc.) come together, communicate and find topics of their interest.

3.11 Conclusion

In this chapter various theoretical and conceptual backgrounds to the preliminary collaborative learning models were presented, including introductory bridges to the actual implementation of the models within the OASIS-validation sites. In the next chapter we will go into more detail, aiming at giving teachers and coordinators of the validation sites more extensive recommendations for the work to be done.

4 Pedagogical Scenarios and Pedagogical Projects

4.1 Content of OASIS projects

As described before, the basis of the approach used within the OASIS project to implement pedagogical models is complementary. The pedagogical models are abstract sets of ideas in which practical implications for designing and implementing learning environments and learning activities are not necessarily present. So pedagogical models should be connected to the provision of a set of different scenario's, which can be used to create learning projects. Teachers, as designers and facilitators, have to localise the models, by taking into account the local conditions and combining them with one of the possible scenario's provided by the pedagogical models.

4.1.1

Within the OASIS project, a significant number of schools will test technology in combination with the pedagogical models as described in this chapter. This will be done in community oriented projects in which learning takes place at different places (not only in schools), at different times (not only during school hours) and on different levels (not only by pupils). The goal must be to establish a relationship of mutual respect and advantage for all partners involved. This is both to practice "learning by doing" in projects related to issues like democratic participation and human rights, citizenship, but also to establish a sustainable relation.

Teachers and schools are free to set up their own projects, as this increases commitment to the project. Furthermore, the project can be adapted to local conditions and it can use for example already available computer programmes. Giving the teachers the freedom is likely to increase the success of the projects. However, the models described in this deliverable give guidelines that teachers can use to incorporate in their projects. These guidelines are:

1. Learning according to more constructivist approaches should be supported (like PIM and CSCL). Teachers are to be introduced for using these approaches, before they start implementing it.
2. Learning activities should emerge at different places (not only in the classroom)
3. Learning should be possible at different times (not only during classroom hours)
4. Preferably learning topics are related to one or more of the following issues: democratic participation and human rights, participation of pupils and parents in the management schools, participation in local democracy, comparative studies on citizenship in the society of yesterday.
5. The learning programme preferably involves contact with actors in the local environment
6. This contact is based on *reciprocity* in order to establish a relationship of mutual respect and advantage for all partners involved

4.2 A Generic Scenario

The framework of the preliminary models of the OASIS project is designed to make a wide variety of projects possible within this framework, giving much freedom to the teacher for developing his or her own project.
A generic scenario can be sketched, however, that helps the teacher to set-up a project. This generic scenario contains the following stages that teachers can consider when setting up projects to validate the OASIS-technology in pedagogical innovative ways.

1. Constraints and possibilities for a new pedagogy
As described in paragraphs 3.2, 3.3, and 3.5 ICT-based change involves many factors, including a redefinition of various interrelated dimensions related to thinking about and acting within education. Before starting projects it is useful for teachers to determine personal and school-related degrees of freedom for change. This may be part of professional development organised before the validation phase, and (ICT-based) support during this phase. Part of this support is provided by formative assessment (see chapter 5).

2. Deciding upon the pedagogic approach
Once the conditions are clear, teachers have to decide upon the elements they wish to introduce. Many elements have been introduced in paragraphs 3.5 up to 3.10. Also it is possible to implement one ‘complete’ pedagogical model, like the progressive inquiry model.
Again, this phase should be incorporated within teachers’ professional development and additional support within Zone Servers or at a more global web-based level. Sharing information with other teachers that are part of the community of practitioners is useful.

3. Identifying partners
Projects are preferably carried out in collaboration with other actors in the local environment. The first step will be to find partners in the local community, including other schools, and to find shared interests. As the idea of *reciprocity* is important for sustainable learning connections between the school and the context around the school, teachers are to find out what these partners can mean for the school, but also what the school can mean to these partners. When a shared interest is identified, the further implementation of the project can be decided upon.
Of course teachers may choose to use the OASIS-technology for other purposes in which collaboration is limited to actors within the school. In that case this stage is not necessary.

4. Defining the subject
The next step is to define the subject of the project, which will mostly be of an interdisciplinary character. Either teachers themselves can decide upon the subject, but also together with his pupils. Brainstorm-sessions with pupils can be organised, or concept-mapping software (like Inspiration) can be used. The first step of the Progressive Inquiry Model is helpful when deciding on the subject. Also project ideas mentioned below can be a source of inspiration.
The outcomes of this step can be communicated with the partners in the neighbourhood, to incorporate their feedback into the final design on the subject.

5. Planning

Projects have a beginning and an end, and should be planned. Some pedagogical models have an incorporated programme or cycle of activities, but others are to be phased by teachers themselves. It is helpful to create a schedule for the time investment of the teacher, the pupils and the possible partners in the neighbourhood. A decision has to be made at what time certain project outcomes are ready.
In case a more general validation of the technology is chosen for, e.g. continuous contribution of lesson plans and didactical units to a community of colleague-teachers, it is still important to plan and phase in order for the activities to coincide with the overall evaluation of OASIS.

6. Activity plan

In addition to the general planning other elements are to be decided upon. In the activity plan the various learning and other activities are included. In general the teacher will be the one to outline this plan.

Questions that may guide the making of such a plan are:

- What preparations are necessary before being able to start; what initial instruction for the pupils on pedagogy and technology will be given?
- What different activities will the pupils undertake, when working on the project, and what are the steps for them to follow?
- How will they collaborate both within the classroom and using the OASIS-system; how do the pupils divide in groups, is there division of labour, do roles change, etc.?
- How are the chosen pedagogical models for collaborative learning and/or problem-based learning implemented; how does it affect teacher and pupil activities and roles?
- How will the contact with actors in the local community be organised; is any training foreseen for them to use the system; will there be face-to-face meetings?
- In what different ways is the technology used to facilitate processes and activities?

If teachers choose to follow an outlined method for their projects, like the progressive inquiry model, they will have to know how to implement the subsequent phases. Although the pupils will go through the different steps of the model by themselves, the teacher has to guide them in switching over to the subsequent steps. Pupils are to be shown the correct way of using the methods, in order to get maximum profit out of the method.

When the activity plan is made, the actual facilities have to be created for the pupils and the other contributors to the project to easily work in the proposed manner. ICT-facilities have to be set-up, schedules have to be made etc.

7. Products

Before the beginning of the project, a decision has to be made what will be the final product(s) of the project. To have the goals of the project clearly defined as

products is important. All participants in the project will know what they are working on and what to expect.
Various types of products can be distinguished. First they can be syntheses of the different interactions and collaborations that took place; the end-products are process-oriented, and reflect upon the teachers' and the pupils' work. Secondly they can be tangible products on a clear subject that can be reviewed by others. They can come in the form of special websites residing on the zone server, possibly on CD-ROM, or as part of repositories with relevant content and resources for teachers and pupils as part of the expanding Open Code Software Library.

8. Evaluation and assessment
In addition to the overall evaluation and validation of all OASIS validation sites (see chapter 5), teachers should also evaluate the projects they are involved in, both formatively during the project and summatively once the project has ended. Evaluation of a project is an indivisible and important part of every project. It should be in simple form focused mainly on the following items:

- Relationship to the *educational needs* of the participants;
- *Individual benefit* for pupils;
- *Individual benefit* for teachers;
- The level of *collaboration among pupils* based on their result;
- The level of *collaboration among teachers* within the project;
- The level of *collaboration with external actors;*
- The *quality* and *correctness* of the outputs.

Continuous formative evaluation is an integral part of the project work and it is done after every step and with all the partners. It is a tool that helps to improve the performance. The teachers should evaluate carefully, the assessment should not have the typical form of grades. In fact it should help to orientate the pupils in the desired direction of their future project work.
Final summative evaluation done by the participants themselves is also compulsory. Its outputs have an influence on assessing the work of teachers and on planning of the future activities. This evaluation can be quite simple one in the cases of obviously successful projects. The projects can be considered successful if e.g. the project Web side has many visitors, or if there was a final presentation to the foreign partners, parents, management of the school, and local education authorities. There are also other ways of securing the positive reception of the project - an exhibition of the outcomes, publishing the presentation on CD-ROM, reporting on the project at specialized conferences, in newspapers, TV, etc.

4.3 Ideas for projects

When teachers, after using the generic scenario, still have problems to create their own learning programmes, here some general descriptions of possible projects are given. These descriptions can serve as anchor points of where to start with making their own learning programme.

Project 1: Meet the experts
In a project like this, experts have to be found that want to communicate with the pupils about their daily business. An "expert" can be anyone: the local shopkeeper, a fireman, the old man living next to the school. Important is that

the expert has the time to tell the pupils something about an interesting subject. The children must come with questions that the expert has to answer. The process of thinking about what questions to ask must be structured by the pupils and the teacher.

Project 2: Comparison of neighbourhoods
What kind of services do you have in your neighbourhood? A police-station, a fire department, a library. Pupils have to make a study of these services: How do they work, how many employees, etc. Then they have to compare the services in their neighbourhood to the ones in another school's region. This can well be a school in a different country.

Project 3: Parliament
As the schools will have to use the topics Democracy and Citizenship as the content of their learning projects, why not choose a scenario, in which this topic is apparent as well? This leads to a form in which the school could act as a parliament that has to control various departments. For example the department of justice (the local police station), the department of Social Affairs (the local community centre), and the department of agriculture (a farmer). A problem could be 'Litter' and the subject would be how to find out how to solve this problem in collaboration of schools and the local community.

Project 4: The neighbourhood on the Internet
Pupils have to describe their neighbourhood on a website. They have to make pages about the history, present and future, about the employment, about the environment, about the population, about possible activities etc. For this purpose, they have to communicate with all kind of actors in the neighbourhood.

Project 5: Visions of Europe, past, present and future
In this project, pupils have to present different viewpoints of European Citizenship through the eyes of different generations, using a variety of multimedia approaches including, video, digital image and sound, text and music.
This project is proposed for the validation within the ENIS-schools. Although still under development, the project is outlined as follows.

1. Project Title: Visions of Europe. Past, Present and Future. 2. Project Theme: The Emergence and Development of European Citizenship. 3. Project Approaches Suggested approaches. To present different viewpoints of European Citizenship through the eyes of different generations, using a variety of multimedia approaches including, video, digital image and sound, text and music. 4. Pedagogical Framework

The two pedagogical theories underlying the design of this project are Computer Supported Collaborative Learning (CSCL) and the Progressive Inquiry Model (PIM). The core of this approach is that the learning activities take place during collaborative sessions where knowledge is discussed, deconstructed and reconstructed and refined by students and teachers to form new insights. This is a continuous dynamic process, which can have implications beyond the lifetime of the particular project.

These collaborative sessions are supported by a number of computer tools such as email, discussion boards, shared journals etc which permit the students to discuss beyond the walls of the classroom.

PIM involves the marrying of both independent inquiry and collaborative and discursive activities. It is ideally suited to project and problem based learning as it allows for a flexible project plan. It involves such elements as:

- Independent research
- Individual and collective brainstorming
- Informal and formal learning
- Peer to peer learning
- Knowledge sharing and exchange
- Negotiated Agreement
- Self and group reflection on activities and knowledge
- In-school and out-school activities

5. Project Essentials

Technological

The project must involve the use of a wireless network environment and a multimedia approach to the project theme.

Pedagogical

The project must involve the collaborative learning techniques outline above as well as the active involvement of the local community in which the school is located.

6. Project Desirables
To be discussed during training workshop. The use of video and/or sound recording is desirable.

7. Project Techniques

7.1 Planning
- Define the Subject approach (within the project scope and title)
- Time Line (to be worked out against the given time scale parameters)
- Define End product
- Identifying Partners
- In-School Partners, like:
    - School Principal
    - ICT Team
    - Other teachers
    - School Librarian
    - Students

7.2.2 Local Community Partners
Suggestions
- Local library
- Mayor/ local community representative
- Older citizens
- Parents/ grandparents
- Youth Groups
- Local newspapers
- Local historians

7.2.3 Other Partners
Suggestions
- Digital libraries
- Media repositories
- European Commission websites
- National websites

7.3 Processes
To be defined by group at training workshop but must include the elements involved in PIM.

8. Project Evaluation Actions
This area is still being defined but will include:
Self-reflection techniques by students and teachers using the journal technique
Online questionnaire

In addition to these examples many more inspiration can be found. Over the past twenty years many examples of computer mediated communication and computer supported collaborative learning have emerged all over the world, from asynchronic e-mail collaborations to collaboration within groupware or electronic learning environments using a mix of communication media. Starting with the work of Judi Harris (see http://virtual-architecture.wm.edu/; Harris, 1998; 2001) within the framework of the Comenius3 thematic network ECOLE (European

Collaborative Learning Network; see http://www.ecolenet.nl) a taxonomy was elaborated for Internet-projects, including many examples (Brdicka, 2003; see http://omicron.felk.cvut.cz/~bobr/role/).

The following distinctions are made:

1) Interpersonal exchange
    a. Keypals
    b. Global Classrooms
    c. Electronic appearances
    d. Telementoring
    e. Impersonations
2) Information collection and analysis
    a. Information exchanges
    b. Database creation
    c. Electronic Publishing
    d. Telefieldtrips
    e. Pooled Data Analysis
3) Problem solving
    a. Information searches
    b. Peer feedback activities
    c. Parallel problem solving
    d. Sequential creations
    e. Telepresent problem solving
    f. Simulations
    g. Social action projects

Teachers involved in the OASIS validation sites will be supported to develop their own projects by consulting this practical taxonomy and the many examples that are included in each category.

4.4 Professional Development

When engaging in collaborative learning and work, not only the technical issues and organisational issues must be taken into account. Of great importance is also to prepare the teachers and the pupils for this new type of learning. There are strong cultural constraints on the level of the teachers and also on the level of the learners.

Teachers and learners have strong beliefs and an implicit understanding on what is teaching and learning about. These beliefs can hinder the easy adoption of the new type of learning in CSCL. Not always the great potential of this kind of learning is seen. And pupils need a highly structured task or environment and clear instructions in order to be able to complete the tasks in a CSCL-manner. For example, it is not always understood that pupils also must be part of the knowledge building, instead of participating in a question-answer game.

The projects undertaken within the OASIS-project, thus have to be accompanied with training for both teachers and learners on the various pedagogical models, but also on the various aspects of the technology to be used.

4.5

4.6 Pedagogic requirements for technology

4.6.1 Introduction

So far, this deliverable was concerned with the constraints of technology and user requirements on the pedagogical models of the OASIS project. But, as can be seen from figure 1 in the introduction of this deliverable, there is a reciprocal relationship between the pedagogical models and the technology as used within the 5 validation sites. The use of the pedagogical models described in this deliverable, has its impact on technology as well. This chapter describes the constraints and demands on technology, as can be derived from the pedagogical models described in chapter 3. The focus is on the computer supported collaborative learning models, but the other models will be addressed as well. However, first some general topics concerning ICT in education are discussed.

4.6.2

4.6.3 ICT in education

ICT can be incorporated in learning in many different ways. A distinction that is often made within the literature on ICT in education is between learning about, with and through ICT.

4.6.3.1 Learning about ICT

One can learn *about* ICT. Computer literacy becomes more and more important these days, and therefore all kinds of computer courses are developed. These courses can be on various levels. For example pupils or teachers learn about word processing or other basic computer skills. Or students learn how to develop computer programmes, or become experts in hardware. Pupils and teachers can learn how to develop websites. All this learning is on how to use computers and additional tools (e.g. digital cameras or scanners): the learning object is ICT itself.

For OASIS some of this learning about ICT will be necessary, both for teachers and for pupils to use the hardware and the different software adequately. For teachers who will develop or adjust Java-applets to be put in the OCSL additional training is to be offered.

4.6.3.2 Learning with ICT

The pupils can learn *with* ICT. Here the learning subject is not necessarily ICT, but can be anything. Where in previous days books were used for learning, or other traditional learning methods, now the computer is used. One well-known example is the drill-and-practice learning methods, in which the computer provides the pupil with a large number of exercises. Nowadays, also more advanced learning software is available, like Java-applets that reside in the OCSL within OASIS.

4.6.3.3 Learning through ICT

The last category is learning *through* ICT. In this case the learning takes place because of ICT, and without ICT this particularly kind of learning would not have been possible. In other words, ICT supports the emergence of new types of learning. One example is the possibility of doing simulations and (large) experiments that previously were not possible. Another example is the possibility of efficient and effective communication with people outside the classroom, for example experts or other classes, or in other countries. Computer Supported Collaborative Learning (CSCL) falls in this category of learning through ICT, and is part of the pedagogical models sketched in this deliverable.

In all, the focus of the educational activities within the OASIS validation sites will be primarily on this third form of learning. But also learning with ICT will be implemented, while it will be necessary to include some learning how to use ICT.

4.6.4 Electronic tools and environments

Many electronic communication tools and computer programmes are available for educational purposes. Some are general tools, which can be used in an educational setting. Word processing tools and other office applications can be used for educational purposes. For communication e-mail can be used, or bulletin boards, chat programmes, electronic discussion groups etc.

Some tools are especially designed for education. Some programmes are designed to teach a specific subject. In earlier days there were the drill-and-practice computer programmes. Nowadays, these programmes are more advanced, incorporating multiple pedagogical models, and offering multimedia enrichment.

Other programmes can better be described as electronic learning environments. A few of the more well known are Blackboard (www.blackboard.com) and WebCT (www.webct.com). These environments do not necessarily contain learning content. The idea is that with such an environment, a teacher can create his own electronic learning space around a subject. Most of these environments have easy tools available for the teacher to create websites, exams, and assignments etc. around the topic of his choice. In addition to these tools, communication tools are available, with which the teacher can communicate with his pupils, and/or the pupils can communicate with peers. The following paragraphs will focus on four aspects that are relevant when describing electronic tools and technology within the light of the OASIS pedagogical models.

4.6.4.1 Communication tools

Communication tools can be either synchronous or asynchronous. When using synchronous tools, like chat-boxes or shared whiteboards, all participants have to be behind their computer simultaneously. They can see the communication of others immediately. Asynchronous tools are used for communication when the activity does not have to take place at the same moment. Examples of these are e-mail, electronic discussion groups and bulletin boards. Participants can contribute to the communication and can check activity of others at a time convenient for them.

Most electronic learning environments have both types of communication as possibility. And teachers have the possibility to adjust the environment to what he or she thinks is suitable for the course (s)he is teaching.

However, using such environments is not sufficient for success. One also has to know how to work with these environments, and the communication tools present. For example, addressing your pupils through an electronic discussion board is something completely different from doing the same face-to-face. Much literature is available on teaching through the web and on 'netiquette' (do's and don'ts in electronic communication, see for example http://www.fau.edu/netiquette/net/).

It clear that when making use of communication, the projects in OASIS will have to consider what kind of communication will be needed within the project. Questions to be asked are: Who will be the ones that communicate, like teachers, pupils, actors outside the school? When will the communication be used, like during school hours, or also outside school hours? Will it be synchronous, asynchronous, or both? What kind of information will be communicated?

The answers to these questions will be different for each school, for each teacher, and for each learning project. A tool that is attractive to one teacher may not be interesting for another teacher. A technology that is perfect for one school may be too difficult to understand for pupils of another school.

Increasingly schools choose to purchase an Electronic Learning Environment (for example Blackboard, see www.blackboard.com), with built-in communication facilities. Rather than merely sticking to these tools it is advisable to adapt communication possibilities to the individual school, teacher, learner or project. Some examples of ELE's provide for some flexibility, but still not much.

Ideal would be an open and "empty" learning environment, with many communication tools (and other tools), varying in layout, possibilities, difficulty, etc. For each different project, teachers would be able to choose from these building blocks to create a new electronic learning environment, perfectly fit to the needs of the learning project. Within OASIS, such a tool is developed: The Virtual Workspace Environment (see chapter 2).

4.6.4.2 Collaboration tools

Collaboration depends on the communication tools, as discussed in the previous paragraph. Without communication, it is difficult to collaborate. Therefore, it is important, when engaging in collaborative learning projects, to provide for a good set of communication tools. Probably best is a combination that makes various kinds of communication possible, like synchronous and asynchronous tools, textual tools in combination with shared whiteboard, public tools combined with private communication possibilities, etc., depending on the needs of the learning project.

In a discussion board, every contribution is a direct reaction to another contribution. But the discussion might have a far deeper, more implicit structure. For example, a contribution might take several other contributions into account. Tools are available to help to make these deeper more implicit structures visible, and making it more explicit in an argumentation graph. An example is Knowledge Forum (http://www.knowledgeforum.com/).

However, there is more to collaboration than good communication possibilities alone. An important issue is the possibility of document sharing and version control of documents. Easy tools for these purposes make collaborative work more pleasant and successful. Furthermore computer tools can support the representation of various perspectives of people, thus making relationships between these relationships more clear. They can aid the comparison of ideas, thus making it easier to bring ideas and perspectives together. Computers can support the glossary discussions that result in glossaries on important terminologies within the collaborative project.

4.6.5

For OASIS flexibility is the keyword. Teachers must be able to adapt their electronic learning environment to the specific needs for the collaboration within the project. Some electronic learning environments are developed especially to support collaborative learning. For example FLE3 (http://fle3.uiah.fi/) and Synergeia (http://bscl.gmd.de/bscl) provide for many of the above-described features. When these environments do not fit, again the Virtual workspace environment is a useful development within the OASIS project.

4.6.5.1 Usage of shared information resources

Within the OASIS-infrastructure and –architecture the schools interoperability framework has a central position. At different levels, within the school, between schools, between schools and the local and global community, interoperability is established. One aspect is communication and collaboration between actors, another aspect is the interaction with systems in which relevant resources are stored, which can be used and re-used.

These shared information resources are diverse. Firstly they contain materials to be used for the primary process of teaching and learning. Teachers can use and re-use content developed themselves, by colleagues or commercial content developers, and the same applies to pupils in their learning. Ideally these materials come in the form of learning objects, stored in a web-based database (preferably XML), to be searched, selected and subsequently arranged to form meaningful learning sequences. The possibilities of sharing resources among teachers makes it possible that these materials are used in a wider scope than one school or one area. Secondly shared information resources at the level of the school organisation are relevant. These can be connected to the learning process like digital portfolios, a pupil monitoring and grading system, but also a multi-purpose school information system, like described for the Grenoble-validation site. Thirdly the sharing of information can extend the boundaries of the school, as in the case of repositories, websites or other information resources actors from both the school and from outside the school can access. The Zone Server is an example of this.

4.6.5.2 Production of new resources

In addition to sharing existing information and resources schools will produce all kinds of new resources. In general the same distinction is used as in the latter subsection, involving various actors creating new resources or adjusting existing resources for use in the primary process. These resources include Java-applets or didactical units belonging to these applets, but also pupil work, like multimedia productions in the case of the Apple validation schools. Also the continuous updating of the School Information System in all its dimensions is part of this aspect. It will be necessary for teachers and pupils to have user-friendly authoring and development tools at their disposition, with built-in standards for products' inclusion in the system seamlessly (like metadata-tagging for inclusion in XML-based repositories).

4.7 Conclusions

Within the framework of OASIS various pedagogical requirements for the technology are distinguished, both at the level of communication and collaboration, and at the level of sharing of and contributing to information resources. These requirements are valid at the level of the school, and at the level of interoperability between the school and other actors and institutes.

Within the school it will be necessary that there is an Intranet in the school and that all the connected stations have access to the Internet. For the interoperability between the schools and the outside world technological structures are to be shared with the local authorities and/or the local community.

It will be further necessary that at least some of the teachers have taken training courses on the hardware and software to be used, including an introduction in authoring software and the use of auxiliary equipment.

As ICT-based change and innovation should be supported by the involved actors, the staff of the school should have some experience of doing qualitative evaluation of the school's ICT policy and approaches. And the staff of the school will have to have a clear view of problems resulting from the current separation between pedagogical development and administrative support.

The implementation of the OASIS-pedagogical collaborative models cannot exactly be prescribed. It is attempted in this deliverable to provide for ample sources of inspiration for teachers to develop their own educational projects within the possibilities and constraints of their context.

5 Evaluation and Validation Framework

5.1 Introduction

The OASIS project is a complex project, as it is both pedagogical innovative and technical advanced and complex. It is dealing with the two main challenges of creating valid and effective technical solutions within the educational area, and postulating a set of modern pedagogical models that fit the needs of today's schools. This chapter deals with the evaluation of the OASIS project. First, the main research questions are introduced, and these main research questions are elaborated in more detailed research questions. Then the research instruments for answering the research questions are sketched, followed by a description of the evaluation framework and approach. Then some words are said about the responsibilities and timeline. The chapter ends with expected results of the evaluation phase of the project.

5.2 The Research Questions

The implementations of the technical aspects at the 5 validation sites must be evaluated on their effectiveness. The CSCL models, as described in this deliverable must be validated on their value for every day classroom teaching and learning.
These considerations lead to the following main research questions that have to be answered:

1) Do the collaborative learning models in this deliverable, together with the proposed pedagogical scenario's and projects lead to pedagogical valuable learning projects in the 5 validation sites?
2) Are the technical solutions, as used within the 5 validation sites, effective for improving education?
3) How do the technical solutions in the 5 validations sites support the ideas within the pedagogical models?

One issue concerning the first question on the pedagogical models is the ease of use for teachers. Can they easily create their own learning processes according to the ideas in the pedagogical models? Another question to be asked is whether the actual learning that takes place indeed follows the principles and ideas of the models. For example, does real collaborative learning takes place. A last issue to address, while looking at the first research question, is whether pupils understand the rationale of these new pedagogical ideas. In other words, do they understand on a metacognitive level, what the pedagogical models are about and can they act accordingly to the ideas of the models, in order to improve their own learning? This leads to the following sub questions:

1.1: Were the pedagogical models and scenario's easily adopted by teachers?
1.2: Did the provision of the models and scenario's lead to projects in which real collaborative learning took place?
1.3: Did the pupils understand the idea of collaboration in the models, and did really collaboration within the projects?

When taking the technology into account, the main research question can be divided in questions on the satisfaction of users, on the effectiveness of the technology, and on the usability of the technical solutions. This leads to the following three sub questions:

> 2.1: Are the users satisfied by the functionality provided by the technical solutions?
> 2.2: Does the usage of the technical solutions support the quality and efficiency of the work of the users? Which indications can be found for that?
> 2.3: Are the technical solutions easy-to-use from the viewpoint of the pupils and teachers (user-friendliness)? What kind of support would the users need in order to be able to use the technical solutions in an effective way?

The interaction between the technological solutions and the pedagogical models has practical questions to it: Which technological solutions function with which type of learning activities (as proposed in the pedagogical models)? What is needed from the technology in order to improve the learning activities? Furthermore the question has to be addressed to what extend the technology really fosters communication and relationships, not only in schools among peers, but also between schools and other actors. A last issue that has to be addressed is whether technology has an added value to the learning processes, and the pedagogical models, or can the same results be achieved with less sophisticated (and expensive) means.

> 3.1: For which types of classroom activities are the technical solutions particularly good? Which extensions or enhancements might be required to extend their application area?
> 3.2: What is the added value of the technical solutions in supporting communication and collaboration as described in the Computer Supported Collaborative Learning models, which are proposed in this deliverable?
> 3.3: To what extend do the technological solutions foster community building, inside the school, and to what extend do they foster relationships between school and neighbourhood?

5.3 The research instruments

The research questions cover a wide area of research. They cannot be answered by a simple research design, with only one or a few research instruments. In order to fully address all research questions, a design of four research instruments will be used:

1. Reflective Notes
2. Teacher Questionnaire
3. Pupil Questionnaire
4. Teacher interviews

5.3.1 Reflective Notes

One instrument that will be used is ‘reflective notes’: written reflections of teachers about pupil activities in their classroom. These notes can have two functions: it gives the researchers insight in the classroom activities and the reflection is a learning moment for the teachers. The notes are not to impose too much on the teachers' time, while the extra-value for the teacher should be evident. Hence, a too strict format or template is undesirable.

Figure 10 shows an example of a reflective note form. The form should be translated to the languages of the involved countries.

Name: School: Date: Class:
Description of the activity:
What were successful aspects of the activity for you (from pedagogical *and* technical point of view)? Why?
What were not successful or difficult aspects of the activity for you (from pedagogical *and* technical point of view)? How did you handle that?
What would you do different the next time?

Figure 10. Example of reflective note form

These reflective notes can be used in the form as a logbook. Especially for project that takes some weeks or months it useful to write notes regularly (e.g. after each activity in the class room) during the project to keep track of what happens as at the end of such a period some aspects can be easily forgotten.

5.3.2 Teacher Questionnaire

The teacher questionnaire is perfect to obtain quantitative data, which can provide the researchers with a general overview of the reactions of the teachers. The questionnaire can consist of closed and open questions. The closed questions will provide robust data about the situation, and will be used for those parts of the research that are similar in all 5 validation sites (the pedagogical models). The open questions can provide a better insight in the use of the technical solutions at the various validation sites, and the implications of the technical solutions on the pedagogical models.

5.3.3 Questionnaire pupils

Because of the large number of pupils, the pupil questionnaires are perfect to obtain quantitative data, which can provide the researchers with a general overview of the opinions of the pupils. The main part of the questions will be evaluating the pedagogical models. But as the number of pupils will be large enough, quantitative data on the technical issues can be obtained as well.

5.3.4 Teacher Interview

A selection of the teachers will be interviewed, either on an individual basis or on group interviews. The interviews with teacher are included to provide in-depth information, which can elaborate on the information obtained from the questionnaire. The data received from the interviews will have a more qualitative character.

5.4 Evaluation Framework and Approach

The design of the research is difficult, as the research is done on 5 validation sites that are all very different from each other. Therefore, careful consideration has to be given to what can be evaluated in general (using data from all validation sites) and what can only be evaluated per validation site.

The overall effectiveness of the pedagogical models and scenario's can be tested in all sites. A comparison of all obtained results will be able to give an answer to the question whether the provision of pedagogical models and scenario's lead to valuable learning projects in which collaborative learning takes place.

For the technical issues, it is of course not possible to compare the various sites. Thus the research questions on the effectiveness of the technical solutions will be evaluated per site. The same applies for the combination of technical solution and pedagogical models and scenario's.
In table 3, the research questionnaires are listed, together with the research instruments that are used to answer the specific questions.

Instruments Questions	Reflective notes	Teacher Questionnaire	Pupil Questionnaire	Interview teachers
1.1: Were the pedagogical models and scenarios easily adopted by teachers?	x	X		x
1.2: Did the provision of the models and scenario's lead to projects in which real collaborative learning took place?	x	X	x	x
1.3: Did the pupils understand the idea of collaboration in the models, and did really collaboration within the projects?			x	
2.1: Are the users satisfied by the functionality provided by the technical solutions?		X	x	x

2.2: Does the usage of the technical solutions support the quality and efficiency of the work of the users?		X	x	x
2.3: How easy are the technical solutions to use from the viewpoint of the pupils and teachers (user-friendliness)? What kind of support would the users need?		X	x	x
3.1: For which types of classroom activities are the technical solutions particularly good?	x	X		x
3.2: What is the added value of the technical solutions in supporting communication and collaboration as described in the CSCL models which are proposed in this deliverable?		X	x	x
3.3: To what extend do the technological solutions foster community building?	x	X	x	x

Table 3: Overview of the research questionnaire, and the research instruments used for them

5.5 Tentative Timetable

Professional development:	March-June 2003
Development of projects:	May – June 2003
Development of research instruments:	March – June 2003
Pedagogical projects:	September - November 2003
Data gathering:	October- November 2003
Final Analysis:	November – December 2003
Writing final report	December 2003 – January 2004

5.6 Responsibilities

5.6.1 Teacher training

As the 5 validations sites are very diverse in their use of technology and pedagogy, it is not possible to design or prescribe a general model on teacher training and professional development. All partners of the validation sites have to prepare their own teachers for the projects. For this preparation, parts of this deliverable can be used.

5.6.2 Reflective Notes

The format for the reflective notes will be designed by the University of Amsterdam, and this format will be distributed among the other project partners. The partners will have to take care of translation, when necessary. The reflective notes are written by the teachers. The project partners of the validation sites, have to encourage teachers to write these reflective notes, gather them, and when necessary translate the reflective notes in English. The partners within Work Package 1 will collect the reflective notes for further qualitative analysis.

5.6.3 Teacher Questionnaire

The teacher questionnaire will be designed by the University of Amsterdam, and distributed to the other project partners. The partners are responsible for translation when necessary. The project partners will distribute the questionnaire among the participating teachers, and collect the completed questionnaires again. The project partners will process the answers in a data sheet, provided by the University of Amsterdam. After data collection the questionnaires will be analysed.

5.6.4 Pupils Questionnaire

The pupil questionnaire will be designed by the University of Amsterdam, and distributed to the other project partners. The partners are responsible for translation when necessary. The project partners will distribute the questionnaire among the participating pupils (possible through the participating teachers), and collect the completed questionnaires again. The project partners will process the answers in a data sheet, provided by the University of Amsterdam. After data collection the questionnaires will be analysed.

5.6.5 Teachers Interview

The University will design a detailed guideline for the teacher interviews. The project partners are responsible for the interviews. The actual interviews, have to be taped, the tapes have to be written down, and this report will have to be translated by the project partners. The analysis on the reports will be done by the partners of Work Package 1.

5.6.6

5.6.7 Further research done by project partners

It is possible that project partners will do their own research next to the general research proposed in this deliverable. For example test specific features of technology. Project partners themselves are responsible for the data analysis and report of this research. Agreement can be made to incorporate these results in the final evaluation report of OASIS.

5.6.8 Data analysis and writing of final evaluation report

All data gathered will be analysed by the WP1 partners, and a final evaluation report will be written. The report will contain general result for the entire OASIS project, as well as more detailed results per validation site.

5.7 Expected Results

As said before, the design of the research is complicated, due to the diverse nature of the 5 validation sites. It will be difficult to obtain large amount of

quantitative data, which can be interpreted unambiguously. However, this fact makes the evaluation and validation not worthless.
The reflective notes that the teachers will write, will give insights in the way the collaborative models are used in practice. They will show what kinds of activities are undertaken in classrooms within the boundaries and with the support of the models and the technologies. The teacher questionnaires will tell about how easily teachers were able to adopt the models and scenarios in their daily lessons, and whether real CSCL-projects emerged in the various testing sites. Furthermore, they will be able to give answers to the technical usability of the various validation sites within the OASIS project, and in what way the technical solutions and the CSCL-models support each other, or hinder each other. In the latter case, ideas for improvement of this interdependency will most likely be found. The results of the teacher questionnaires will be further explored in teacher interviews, with the possibility to enter more in-depth information The pupil questionnaire will be able to answer these questions from the pupil's perspective. Especially large amounts of data will be gathered on the usability of the technical solutions, in order to be able to improve them. The pupil questionnaire will also provide insight in the ways pupils think about these (new) kinds of pedagogies, and whether they are able to incorporate it into their own thinking processes and learning strategies.

When the research is done, enough input will be gathered to enhance and modify the preliminary CSCL models to build new CSCL models and scenario's that can easily adopted by all teachers in Europe, while using any of the technical solutions that are tested within the OASIS project.
With the data of the research, these technical solutions can be evaluated on their merits for the European Learning Community, and especially the community that uses computer supported collaborative learning in their daily classes.

6 Conclusion

This deliverable makes clear that the OASIS project is a technologically advanced but very complex project. In chapter 2, a wide variety of technological solutions are described. In addition to the technological solutions, an extensive set of user requirements is sketched. The technological solutions will be tested in 5 test sites that differ more than they have in common. And still, general pedagogical models have to be described that can be used by teachers within all the test sites.

From the complex OASIS context of chapter 2, the most important building blocks for the pedagogical models were derived:
- Communication
- Collaboration
- Contacts with actors outside school
- Usage of shared information resources
- Production of new resources

These building blocks resulted in the description of pedagogical model that are based on these principles: Constructivism, Computer Supported Collaborative Learning, Problem based learning, the Progressive Inquiry Model, and ideas on the role of the school in society.

All models are described with a complementary approach in mind: a top-down approach is combined with a bottom-up approach: Pedagogical models provide a set of different scenario's which can be used to create learning projects, but teachers (and designers and facilitators) are to localise these models by taking into account the local conditions, constraints and possibilities to create their own learning projects. This approach has a clear advantage: teachers are responsible for their own projects, thus increasing commitment.

As said, a set of different scenarios is provided. Chapter 4 starts with a description of the content of OASIS learning projects, and then sketches a generic scenario for setting up these kinds of projects. Then, a list of projects is given, that can be a source of inspiration for teachers to build their own learning projects. The chapter concludes with implication of the pedagogical models and scenario's on the technology, as there is a relationship of reciprocal influence between technology and pedagogy, within the OASIS project.

The deliverable concludes with a framework for the evaluation of both the technology of the OASIS project and the pedagogical models and scenario's that are described in this deliverable.

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