

Applied Knowledge Management in Education: e-School architecture

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Abstract

Every society needs to invest in resources that provide prosperity and development. The intellectual capital of any community of people has to be recognized and exploited through new definitions of social priorities. Education constitutes the cornerstone of the social efforts but for many years the educational systems of many countries seemed to ignore the impact of the information technology in performance. The development of knowledge management systems capable to support the national educational systems is a very challenging issue. This paper discusses a project proposal called e-School, which was submitted at the 3rd IST call for proposals.

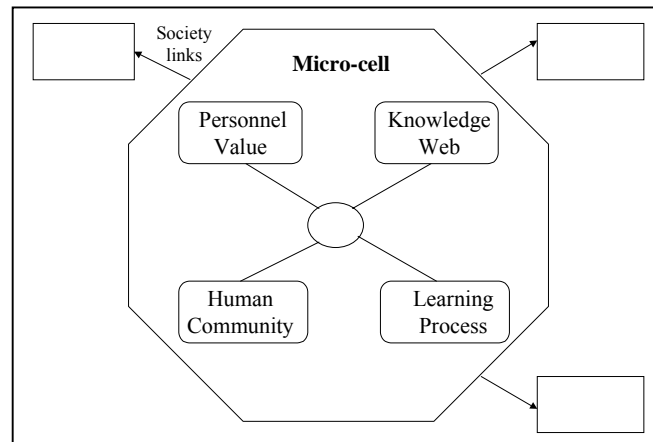
1.Introduction

The *e-School architecture* promises a new definition of what schools have to be in terms of collaboration, knowledge, relationships and learning. The underlying idea is that the School of tomorrow must be open to the society and has to combine the value that delivers in all the dimensions that can prove it, in order to set an integrated web of services available for everyone without social or other discrimination.

In the new century the challenge is to create mechanisms focused on diversity. Future School has to be *flexible* as well as a *learning community* based on participation, active learning, team synergy and problem solving. Thus, the School of tomorrow has to integrate technological facilities in four dimensions:

- ❑ **The realization of the personal value of the learning context and the learning content** for every stakeholder. This demanding issue is one of the main objectives of e-School. The creation with the technological combination of leading edge solutions of mechanisms that customize the learning environment and provide personal meaning will be the required motivating mechanism for the acceptance of e-School in real world environment and daily conditions.
- ❑ **The facilitation of the human community that every School represents.** Without substituting the face to face communication but with concern to establish collaboration mechanisms including off-line and on-line components such as teleconferencing, newsgroups, forums, newsletters, newspapers on the web etc.
- ❑ **The analysis of the learning processes in the e-School environment.** The basic objective here is to scientifically investigate the way that traditional pedagogical approaches differentiate in the context of e-School. The establishment of new learning scenarios, the reveal of new learning processes and their combination in order to create concrete learning templates.

- **The establishment of the knowledge web.** The core competencies of the School of tomorrow have to be based on knowledge transfer that expands further the traditional School. The definition of knowledge as the capacity for effective action incorporates skills development such as team building as well as new blocks of knowledge that can dynamically created with specific characteristics. The concepts of educational products, learning templates as well as case studies become the central orientation of the knowledge web creation.



The e-School has to be based, employing the various aspects of information technology an internal core of knowledge management mechanism in a way that secures the personal value for its users, and secondly a wider web that can be accessed by each involved to the school word.

The new challenging Europe of Knowledge, the recognition of knowledge as an asset and the need to redefine the value of learning for every citizen constitute a new demanding web of issues that information technology has to support. **E-School** derives its innovative approach from many dimensions such as technological, pedagogical and psychological, which are presented below:

- **Identity.** The technological infrastructure that will be developed innovates in the way it recognizes the personal needs of students and customizes the learning content through a complicated system of learning templates
- **School memory.** Derived from the organizational aspect of organizational memory, school memory is a new concept that e-School delivers. It stands for the capacity of e-School to manipulate learning objects and to transform these in a way that creates cumulative value for the school as a human community of interactions and relationships. Experience, knowledge and processes are combined and implement an integrated system of common use. E-school uses knowledge management techniques, template databases and learning content construction mechanisms that summarize the educational product of the school.
- **Organization structure.** E-school, our new concept for the school of tomorrow has to redesign its boundaries as well as its internal structure. The key word is the openness and this characteristic is secured through a complete Internet solution based on three levels: E-school Intranet, E-School Extranet, E-School Internet constitute the three parts of a whole system that expand the traditional limits of a school within a geographic area. IS

technologies are used in combination without their involvement being the main issue.

- **Developing shared meaning.** E-School innovates in the way that uses information technology for the development of a shared meaning within school communities and the society. The three levels of support (Intranet, Extranet, and Internet) that will be described in a following section, and the combination of internal capabilities and the social environment set the prerequisites to establish common values.
- **Gaps between cultures.** E-School treats equal students irrelevant of cultural differences and through its facility of personal value uses each contribution for continuous improvement.
- **Teamwork community/social dynamics.** E-School must realize a shift on the orientation of the developed skills. Team is a key concept for the school of tomorrow and we have to support it using a number of advanced communication means that reveal the social dynamics of the schools.
- **Metacognition (learning how to learn).** E-School sets new standards for Metacognition. The capacity of learning organisms to reform their processes, so that can be capable of absorbing new learning objects is provided through the development of learning scenarios.
- **Learning Styles.** E-School is dynamic and one of its main customizing tools is the learning styles wizard, an expert system facility that investigates the appropriate learning process for the accomplishment of a given learning procedure. Learning styles are formulated through a scientific research of bibliography and action research.
- **Motivation.** E-School needs the active participation of students, teachers and other stakeholders. From this perspective the employment of information technology will be and for the development of motivating mechanisms that can foster the interactivity and the participation. On-line help mechanisms, awards, as well guided tours are part of the motivation system of e-School
- **Cognition.** E-school will be based on a clear **pedagogy**. The main innovation from this perspective will be the analysis of specific learning goals such as Analysis, Synthesis, Understanding, Problem solving, Team synergy in order to formulate different cognitive templates and scenarios. Thus the case studies that will be developed for each scientific field will combine on an educational scene a variety of learning goals. So a student that uses E-School will be guided to use an integrated learning scenario that combines processes with different level of cognition.

This set of innovative factors changes the traditional approach to Integrated Learning Platforms in terms of technological functionalities. The data manipulation isn't any more the key issue in the knowledge exploitation. The school learning capability isn't a solved problem but for sure enhances the potential competence of each society. The same stands for the school memory and the knowledge base of schools. The core issue of learning processes links people, minds and skills in order to formulate the hidden knowledge in reusable formats. The technological requirements for such an effort exceed the data manipulation capabilities that we have available today in excess. The reusability needs to be based on

common templates and clear processes that ensure the circulation of knowledge between its living cycle.

2. Theoretical presentation of e-School functionalities

2.1 The e-school micro-cell

The four dimensions of e-school micro-cell, personal value, knowledge web, human community, learning process, provide a context for analysis. The scope is not to exhaust their practical meaning but to understand the complexity of the related issues and the efforts that have to be paid in order to define the technological implications of the desirable learning environment.

The dimension of personal value for the e-school architecture is of critical importance. If we develop a customized learning environment with concern not only to class management characteristics then we could be able to prove the significance of personal value in school settings. The need to reveal the personal value could imply characteristics such as profiling capabilities, needs recognition, customisation of knowledge, learning styles classifications, personal webs and many others that have to be specified.

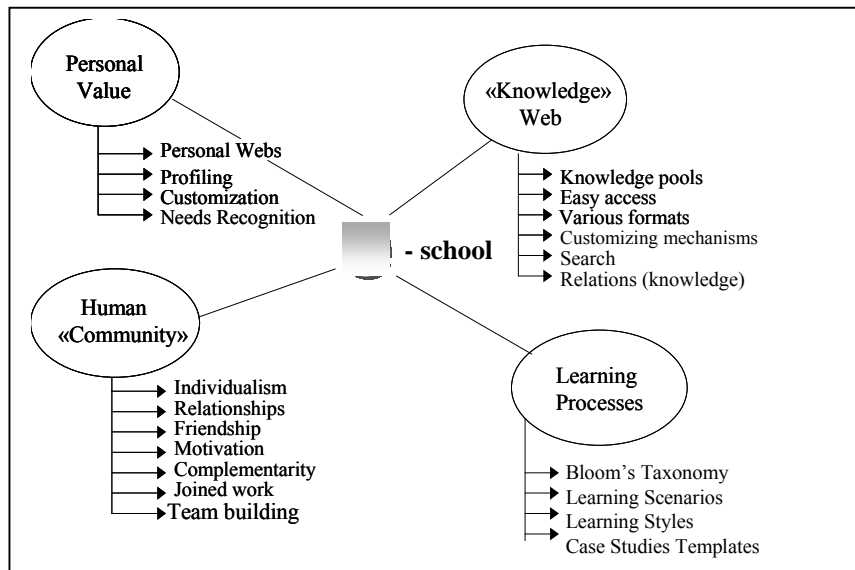
In correspondence the dimension of the knowledge web recognizes the prerequisite to create an advanced knowledge management mechanism since the knowledge component in schools reality is more than important. The establishment of customized knowledge situations, the capacity of e-school to support and deliver knowledge in various formats, the ability to organize and to classify the knowledge assets, the development of search facilities that ensure knowledge discovery are only a few of the technological implications of the knowledge web dimension.

The realization of the human community within the e-school requires the support of team building through distributed work, the establishment of complementary tasks, the promotion of dialogue and relations, the evolvment of motivational mechanisms and the setting of personal development.

Finally the endorsement of the learning process of e-school needs the detailed analysis of concepts such as learning scenarios, learning styles, learning situations, learning goals and their integration with technological capabilities.

To sum up, the e-school architecture has to build its capacity on Knowledge management mechanisms such as:

- knowledge creation, knowledge codification, knowledge categorization in concrete ways of learning templates in various fields,
- case studies templates specifically codified for the needs of primary and secondary education and
- communication mechanisms, including teleconference.



2.2 The e-school macro dimension

The e-school is not limited to a closed internal circuit. Its basic objective must be to be open to the society. In such a scope of participation the EU educational policy, the opinions of educational associations as well as the experts experience and moreover the social culture are not regarded as external push factors. They develop a wider web of access and constitute stakeholders with specific interest for the being of e-school. The government bodies, the teachers, the students, various scientific forums and associations, experts in various fields, the academic community have to play a significant role for the e-school efficiency. All the above-mentioned stakeholders have to be connected with e-School architecture on a way that maximizes the potential usefulness of the whole system. Their connections to the e-school have to be analyzed in order to specify the technological requirements for the realization of the effort.

On e-School the object is to enhance the contributions from the various stakeholders and to facilitate their relations with specific procedures. The role of each stakeholder has to be analyzed very carefully. A critical question concerning this analysis is whether e-School is going to be configured on a national base. Our intention through the analytical description of e-school is to establish an integrated system, on which there will be different levels of functionality and access permissions supporting schools on a national as well as on a local basis.

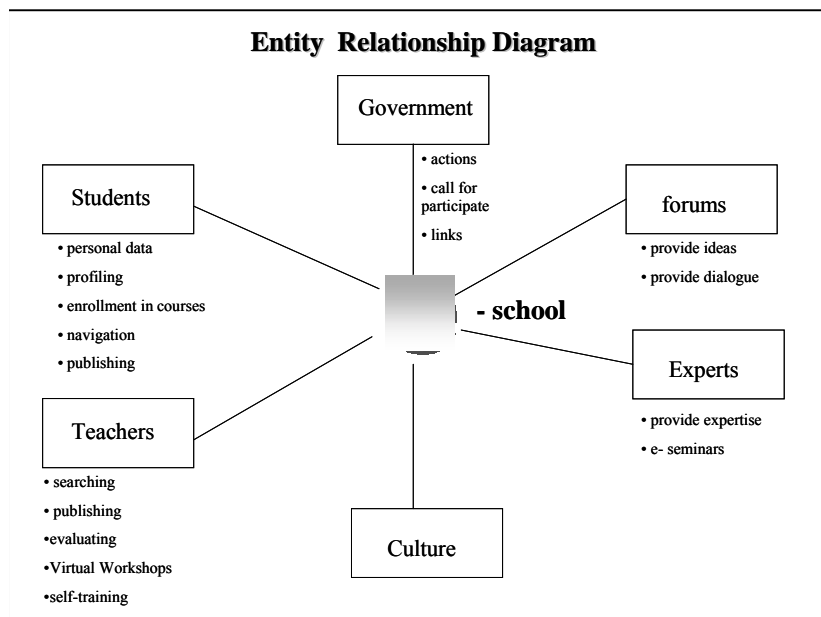
The knowledge diffusion within e-school links the two distinct components of e-school. Through the establishment of direct relations the school community proves its interest for the empowerment of the performance. Students provide personal data, use profiling techniques, publish info on personal webs, navigate through learning scenarios, discover knowledge, enroll in courses and in seminars, ask experts, prepare team works, and prove their many interests through special events such as an on-line newspaper. Teachers prepare learning content, use different media in order to test their educational value, organize virtual workshops, use self-training and implement evaluation of the learning process.

The government in general provides the context for the host of e-school on an (inter) national basis. The technological subsystems of e-school are developed in order to support a wider in

terms of place and time school community. They support the operation of e-school in financial aspects and provide links for the e-school to government organizations etc.

Experts in various fields, e.g. academics, professors, associations, non-profit institutes, provide their expertise in order to expand the functionalities of e-school through forum discussions or e-seminars that organized for various target groups.

With no doubt the reinforcement of e-school micro-cell through this web of stakeholders requires a technological infrastructure and the development of innovative strategies for their effective implementation. The two levels of e-school conceptual approach the micro-cell and the macro-dimension constitute a knowledge management mechanism that tries to capitalize the tacit and the explicit knowledge of all the participating stakeholders.



3. E-school KM requirements

3.1 The e-school conceptual layers

E-School proves that information society is a critical success factor for the effectiveness of the school of tomorrow. From a technological perspective e-school uses leading edge technologies (web based training, teleconferencing, web databases, Internet programming, multimedia authoring tools) to set a complete Internet solution. The diversification of the potential components of e-School, and their flexibility to create customized learning procedures that deliver value to its users.

Furthermore the specific development characteristics of E-School do not intend to substitute the traditional school with a complete virtual learning environment. The scope is to analyze the requirements of this school and from social perspective as well as from evolutionary psychology and to justify the use of information technology. To be more concrete e-school:

- ❑ Expands the learning capabilities of traditional school
- ❑ Enables excluded people to participate in learning
- ❑ Allows the implementation of flexible knowledge construction
- ❑ Secures the openness of the school of tomorrow to the society

- Establishes synchronous and asynchronous modes of communication for students, teachers, experts, government establishments, universities and other bodies that influence the school field.

The overall proposition of e-School is the **total Internet solution** that combines three level of analysis:

- Learning Intranet,
- Learning Extranet and
- Learning Internet.

The first level is the internal web of capabilities that e-school has to utilise in order to support all of its users but especially those that are dominant in the traditional school e.g. student, teachers. The flexible IS technology is for **e-School** a critical issue. For this reason on this level too much attention is paid on customisation techniques that secure that **e-School** content is customised and reformed in templates due to user needs.

The second level expands the communication capabilities of the **e-School**. It brings together experts, associations and universities with the school community. Using technologies as teleconferencing the e-School gains flexibility and communication capabilities that can not be realized in the traditional school. The learning Extranet is mainly responsible for the adoption of distance seminars, teachers training and virtual web based seminars.

Finally on the third level of analysis the e-School is opened wider to the society. The resources on this level are available to everybody that has access on the Internet and all the facilities are facilitated through an integrated learning “portal”. Technological capabilities such search engines, indexing, chat, newsgroups, encyclopaedias are created with a problem solving orientation and team skills development.

3.2 The e-school total Internet solution presentation

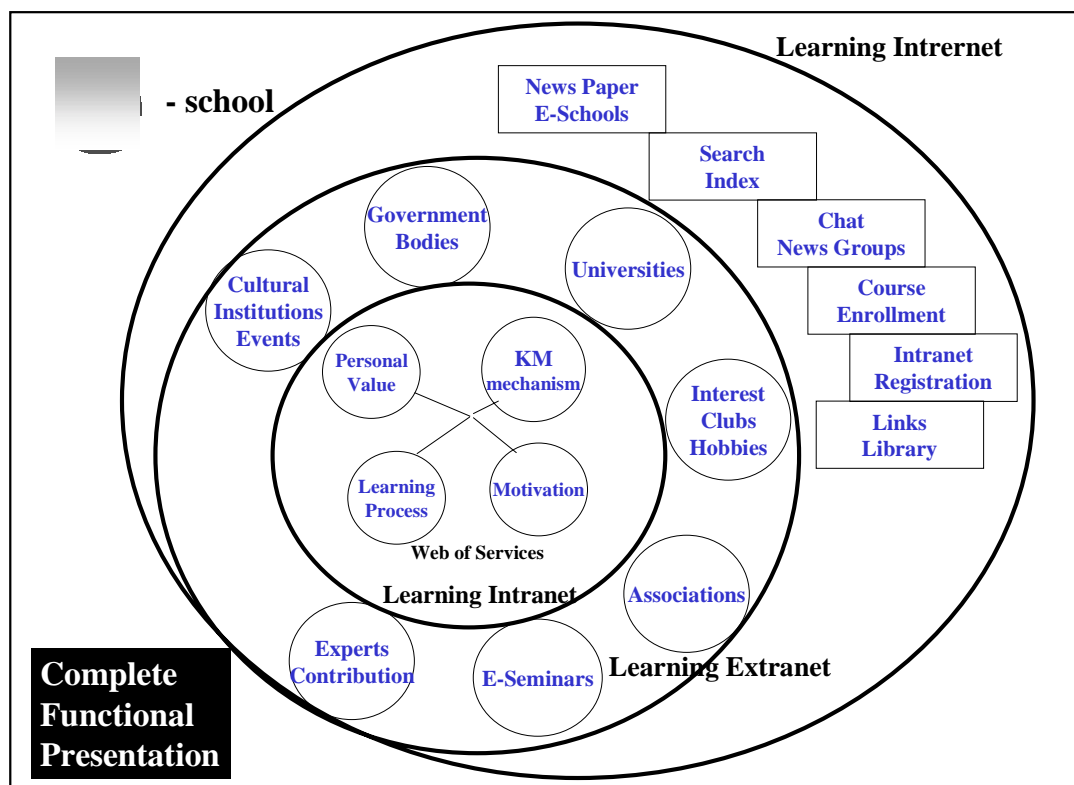
The school of tomorrow must be open, flexible, capable, dynamic, and in this context the information technology provides personal value, Knowledge Management mechanisms, learning processes, dynamic linking of educational scenes, templates building, role playing in a systematic way.

For the fulfillment of the pursuing objectives, the e-school needs firstly to create by the support of informational technology an internal core of knowledge management mechanism in a way that secures the personal value for its users, and secondly a wider web that can be accessed by each involved. In other words, the e-school consists of two distinct technological structures: The internal web of services that constitute the Learning Intranet and its portal entrance to the wider social environment. For each of them is required a systematic scientific approach concentrated on two basic dimensions of analysis: Firstly understanding and revealing the pedagogical issues of the technological supported school of tomorrow and secondly implementing and utilizing leading edge technologies and information systems for the setting of its services. A complete presentation of e-school capabilities is presented in a following section. In general e-school derives its flexibility from three different but interconnected facilities:

- The **Learning Intranet**, which is a sophisticated system of KM mechanism, student profiling, motivation subsystem and learning process management, the access of which is

limited to students and teachers at the operational phase. Access is given through a system of registration and levels of security.

- ❑ The **Learning Extranet** with special technologies as teleconferencing and web based training through which the e-school opens to the society bodies. Via this subsystem the core knowledge of e-school can be accessed and multiplied with contributions from bodies that have specific interests in the schools matters. At this level it is planned to develop a number of teleconference studios for the delivery of on-line seminars.
- ❑ The **Learning Internet**, a wider subsystem that can be accessed potentially by citizens interested in the learning process and content of e-schools. Functionalities of this level include a sophisticated search index with categorized links for scientific fields and support material. The creation of such an index will be based on a specific evaluation methodology of the scientific value of web sites that refer to links. Additionally there is special interest for the establishment of asynchronous mechanisms of communication through chat rooms and newsgroups. Moreover the web of schools that have access to e-school technological infrastructure can publish information on a virtual newspaper. Through this level access is allowed to the learning Intranet and learning Extranet.



3. E-school project management considerations

The analysis work in the project will strive to collect and synthesize five distinct types of material required to elaborate the E-SCHOOL concept:

- ❑ ANALYSIS OF e-School PEDAGOGY
- ❑ ANALYSIS OF e-School TECHNOLOGIES
- ❑ ANALYSIS OF e-School INTRANET

- ANALYSIS OF e-School EXTRANET
- ANALYSIS OF e-School INTRANET

Each of these analytical approaches has a specific orientation. To uncover all the requirements that information technology has to support in the environment of the school of tomorrow.

First, the current state-of-the-art understanding on the socio-cognitive, pedagogic of the rapidly evolving field of Internet based training will be submitted to a thorough as well as focused critical analysis to identify the reference theories relevant to the proposed work. This theory development task aims to:

- operationalise the concepts necessary for the development of the E-School holistic learning approach
- to guide the subsequent tasks of technology and content analysis of e-School , and
- to provide the understanding of the learning processes that e-school has to support with the technology employment.

Second, the analysis will look into particular technologies to provide a thorough understanding of the technology capabilities today. This type of analysis will elicit appropriate types of technological tools in a wide area of learning and knowledge management. This analysis work, will provide to the E-School the specifics of technological components they have to develop in order to implement the overall educational system.

Third, analysis work will turn to examine the concept of the e-School Intranet, the core competencies that have to be derive through technological subsystems. This is essentially the task of defining the knowledge management subsystems requirements that will form the basis for the relevant part of the E-SCHOOL methodology such as content specification, user profiling and learning processes manipulation. This analysis task is critical for the subsequent methodology development effort in E-SCHOOL

The fourth type of analysis in E-SCHOOL will focus on the Extranet subsystem Such activities span from distance learning programs through to learning support mechanisms in academic research laboratories.

The next project phase is concerned with development type activities. There are two major aspects of development work in E-SCHOOL. First, the project will be concerned with the development of a conceptual framework for E-SCHOOL with the following characteristics:

- Provisions for conceptual and procedural guidance in the design and development of interactive case studies in a knowledge management context. This guidance will span the full spectrum of methods for situation evaluation, material capture, actor involvement, design learning templates, implementation guidelines and operational management techniques.
- Provisions for the definition, deployment, monitoring and evaluation of the learning services a E-SCHOOL based environment will supply in real use. To this end, the E-SCHOOL framework will incorporate an e-SCHOOL value chain anchored on learning process characteristics on the one hand and knowledge flows and outcomes on the other.

Second, the development work in E-SCHOOL will focus on the technological infrastructure necessary to realize the E-SCHOOL concept. In this area work as a priority will seek to

exploit existing technological capabilities. Furthermore, this development activity will provide the necessary components on the network, data, interface, metadata, and learning process levels as well as knowledge management techniques in order to supply an integrated implementation of the E-SCHOOL concept. The design imperatives set for this project is ease of use and expandability of the technical product as prerequisites for achieving sustainable use. The three levels of the e-School, learning Intranet, learning Extranet, and learning Internet are giving a context through which the implementation process will be employed. Components such as: Knowledge management subsystem, Learning process manipulator, User profiling subsystem, Learning template handler, as well as Search Index (yahoo like), subsystems integrators, student management subsystems, portal site, are critical parts of the e-School concepts.

The third and final phase of the project is concerned with pilot use, evaluation and exploitation activities. Two important features of the implementation approach ought to be stressed here.

Moreover, component-based development will ensure that early in the implementation activity the pilot user organizations will have a usable system to experiment with. The 3-level approach in the development process (intranet, extranet, internet) secures the early experimentation with the systems. The evaluation approach for the E-SCHOOL concept and system will place high priorities in benefit identification activities that will provide feedback for the iterative development process of the E-SCHOOL. The next paragraph summarizes the work program for the realization of e-School system.

WP1. PROJECT MANAGEMENT

- T.1.1: Set up of the administrative procedures.
- T.1.2: Definition of Quality Assurance plan
- T.1.3: Project Management and Administration

WP2. ANALYSIS OF E-SCHOOL PEDAGOGY

- T.2.1: Analysis of Learning Theories. Formulation of Internet based Learning Models
- T.2.2: Analysis of learning processes of E-school and their impact in technological requirements specification
- T.2.3: Formulation of e-School Learning Model

WP3. E – SCHOOL TECHNOLOGY

- T.3.1: Market Analysis of collaboration technologies
- T.3.2: Web Based Training Tools Evaluation
- T.3.3: Portal sites functionalities. Search engines facilities
- T.3.4: Specification of e-School technological requirements

WP4. E – SCHOOL INTRANET

- T.4.1: Content Specification
 - T.4.1.1: Templates Design
 - T.4.1.2: Case studies development
- T.4.2: Knowledge Management Tool requirements
- T.4.3: Learning Process Manipulation
- T.4.4: User Profiling
- T.4.5: Specification of e-School Intranet architecture

WP5. E – SCHOOL EXTRANET

- T.5.1: Analysis of Stakeholders
- T.5.2: Teleconferencing Requirements
- T.5.3. Intranet Integration
- T.5.4: Specification of e-School Extranet architecture

WP6. E – SCHOOL INTERNET

- T.6.1: Links Collection and Evaluation
- T.6.2: Search Index (Yahoo like) analysis and design
- T.6.3: Communication facilities specification
- T.6.4: e-NewsPaper subsystem analysis
- T.6.5: e-School Intranet-Extranet interface
- T.6.6: E-school Internet Integration

WP7. INTEGRATION AND DEVELOPMENT

- T.7.1: E-SCHOOL Intranet Development
- T.7.2: E-SCHOOL Extranet Development
- T.7.3: E-SCHOOL Internet Development

WP8. PILOT RUN

- T.8.1: Set up of E-school
- T.8.2: Help Desk set up
- T.8.3: Pilot Use
- T.8.4: Evaluation

WP9. DISSEMINATION

- T.9.1: User seminars
- T.9.2: Definition of Exploitation strategy for e-SCHOOL
- T.9.3: Dissemination Activities

Conclusions

The e-School architecture needs further exploitation and justification. In the current stage we are trying to prepare a new proposal under the EUMEDIS call that is going to support a Euro-Mediterranean network for advanced learning using ICT's. In parallel we exploit the capabilities of ORACLE 8i to collaborate with platforms such BlackBoard, WebCT in order to create the re-usability mechanism of knowledge objects. The theoretical research is concentrated on the development of a learning framework capable to support the dynamic nature of e-school micro-cell. Our research unit ELTRUN (www.eltrun.aueb.gr) is looking forward to collaborate with research laboratories and IT providers in the directions of creating dynamic learning environments. It is more than evident that e-School approach could be transformed to a Corporate Learning Portal approach since the described subsystems can be customized irrelevant of the learning content. The presentation in ECKM 2000 will focus on technological issues, and the PowerPoint presentation file as well as the paper will be available the next day of the conference in our web site (www.eltrun.aueb.gr) We are looking forward to have comments on our work. Please use the following e-mail address: mdl@aueb.gr , miltos@atrac.gr (Miltiadis D. Lytras)