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Ninth DELOS Workshop

Digital Libraries for Distance Learning

Brno, Czech Republic, 15-17 April 1999

NINTH DELOS WORKSHOP

Digital Libraries for Distance Learning

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Introduction

Pasquale Savino and Pavel Zezula

The 9th DELOS Workshop on Digital Libraries for Distance Learning (http://www.cis.vutbr.cz/delos/) was held in Brno, Czech Republic, 15-17 April 1999. The objective of the DELOS Working Group (http://www.iei.pi.cnr.it/DELOS/), part of the ERCIM Digital Library Initiative funded by the ESPRIT Long Term Research Programme, is to promote research into the further development of digital library technologies.

This year Brno Technical University held its 100 year anniversary. It also recently become an associated partner of DELOS. The workshop was organized in celebration of these two events.

The workshop addressed two very important and rather recent research problems, namely, Digital Libraries and Distance Learning. Access to education has become increasingly important for individuals who need to gain a competitive edge in the labor market through acquisition of specialized or new knowledge. This demand for new information, coupled with the ever increasing quantity of information available in digital form, has lead to a change in traditional teaching methods. Face to face teaching is gradually being replaced by distance education. In order to make this form of education both effective and efficient, advanced information and communication technologies must be exploited. To this aim, digital libraries of distributed complex multimedia data can serve as suitable repositories of continuously changing up-to-date information, which are indispensable for distance education.

The DELOS organizers cooperated with the Czech Association of Distance Learning Universities and the European Association of Distance Learning Universities in preparing the program for this workshop. The Call for Papers was circulated not only to all DELOS Project partners, but also to the electronic network, reaching hundreds of individuals.

The final program, organized into seven sections, contained contributions from nine countries. The invited talk, by John A.N. Lee, concentrated on distance learning experiences at the Department of Computer Science at Virginia Tech, USA. The remaining presentations can be divided in two categories. Papers in the first category concentrated on conceptual issues of distance learning, emphasizing the position of digital libraries in the global process of knowledge acquisition. Papers in the second category presented information about actual prototypes for distance learning or addressed some of the advance technology tools necessary to meet this aim.

One section, highly appreciated by the workshop attendees, was devoted to prototype demonstrations. Six different prototypes were presented.

The workshop inspired numerous discussions. The most important issues can be summarized as follows:

1. Closer cooperation between the Digital Library and the Distance Learning communities is needed in order to better understand learning needs and technology capabilities.

2. A stronger theoretical foundation of actual systems is needed, including data modeling, search strategies, network communication, and user interfaces. Moreover, the performance of the hardware is not always sufficient.
3. Most of the participants expressed interest in cooperating under suitable research frameworks.

Finally, we are grateful to Tarina Ayazi from the IEI-CNR, Pisa, Italy for all her organizational help in making the workshop a success.

ODL for SMEs: developing a training system for the Liguria region

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This paper draws on the experience developed within the FADxPMI project, funded by the Provincial Administration of Genoa (Italy) and run by the Institute for Educational Technology of the Italian Research Council (ITD/CNR). FADxPMI is the Italian acronym for Distance Training for Small and Medium Enterprises: the project tackles the problem of managing the change from face-to-face training to distance training in Liguria, the region in North Western Italy where the city of Genoa is located.

SMEs are a major economic resource of this area, and it is fully acknowledged that:

1. Their chances of surviving and prospering are heavily dependent on their flexibility and ability to cope with the challenges of a very dynamic market;
2. These important qualities can and should be strongly supported by an open and flexible training system, and particularly one that doesn't require very small enterprises to do without staff for significant amounts of time.

Unfortunately, it is also widely acknowledged that the Ligurian training system presently fails to satisfy these requirements, in that most of the training on offer is face-to-face, and the many training institutions in the area do not possess the know-how and infrastructures needed to implement distance training initiatives. However, there have been some interesting and promising experiments in this field, but what the Provincial Administration of Genoa wants to promote with this project is a significant step forward in the direction of setting up a system to support a more systematic implementation of ODL for in-service training of SMEs' staff. Such a system, although designed specifically for the local context, might also be easily transferable to similar contexts, bearing in mind that SMEs are the backbone of the whole Italian economy, not only of our region.

It should also be noted that the problem of shifting the perspective from traditional face-to-face training to distance training cannot be reduced to a mere problem of training the trainers: the lack of know-how is by no means the only problem to be solved. In fact, those trainers that seek to engage in distance training face a number of problems deriving from the fact that everything around them is conceived for traditional training: from the way funds are obtained to the way they are supposed to be invested, from the lack of centres for the production of learning material to the lack of infrastructures for the delivery of the courses; even the mental approach of trainees and their bosses is still tuned to face-to-face training and must change to accommodate a new way of learning.

For these reasons, the FADxPMI project is being developed through the following phases:

1. the analysis of distance training techniques and methods, and the identification of selection criteria that should be borne in mind while designing a solution to a training problem;
2. the dissemination of know-how in the design of distance training events among trainers and course designers belonging to local training institutions;
3. the development of proposals for a distance training system suitable for the local context.

The first phase of the project started in 1996 and was completed in 1997. It entailed the production of a comprehensive report where the pros and cons of the use of print, audio, video, computers and telematics in distance training are discussed, as well as the ways in which such media can be employed. In this report it is assumed that a training problem can be defined in terms of target population, educational objectives and content domain, and context requirements and constraints. On the grounds of this definition, solving the training problem will consist in wisely orchestrating different techniques, media and teaching strategies according to criteria which maximise the cost/benefit ratio, though costs and benefits aren't always quantifiable.

The second phase (completed in 1998) consisted in the design and implementation of a course addressed to trainers and instructional designers belonging to local training institutions. The course lasted five months and made use of the results of phase 1, which were made available to the participants through a pass-worded section of the course website. The course consisted of both traditional, face-to-face sessions, and of distance training activities, based on individual study and group work. Participants were given the opportunity to experience directly both the training techniques and the problems that may be faced in the creation of a virtual community of professionals, who are sometimes in competition among themselves, and often resist innovation in that they feel it undermines their individual experience. The course structure and content are illustrated in fig. 1.

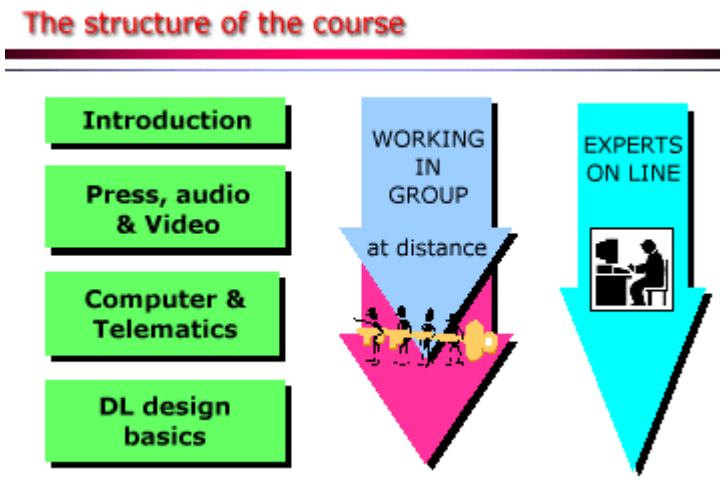

Fig.1 The content and the structure of the Designers of Distance Training course

The third phase started in 1998 and is still under development. It aims to draw up specific proposals for the local context, such as the creation of infrastructures that "factor out" those activities presently duplicated in different training institutions, or that are not carried out by anybody because they are too expensive for any single institution (e.g. production and adaptation of materials, training needs identification and evaluation, etc). These proposals will be the conclusive project deliverable, and of course it is our hope that the Provincial Administration of Genoa will take them into consideration while promoting further initiatives for the development of the local training system.

This paper will focus on the second phase of the project, and in particular on how the large amount of information produced by the first phase was organised and made available through the web to course participants as well as how distance learning was supported through an on-line collaborative learning environment.

The website of the course for Designers of Distance Training

As mentioned above, the second phase of the FADxPMI project entailed the development and pilot test of a course for designers and tutors of vocational courses on Open and Distance Learning (ODL) methodologies and tools. The documentation produced during the first phase of the project was a very important component of the learning material, and had to be made available to course participants. Of course, it could have been printed out and handed down to participants at the beginning of the course, but there were at least three good reasons for choosing the alternative of embedding it into an ad-hoc web-site. The first reason was that the structure of the material is of an hyper-textual nature, in that it contains both internal links from one section to another and external links to web-sites of other institutions. Producing a printed version of this material would have resulted in a loss of this hyper-textual nature. The second reason was that although the learning material was being piloted with a small sample of the target population (22 trainers of the Liguria region), the Provincial Administration of Genoa, who funded the project, intended to spread these competencies among all practitioners in the field. Scale economy therefore suggested that a web-site would have been more costly at the beginning, but cheaper in the long run. The third reason was that creating a website for the course would have given participants the opportunity to try out web navigation as a learning technique during the course.
The amount of information made available through the website called loud for a careful interface design; in order to prevent users from "getting lost in cyberspace" we decided to lay down on the page all the instruments which allowed users to easily surf the web. Among these tools, maps of the various sections of the content domain (fig.2) were made available to users at all times.

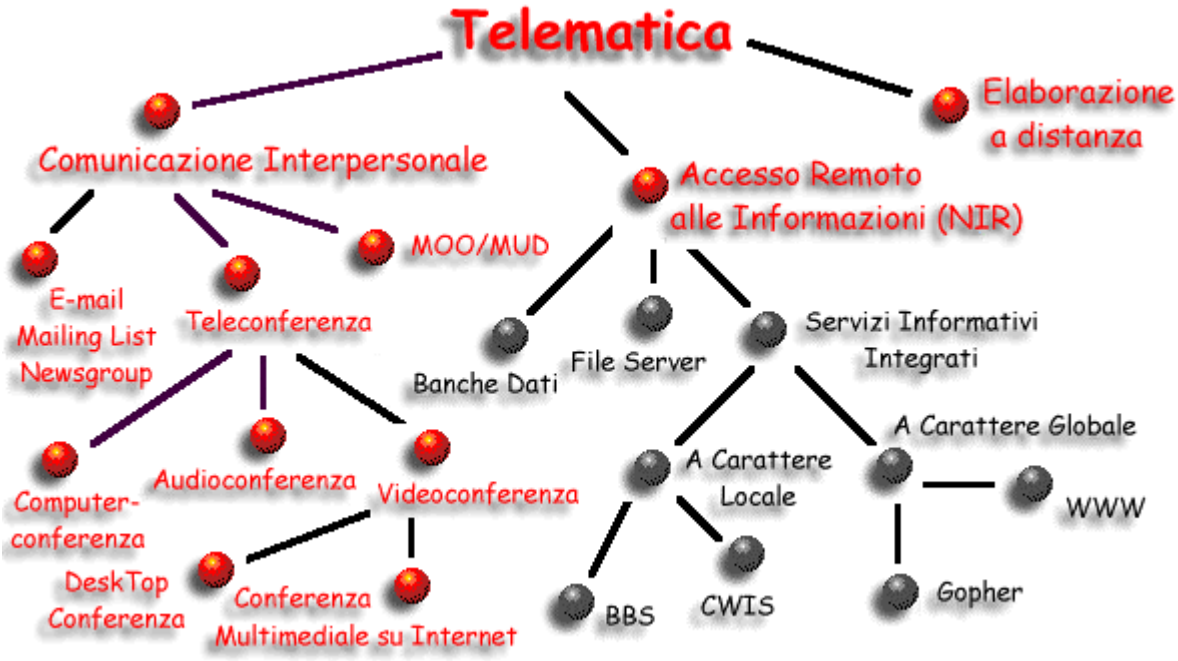

Fig. 1: navigational map - section Telematics

Alongside an introductory section where users could find both general and specific information about the project and the course, the website offers the users the possibility to access all the educational materials through an environment divided into three main frames (fig. 3):
URL: http://ww2.itd.ge.cnr.it/fadxpmi/

- on the top of the screen: headings of the course and of the current section;
- on the left pane: table of contents;
- on the right pane: the section body, updated each time the user clicks on the links in the table of contents.

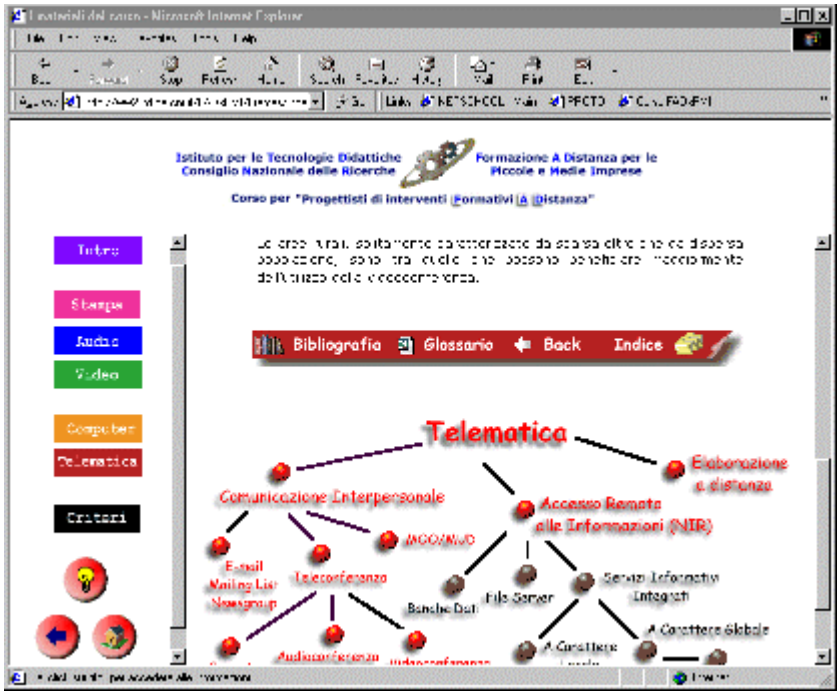

Fig.3: screenshot of the frameset - section Telematics

The educational materials include seven macro-sections: Introduction, Use of Text in ODL, Use of Audio in ODL, Use of Video in ODL, Use of Computers in ODL, Use of Telematics in ODL, Principles of Distance Training Design. Sections were made recognisable by assigning each a distinctive colour and a contextual navigational map showing all the possible paths to follow, according to the unwinding of the lessons in presence.

The site also includes:

- a selected bibliography bibliography for each section;
- a glossary of telematics and computer related terminology;
- an on-line mini-guide section showing participants how to use properly all the resources at their disposal;
- a section devoted to information about the learning community (names, resumés, URLs and roles of all members) and any other organizational issue concerning the course.

Each of these elements is displayed inside a small, resizable "pop-up" window which opens a new browser session, allowing users to keep the parent window of their browsers opened on the desktop of their computers, so that they do not loose the pages they were connected to.
Since the fruition of the website followed step by step the unwinding of the lessons in presence, from week to week participants were also given on-line access to the Microsoft Powerpoint™ slides used during the face-to-face presentations. The formative evaluation of the course showed that this facility was greatly appreciated by participants, both to revise topics and to make up for missed sessions.
URL: http://ww2.itd.ge.cnr.it/FADxPMI/Corso/SlidesIncontri/slides_index.html

Using CMC to support Distance Training

As already mentioned, the course consisted of an alternation between face-to-face sessions, individual study of the learning material and collaborative activities among participants, proposed and tutored by the experts who conducted the face-to-face sessions. To support these interactive activities, a CMC learning environment was implemented and made accessible from the course website. The adopted software infrastructure was Softarc FirstClass™: a general purpose CMC system that is often used in on-line education[1].
The course main discussion forum (called FADxPMI) was structured into six different sub-conferences, as shown in Fig.4. Some of these sub-conferences contained a further subdivision into sub-folders, according to the structure shown in Fig.5. It should be noted that while the top-level structure was decided by the tutors before the beginning of the course, some of the lower level conferences were created at run-time according to training needs and course developments.

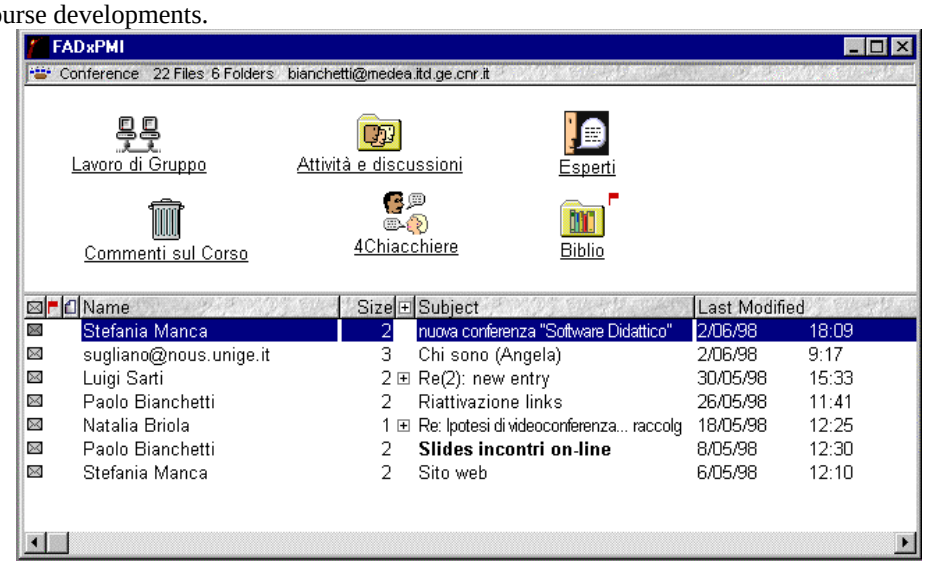

Fig. 4 A screenshot of the desktop of First Class™ in its configuration for the Developers of Distance Training course.

[1] Softarc First Class™ Intranet Client is an easy to use computer conferencing system for Windows and for Mac. With it you can send and receive electronic mail, share files, use electronic conferencing to exchange ideas, and participate in on-line chats. http://medea.itd.ge.cnr.it/Login/FADxPMI/

Each conference had its own purpose, as described below:

- Group-work (Lavoro di gruppo): participants were split up into two groups, each of them having to carry out given learning tasks.
- Activities & Discussion (Attività e discussioni): participants had the possibility to discuss and compare their opinions and ideas on the matters introduced during face-to-face lessons.
- Experts (Esperti): participants could rely on on-line experts' helping hand in order to answer their questions and solve their problems, from technical problems to methodological or bureaucratic ones.
- Comments on the course (Commenti sul corso): this conference aimed to collect participants' opinions on the structure and the unwinding of the course.
- Cafè: (4chiacchiere) here participants had their virtual space where to socialise, meet the other participants and speak of everything but the course.
- Library (Biblio): a library of distance training materials exemplifying the use of various media was put together before the beginning of the course, including material developed by different Italian and Foreign distinguished institutions. Participants were encouraged to borrow materials and review them.

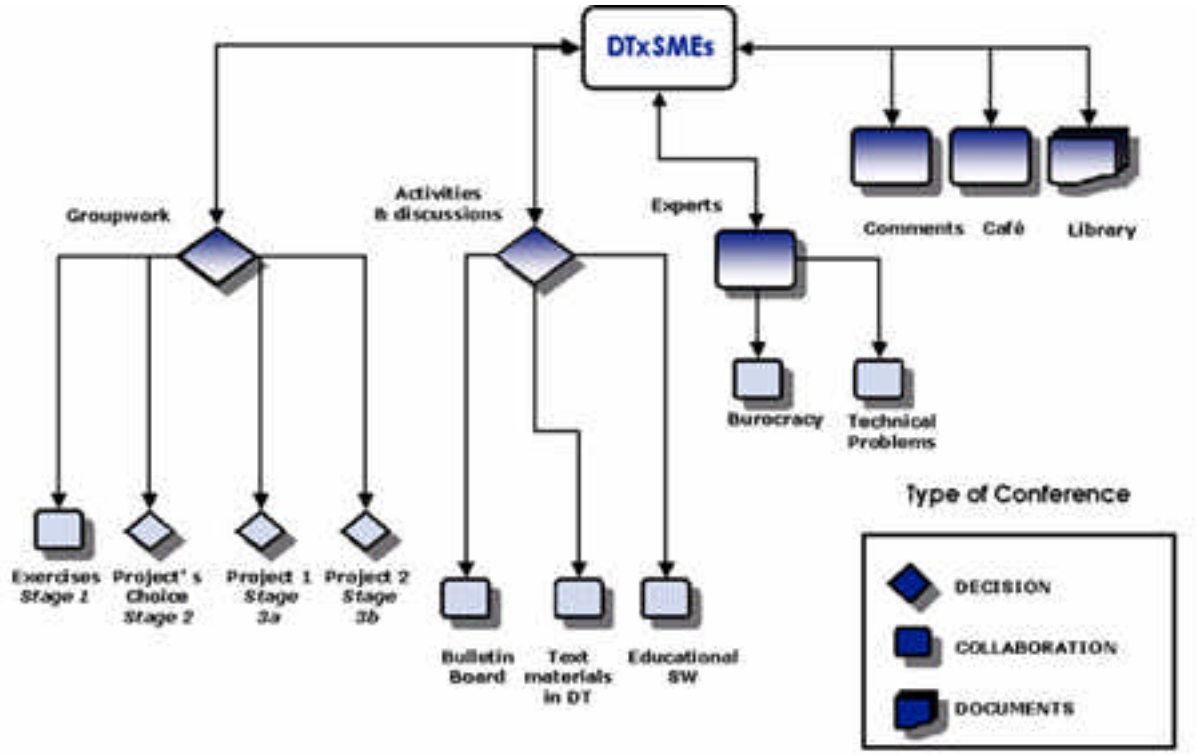

Fig. 5 The structure of the communication forum.

Each conference hosted a number of communication flows and was moderated by one or more remote tutors. At first, tutors specify the aim of each conference, the purpose of the involved activities and their time scheduling. As mentioned above, participants carried out their given tasks and activities under the supervision of the tutors; the results of these activities, usually having the shape of a digital document (doc, rtf, ppt or HTML) was made available to the community through the suitable conference for final discussion and evaluation. In order to meet the goals of the course, participants had to exchange information, share knowledge, design and develop study products (i.e. a web page or a slide presentation) in a collaborative way, take decisions and negotiate critical issues, always at a distance.

Conclusions

The particular "mixed" nature of this course, which alternated weekly lessons in presence with distance individual and group activities, needed to be supported and implemented with specific tools that allowed and facilitated on one side individual learning and on the other the development and the creation of a virtual community where collaborative learning took place.

The decision to implement a learning environment where a website of learning material is integrated with a CMC environment turned out to be successful. Nearly all the participants showed to enjoy and appreciate this kind of environment. Each participant was asked to fill in three evaluation questionnaires (one at the beginning of the course, one half way through it and one at the end) to carry out the formative evaluation of the course, whose results are described in detail at http://ww2.itd.ge.cnr.it/FADxPMI/Corso/valutazione.html. The collaborative aspects and the flexibility of the course were the two most frequently mentioned positive aspects.
To conclude, it should be noted that the solution to an educational problem hardly ever lies exclusively in collaborative activities or in individual study of material: real problems call for an integrated approach. As a consequence, adopting an approach where the balance is struck between the use of telecommunication technology for interpersonal communication and its use for information retrieval (as in the Designers of Distance Training course) is very often the most sensible solution.

References

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Support of multimedia services for distributed network training applications in CORBA-3

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Abstract

In this paper, fundamental technological issues in the implementation of today and tomorrow distributed network training systems are outlined. Given their highly distributed nature, the problems inherent to interoperability among heterogeneous systems are discussed. In this respect, the role of CORBA, an emerging standard for application integration technology, is presented. The limitations of today CORBA definition are discussed, and the extension of CORBA-3, with respect to the management of multimedia data (fundamental in the development of the next-generation distributed network training systems), is examined in more detail.

1. Introduction

In order to provide a network-based training tool for geographically distributed user groups with different learning backgrounds, the following features are required [1]:

- self-instruction;
- interactive training (teacher-student and student-student);
- presentation through the network of various didactic material (texts, multimedia documents, audio/video material, etc.);
- creation and use of distributed databases for training course documents, books and other didactic material.

The range of users that can utilize networked training is broad: students and company workers, adult learning, middle school students, disabled, non-native language speakers, changing work-patterns, personnel training. There are two main implementation choices for this type of applications:

1. use of Internet only, which is wide-spread and low-cost;
2. use of a specialized network which allows a greater service quality, but at a higher cost.

While most today tools for NBT (Network Based Training) adopt the first choice, it seems likely that future system will enhance their functions adopting multimedia paradigms, therefore shifting to the second choice.

2. CORBA solution

Given the highly distributed nature of Network Based Training systems, the problems inherent to interoperability among heterogeneous systems are essential. In this respect, the role of CORBA, an emerging standard for application integration technology, can play an important role.

CORBA is an open standard for distributed object computing. It defines a set of components that allow client applications to invoke operations on remote object implementations. CORBA enhances application flexibility and portability by automating many common development tasks such as object registration, location, and activation; demultiplexing; framing and error_handling; parameter marshalling and demarshalling; and operation dispatching.

The objective of CORBA is to achieve portability and interoperability via object-orientation:

- Design portability is the ability to create applications which only rely on the knowledge of objects interfaces.
- Interoperability is the ability to invoke operations on objects regardless of where they are located, which platform they execute on, or what programming language they are implemented in.

CORBA is the specification of the functionality of the Object Request Broker (ORB), that is the key component intended to support location transparency, i.e., the ability to access and invoke operations on a CORBA object without needing to know where the object resides. The basic idea is that it should be equally easy to invoke an operation on an object residing on a remote machine as it is to invoke a method on an object in the same address

space.

An object implementation is the part of a CORBA object that is provided by an application developer. It usually has an internal state and causes side effects on things that are not objects, such as databases, displays, network elements. An object reference is a handle to an object. An object reference will always denote a single object, but several distinct object references may denote the same object. Object references can be passed to clients either as values of their interface type, or as strings which can be turned into live object references. They contain enough information for the ORB to locate the correct implementation, but this information is inaccessible to their users. Unless an object has been destroyed or the underlying system is malfunctioning, the ORB should be able to convey an operation invocation to its target and return results. An object interface is a description of the operations that are offered by an object and can also contain structured type definitions used as parameters to those operations. Interfaces are specified in IDL (Interface Definition Language) and are related in an inheritance hierarchy.

The ORB structure (see Fig. 1) is composed of:

- IDL Stubs: pieces of codes needed to marshal client requests, generated by the IDL compiler and linked to the client
- IDL Skeleton: pieces of codes needed to unmarshal client requests, generated by the IDL compiler and linked to the object implementation
- Both these interface with the ORB run-time system to do their job for static invocations, i.e. the IDL is defined at compile time and only operations on known interface types can be invoked.
- Dynamic Invocation Interface: an interface that allows requests to be built dynamically for any operation by a client.
- Dynamic Invocation Skeleton: the symmetric interface for responding to arbitrary requests.
- ORB Interface: for communication from either client or server, mainly dealing with ORB initialization and object reference manipulation.
- Object Adapter: provides extra facilities for managing the interaction of object implementations with the ORB. The object implementation uses it to make itself available through an ORB, while the ORB uses it to manage the run-time environment of the object implementations.

The IDL interface definitions inform clients of an object what operations the object supports, the types of their parameters, and what return types to expect. A client programmer needs only the IDL to write client code that invokes remote object operations. The client uses the data types defined in IDL through a language mapping, which defines the programming language constructs that will be generated by the IDL compiler. The IDL compiler also generates stub code that the client links to. The stub code translates the programming language data types into a wire format for transmission as a request message to an object implementation. The implementation of the object has linked to it similar code, the skeleton, that translates the request into programming language data types.

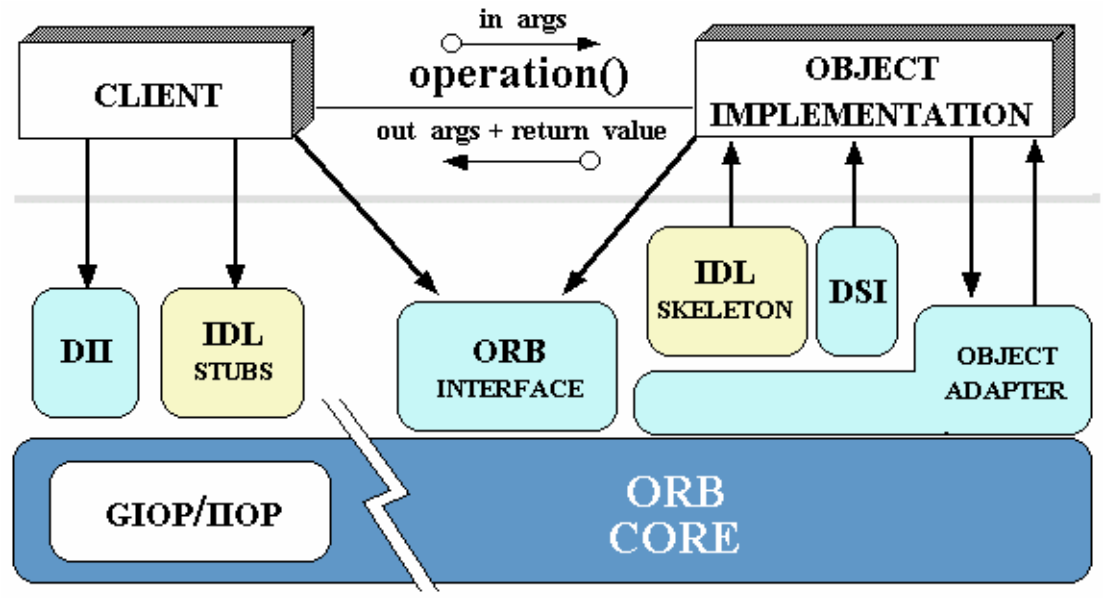

Fig. 1

The ORB acts as a message bus between objects which may be located on any machine on a network, implemented in any programming language, and executed on any hardware or operating system platform. The caller only needs an Object Reference and well-formed arguments in its language of choice to invoke an operation as if it were a local function. Different ORB's can interoperate according to the GIOP protocol. The GIOP defines a linear format for the transmission of CORBA requests and replies without requiring a particular network transport protocol. The Internet Inter-ORB protocol (IIOP) is a specialization of the GIOP which specifies the use of TCP/IP. It defines some primitives to assist in the establishment of TCP connections. Environment Specific Inter-ORB protocols (ESIOPs) allow the introduction of third-party protocols.

3. Multimedia Systems

Multimedia systems are bringing together efforts industries of computers and software, telecommunications, publishing, and consumer electronics. This convergence of the relevant technologies will allow information to be distributed on demand from very large information servers through a variety of high-capacity telecommunication media. This situation will have a major impact on the technology for network-based learning. The multimedia information servers will store very large amounts of multimedia data to support a large number of applications, such as movies (and other audio-visual data) on demand, tele-shopping, news on demand, tele-medicine etc. [4]

The main issues in the design and implementation of Multimedia Systems are:

- Large amount of data (e.g. Video)
- Unpredictable data distribution (burst data, non-Poisson arrivals)
- Delay sensitive & real-time data processing
- Flow control & buffering
- Admission control (dynamically guaranteed band-with)
- Quality of service - *QoS* (dynamic failure/recovery control)
- New cost/performance requirements

For example, supporting delay-sensitive data streams, implies the investigation of performance tradeoffs. One key question is how many disks of the array will be used for striping a multimedia object; as this number increases, the transfer time becomes smaller, which, in turn, reduces the user-observed latency . On the other hand, as the number of disks used for striping objects increases, the number of requests that the disk array can serve concurrently decreases, which in turn may lead to poor throughput.

The current state of CORBA does not support the function required by multimedia systems. However, since these perspective is considered of fundamental importance, CORBA is evolving towards this direction. This evolution is emerging in the latest evolution, i.e., CORBA3.

4. New features in CORBA3

CORBA has demonstrated to be is well suited for client/server applications running over conventional local area networks (such as Ethernet and Token Ring). However, building highly available applications with CORBA is much harder. Neither the CORBA standard nor conventional implementations of CORBA directly address complex problems related to distributed computing, such as real-time quality of service (*QoS*) or high-speed performance, group communication, partial failures, and causal ordering of events. This is also the case of multimedia systems.

There are three new main features in CORBA-3:

- Portable Object Adapter
- CORBA (asynchronous) Messaging
- Object passing by value

In the implementation of multimedia systems, the first two features are most important: the Portable Object Adapter because gives the application designer the possibility to program a suitable scheduler of multimedia object services, the CORBA Messaging because introduces the support of asynchronous data flows, typical of multimedia systems.

4.1 The Portable Object Adapter

The Basic Object Adapter (BOA) was introduced in CORBA 2.1. For the object implementer, the BOA is the interface to inform the ORB when objects come into existence and when running processes or tasks are ready to accept incoming requests on those objects. For the client, the BOA is the component of the ORB that ensures that an invocation on an object reference always reaches a running object that can respond to it. The BOA is

capable of launching processes, waiting for them to initialize, and then dispatching requests to them. To do this, the BOA accesses the Implementation Repository, a component proprietary to each ORB, which stores information about:

- where the executable code that implements objects resides and
- how to run it correctly.

The semantics of the BOA specification were left intentionally vague because it was not clear which features would be required on various platforms. As a result, different vendors implemented different parts of the BOA with differences in their semantics. This implementation experience was used as the basis for the specification of the Portable Object Adapter (POA).

The POA (see Fig.2) aims at providing a comprehensive set of interfaces for managing object references and their implementations, now called servants. The code written using the POA interfaces should now be portable across ORB implementations and have the same semantics in every ORB. The POA provides standard interfaces to four kinds of tasks, very similar to the tasks that a TP monitor typically performs:

- Map an object reference to the servant that implements that object
- Allow transparent activation of objects
- Associate policy information with objects
- Make a CORBA object persistent over several server process lifetimes

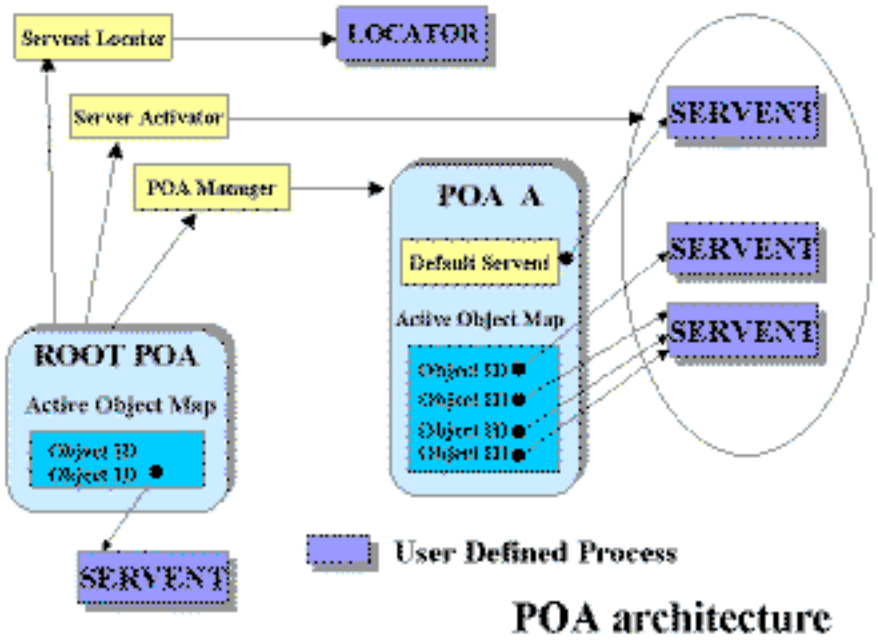

Fig. 2

The purpose of a POA is to dispatch incoming invocation requests to the correct servant object. It does so in a number of different ways (policies) which range from entirely automatic association of CORBA objects to servants, to the use of programmer-supplied servant manager objects. There can be more that one POA active in a particular server. However, there is always a root POA from which all of the other POAs are created. A reference to the root POA is always available from the ORB, and is obtained by using the *ORB::resolve_initial_references* operation. When a server is being initialized it is responsible for setting up any other descendant POAs that it requires to support its objects. POA provides operations to map CORBA objects IDs to servants, creating usable object references that can be handed to clients.

To summarize, the Portable Object Adapter in CORBA 3 provides the following new services:

- creation of CORBA objects and their references
- de-multiplexing of requests on target CORBA objects
- dispatching requests to servants (providing implementation of target CORBA objects)
- activation & deactivation of CORBA objects
- and the following new features:

- persistent and transient objects
- different policies of multi-threading
- application control over object existence
- static and dynamic skeleton interface
- DSI - Dynamic Skeleton Interface
- dynamic access to interface repository (IDL definitions)
- multiple POA

The explicit process control, possible in the POA of CORBA 3, allows the designer of multimedia applications to implement the specific implementation techniques which are necessary for handling delay-sensitive multimedia data.

42 The CORBA asynchronous messaging

The basic paradigm of CORBA communications is a blocked, synchronous model. Clients invoke operations on their proxies, which in turn do the work: construct a Request object, marshal arguments, send over the network, await response, and return it to the client. Meanwhile, the client application code is blocked on the request until completion.. Note, of course, that this is the same Basic Paradigm of all RPC (Remote Procedure Call) based systems.

In many cases, the synchronous paradigm is sufficient, and greatly eases development since it extends distributed computing in a straightforward manner from normal non-distributed function calls. However, there are many situations in which the synchronous paradigm is not sufficient. Examples of this include most distributed multimedia applications. There are three CORBA-standardized mechanisms that extend beyond the synchronous paradigm: one-way, DII deferred invocation, and the OMG Event service.

One-way is merely an IDL keyword that identifies an operation as flowing exclusively in one direction. There is no CORBA requirement for the underlying operation to be non-blocking. CORBA says only that the delivery semantics are “best effort”, which implies that the efficiencies of non-blocking sends are allowed, but are not required, leaving the determination up to individual implementations.

DII Deferred Synchronous Invocation offers a deferred mode, via *send* and *get_response* DII operations, to separate the act of sending a message from the act of obtaining its response.

Events in CORBA *Event Channel* are not part of the ORB itself, or a transport mechanism underneath it, but rather are considered as a layered service above the ORB. Nonetheless, this is a fairly fundamental service in that it offers perhaps the richest CORBA-supported alternative to the synchronous paradigm. Basically, Events offer a publish/subscribe model of messaging between directly coupled clients and servers. The real power of Events comes from the injection of an Event Channel between the client and server.

Asynchronous messaging is considered a highly scalable solution for deployment of large scale distributed multimedia systems. Therefore, it is a key extension in CORBA 3.

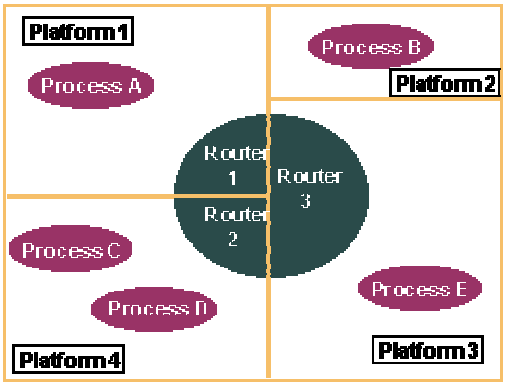

Fig. 3

The next generation of distributed object applications requires a new way of thinking about the CORBA model as its services are expanded and integrated with other technologies such asynchronous messaging. CORBA today does a great job of hiding the details of object distribution, as it was intended. CORBA's infrastructure is hidden under an object model that makes distribution transparent. It truly behaves as though objects were local. But they are not. They are often distributed across a wide, disperse network. Because the objects reside on a

variety of distributed systems, load balancing and message replication become the responsibility of the application. This means that applications now have to be aware of infrastructure ñ the very aspect that CORBA was trying to hide. By integrating asynchronous messaging into CORBA, infrastructure details can be hidden while preserving the CORBA object model.

Since asynchronous messaging is considered a highly scalable solution for deployment of large scale distributed multimedia systems, it is considered a key extension in CORBA 3. This is accomplished with software routers and by renaming remote objects with a logical name instead of a hard-coded host name and port number.

To overcome the limitations of a tightly bound object reference and object implementation, software routers are introduced (Fig.3). It has been said that any software problem can be solved with enough layers of indirection. This is precisely what the software routers do. They de-couple the object reference and object. With this architecture, the client maintains a single connection to the router, instead of having a network connection from a client process to all server processes. The router maintains a routing table that directs requests from a client to the correct server process, resulting in a loose coupling between the object reference and object implementation. This provides a vastly more scalable architecture, because a single connection to the router is maintained regardless of the number of server processes it communicates with.

When a client invokes a method on the ambiguous object reference, the message is actually sent to the software router. The software router looks at the *QoS* specification and determines which objects should receive the message. The router then fans out the message to all qualifying objects. To the developer of the client there is no difference in programming. The infrastructure details are completely hidden, as they should be. Load balancing of client requests has received much attention and fostered much discussion. However, current load balancing schemes tend to distribute the connections evenly across the servers, without considering the actual load generated by the clients. While connection distribution is better than no solution at all, it is far from what is required for reliable, high performance load balancing.

Consider what would happen if you had two servers, with one at idle and the other running at capacity. A simple round-robin load-balancing algorithm would send some connections to the server running at capacity. This is not the desired behavior and not what anyone would consider good load balancing. What is required is real-time load balancing. Every time a client request is made, it should go to the least loaded server, not the one to which the client is randomly connected. Fig. 4 illustrates how load balancing is achieved. When the client issues the request and sets the *QoS* to load balance, the router determines which server is least loaded and directs the message to that server only. The servers are the elements that determine the load balancing policy.

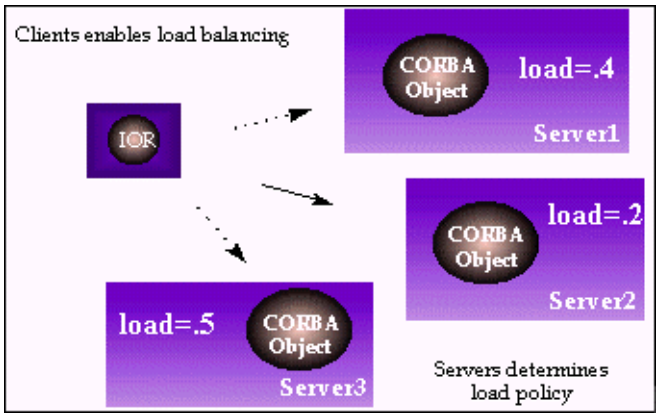

Fig. 4

To summarize, CORBA 3 introduces two new message specification:

- callback (additional object reference, invoked when the answer arrives)
- polling (value type returned, used to poll or wait for response)

5. Conclusions

Considering the state-of-the-art in implementing Network Based Training systems , the use of actual CORBA technology brings:

- Advantages with respect to native Web tools (based on HTML dialog)
- Advantages with respect to native Java tools (based on RMI dialog)

Future Network Based Training systems, based on specialized networks which allow greater service quality, will enhance their functions adopting multimedia paradigms. In this case, the actual CORBA technology is limited, while CORBA 3 extensions are intended to support also multimedia functions.

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Cooperative Learning Centre:
concepts, standardization issues and commercial approaches

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Abstract

This paper presents the general concepts of the current implementation of a cooperative learning centre, being developed as a set of facilities of the digital library of the Faculty of Engineering of University of Porto. The standardization efforts in the area of computer based learning facilities are also covered, as they present important guidelines for the project.

Introduction

In the new information society era, knowledge and innovation are certainly the basis of the added value and competitiveness of most successful corporations. The vital question to each corporation is then: how to continously develop, refine and use knowledge? Successful corporations strategically promote a knowledge exchange culture. The organizations of the future will certainly rely on a set of virtual technical communities, exchanging corporate database information and communicating through mail, bulletin board and conferencing systems.

In a knowledge era economy, the learning enterprise is strategically crucial. Too much crucial to be left to conventional schools. What is needed is learning on demand, when and where desired. Corporations must improve knowledge as the single institutional and economical security base. The best organizations of the XXIst century will merge intelectual power wherever it exists and not where it can be institutionalised. They aim to develop an intelectual republic, open to everybody, where the natural electorate will be those who stay intellectually informed all over their lives.

The role of Digital Libraries

Digital libraries may play an important role in the organization and management of information flow and cooperative work. Libraries may act as the interface between the research community and the commercial and industrial worlds, by means of the dissemination of scientific and research work and of the learning and collaboration facilities supplied [1]. Digital libraries are learning centers, the nodes of knowledge in the world-wide information society networks.

The technological evolution of storage and representation of different media made possible the developement of digital multimedia libraries, integrating in a single support text, image, audio, video, and also interactive content,

like simulations and presentations. Meanwhile, the standardization of catalogue and classification procedures leaded to flexible and open networked search and retrieval systems.
Nowadays, other promising new technologies are also being applied to digital libraries, introducing radical changes in the intellectual practices and in the social and economic organisation. Transparent world-wide interaction is aimed at distributed systems and component software technologies, while automatic content description, object oriented and agent technologies enhance the collaborative and productive work.

The functionalities of a digital library service should satisfy the needs of such different users as students, teachers, researchers or teleworkers, and make them collaborative and interdependent in the search of the relevant knowledge for their activities.
Administrative support and security procedures are key system facilities for the correct management and maintenance of the databases, the access control and the protection of intellectual property rights. Powerful and relevant document search and flexible browsing methodologies are needed for an efficient use of the digital database resources available, in particular when distributed services and large multimedia contents are available.
Content creation and cooperative work facilities should be available to users, so that everyone can contribute as a content provider and digital library access can be considered as a learning experience. Finally, commercial exploration of the digital library resources must be considered, requiring accounting and billing mechanisms, for electronic publishing purposes.

The Faculty of Engineering of Porto University, is following an operational plan for the development of a digital library since 1996. The Library wants to constitute a reference, in the access to information resources in the scientifical and technical areas of Engineering and related fields, in the Northern Region.
Besides providing the traditional library services at a high level, the plan has a great component related to information technologies, both by the service enhancement they provide and by the new habits of access, production and dissemination of knowledge they will produce in the future. Thus, a learning centre philosophy is followed in the plan, regarding the cooperative production, open access and international dissemination of scientific and technological information.

The installed Library Management System, ALEPH [2], commits with all the relevant standards in the cataloging area. In particular, it supports UNIMARC records, integrates CCL (Common Command Language) and Web OPAC (Online Public Access Catalogs) search capabilities, and supplies a Z39.50 Information Retrieval gateway. The ALEPH system is based on open, standard RDBMS (Oracle), and supports multimedia contents and URL links from bibliographic information, through field 856 of UNIMARC record.

The Cooperative Learning Centre

The massive multimedia information currently available on the Internet for search and retrieval offers exciting new opportunities for learning and research. However, the search of relevant and useful information, as well as the navigation functionalities, are still not very efficient, asking for new methodologies to format and organize the multimedia information in a coherent and controlled way.

A possible model for the development of distributed databases of learning content considers multimedia information entities, the learning objects, cross-connected in tematic subject paths, allowing for the representation of several associations of ideas, or annotations, on the primary contents [3]. In an operational view, the model is divided in four different levels of structured information: the assets pool, which are monomedia elements refernced in the cataloging system, the learning objects database, where documents that group objective elements are stored, the subject path connection service and the annotation facilities at each node. The combination of these four levels creates a dynamic and evolutive system: the hypermedium.

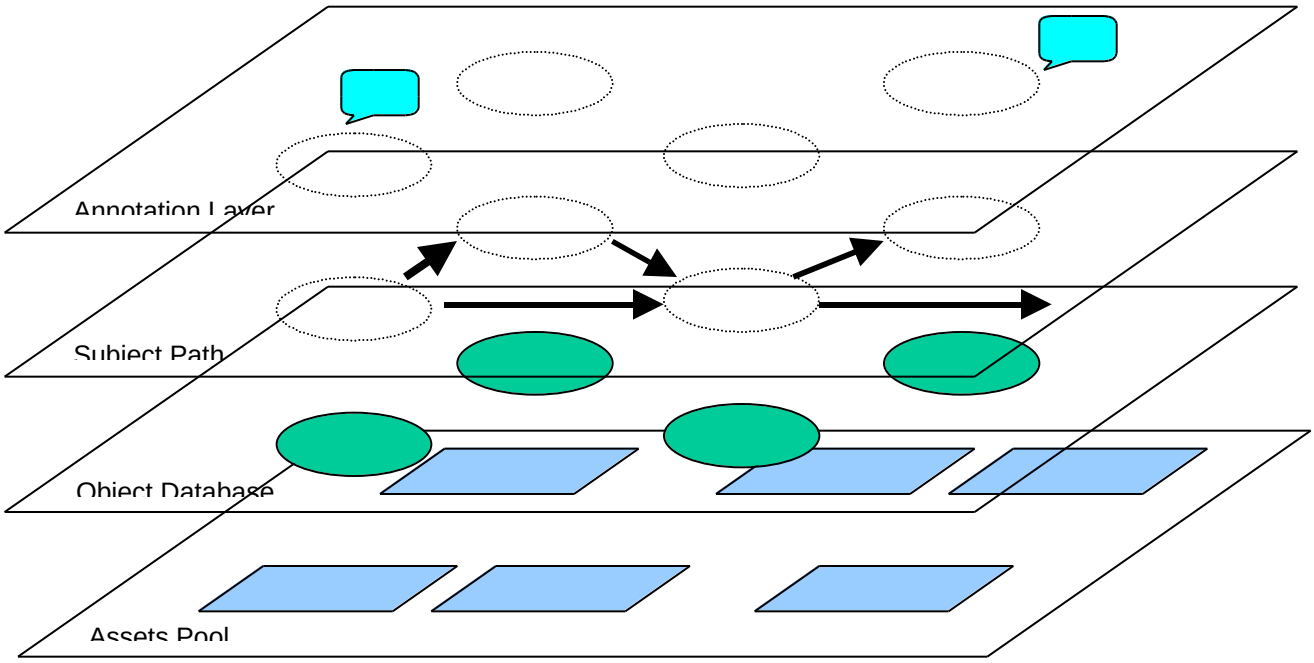

Fig. 1: The cooperative learning hypermedium model

The mediabase is supported in a conventional relational database, where the contents are multimedia entities, self-described and objective, and that can even be interactive (eg. a lab simulation). An entity acquires significant relevance in the context of an argumentation, described as a tematic subject path connecting several entities. A reader should be allowed to query an entity about the referencing paths, and move orthogonally on any one of those alternative paths.

The proposed model does not demand too much performance from terminal equipment and communication networks, as it is basically divided in a remote query (the subject path) and the download or streaming of self-described entities (the mediabase objects) [4].

The long term success of this model depends on the massive involvement of active users in the system, multiplying the entities and the subject paths defined on them. Intellectual property rights related with the annotations inscribed on the subject paths are protected by the nature of the hypermedium, as any copied entity

from the system looses the most important quality, which is the relational information inscribed in the subject paths [5].

Mediabase objects can include any kind of multimedia standards and formats. The initial content will be based in the large number of monographies, thesis and papers available in digital support (eg. PDF format). Video cassettes can also be converted to any suitable digital video format (eg. MPEG2) for distribution all over the campus.
More elaborated multimedia objects, such as, presentations (eg. Microsoft Powerpoint), application demos (eg. Lotus Screencam) or interactive simulations (eg. Macromedia Flash or Sun Java) can also be developed. A team including experts in multimedia production, interface design and pedagogic aspects will assist teachers and researchers in their development, providing also training courses and on-line support.

The Knowledge Centre will be available from a single web interface application, supporting the bibliographic and serials searching tools provided by the ALEPH library services, the access to external databases and contents (eg. Dialog, Engineering Information Village) and to the mediabase, in an object-oriented manner.
Annotation functionalities will provide for the user creation of subject paths connecting those entities, which can then be exported, if desired, to a restrict group of users or to all the research and learning communities inside the campus or in the Internet. Agent technologies will allow the development of pro-active and user configurable information services, providing a better exploitation of the available resources. Accounting and billing mechanisms will provide the needed security procedures for searching, editing or distributing the contents, and for statistical analysis of the users behaviour and taxation of commercial services.

Standardization activities

Computer-based training materials are largely developed on a proprietary, company-by-company basis, resulting in high development costs and limited re-sale value. The development of guidelines and standards fastens the creation of new markets for training materials, reduce the cost of development, and increase the potential return on investment. Some international efforts are now arriving to a consensus, in the field of computer based learning, and the most relevant initiatives that play a role in the standardization are listed below.

IEEE LTSC

The mission of IEEE LTSC - Learning Technology Standards Committee working groups [6] is to develop technical Standards, Recommended Practices, and Guides for software components, tools, technologies and design methods that facilitate the development, deployment, maintenance and interoperation of computer implementations of education and training components and systems.

The Learning Technology Systems Architecture (LTSA) 4.00 was accepted as a base document for IEEE 1484.1 (LTSC, Architecture and Reference Model Working Group). The LTSA specification covers a wide range of systems, commonly known as learning technology, computer-based training, electronic performance support systems, computer assisted instruction, intelligent tutoring, education and training technology, metadata, etc.

The LTSA specification is pedagogically neutral, content-neutral, and platform-neutral, providing a framework for understanding existing and future systems, promoting the interoperability and portability by identifying critical system interfaces. Five refinement layers of architecture are proposed. They are applicable to a broad range of learning scenarios. These refinement layers are called, from highest to lowest levels: *Learner and environment interactions*, *Human-centered features*, *System components*, *Stakeholder perspectives* and *Operational components*.

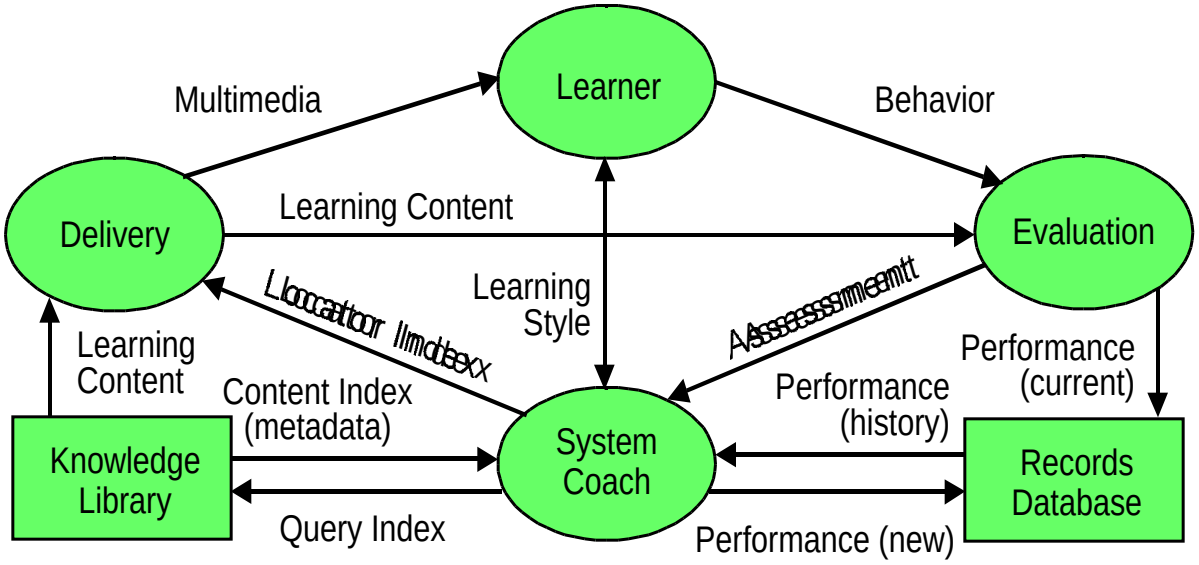

Fig. 2 : IEEE LTSC - Learning Technology Standards Committee / Edutool – System components

AICC -Aviation Industry CBT Committee

This committee recommendations are considered the *de facto* standards in computer based learning, and several commercial products comply with the Computer-Managed Instruction guidelines for interoperability (AICC document CMI-001) [7]. Interoperability means the ability of a given CMI system to manage CBT lessons from different origins. It also means the ability for a given CBT lesson to exchange data with different CMI systems. AICC-compatibility of courseware and CMI systems can be verified by the AICC-sponsored Independent Testing Laboratory.

The CMI document defines the standard and includes guidelines for: launching a CBT lesson from a CMI system, communication between a CMI system and a CBT lesson, moving a course between different CMI systems and generating and storing lesson evaluation data.

DoD ADL - Advanced Distributed Learning

The purpose of the ADL initiative [8] is to ensure access to high-quality education and training materials that can be tailored to individual learner needs and can be made available whenever and wherever they are required.

This initiative is designed to accelerate large-scale development of dynamic and cost-effective learning software and to stimulate an efficient market for these products. It will do this through the development of a common

technical framework for computer and net-based learning that will foster the creation of re-usable learning content as "instructional objects."
The main objectives of the ADL initiative: are then: to develop the guidelines for the implementation of efficient distributed learning systems, to identify business models, promoting the establishement of a networked community of consumers, and to stimulate collaborative developments identifying technical challenges still open.

EDUCAUSE IMS - Instructional Management Systems

This initiative, initially called the National Learning Infrastructure Initiative, identified a common need among educational institutions for non-proprietary, Internet-based strategies for customizing and managing the instructional process and for integrating content from multiple publishers in distributed or virtual learning environments. Toward this end the IMS [9] was formed as a catalyst for the development of a substantial body of instuctional software, the creation of an online infrastructure for managing access to learning materials and environments, the facilitation of collaborative and authentic learning activities, and the certification of acquired skills and knowledge.

The development of instructional software and its integration into the learning environment, have been impeded by a lack of standards that would permit sharing across institutions and across a wide range of technical environments. The current Internet-based solution has improved access to learning materials, but this access is limited at best. Finding relevant, valuable, and interesting information on the Web is a difficult process because there is no inherent structure or standards for describing available content. Furthermore, the Web tends to be primarily used as an information repository rather than an interactive space supporting the collaborative and dynamic nature of learning. Interactive technologies are developing to augment standard HTML, but translating the resulting content across sites requires a significant amount of expertise and time. Finally, the development of online learning environments has also been hampered by the lack of electronic commerce solutions for compensating the production and distribution of content or programs.

The IMS is a set of standards and tools that address three obstacles for providing effective online materials and learning environments: locating and operating interactive platform-independent materials, support for the collaborative and dynamic nature of learning and incentives and structure for developing and sharing content.
The IMS technical specification will provide the general guidelines and requirements developers must write to in order to create interoperable content and management systems, and five main areas were identified in which specifications are being developed and prototype code is being built: *metadata*, *content*, *management functions*, *human profiles* and *external interfaces* (eg. Databases).
ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe) [10] is an european project that focuses on the development of tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics supported training curricula, and has liasons with IMS, in particular in the field of metadata description.

The current standardization activities in the area of computer based learning are the result of the concertation of the efforts of these and other organizations, as the next figure tries to illustrate.

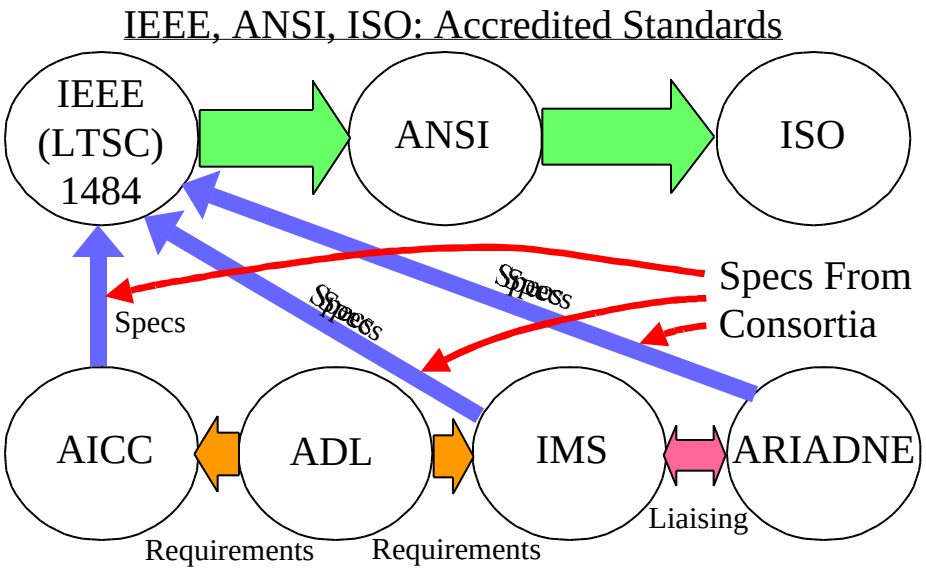

Fig. 3 : Standards and specification development organizations

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Digital Library for Multimedia Content Management

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Abstract

Digital Libraries are emerging technologies for document management. These documents includes multimedia objects. It requires new methods of all aspects of multimedia data management. Starting from the source through storage to delivery. Digital libraries have to use all modern network and servers technologies in order to supply services of a high quality. Its universal nature makes the digital library an excellent foundation for other multimedia-based services such as distance learning. In this paper we describe the first attempts of PSNC and POL-34 network to build a digital libary as a base system supporting different application areas.

1. Introduction

High performance computing and networking infrastructure has been developing in Poland for the last five years. Five high power computer centres and over 20 metropolitan area networks, which have been founded in this time, were connected with a countrywide ATM network POL-34 in 1997. It is based on SDH 622 Mb/s system from TEL-ENERGO S.A.

Pozna_ Supercomputing and Networking Centre (PSNC) is one of the designers of the Polish National Broadband Network POL-34. The main goal of this initiative is to provide scientific users with new opportunities for the development of science-oriented applications and telematic services. The range of the development covers a new implementation of standard Internet services as well as multimedia and metacomputing applications. At present, in the scope of POL-34 network, several projects are prepared to be operational as well. Because most of the metropolitan area networks in Poland are based on ATM technology all the projects can be developed in the end-to-end mode. The ATM technology is provided directly to the end-user.

New multimedia services, which are being deployed in broadband networks, require new systems for multimedia content management. Examples of the usage of such a system are considered later in the paper. The principle assumption is that for the management of multimedia content of different multimedia services, a common platform is designed – digital library system (DL). A pilot system was developed in the 1998. Since that time some former design issues had to be revised. This led to the next stage of DL system development.

2. Digital Library at PSNC

A pilot DL was developed in the first half of 1998. This installation uses the available software resource existing at PSNC. It provides the foundations for multimedia content management. The Architecture of this system is presented in Figure 1.

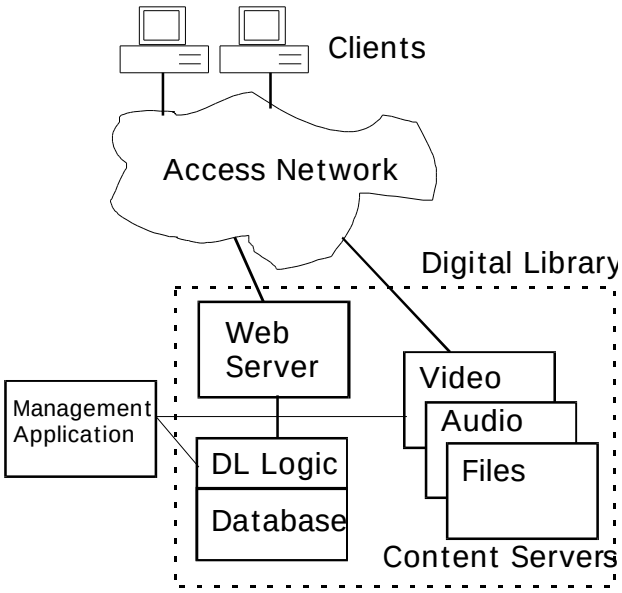

Figure 1: Pilot system architecture

The DL is based on a few components. Inter-component communication is network based, so each one can be placed on a different host, however we do not use any middleware. All communication is based on standard or proprietary protocols.
Main components are:

- metadata management application (DL Logic)
- content servers for storing and serving multimedia objects
- web server for the presentation of library content
- GUI mangement application for content load and management

The main component of this system is the Oracle database which stores all metadata. This describes the library content and user privileges. DL logic was implemented using a server stored procedures written in PL/SQL. DL logic means rules imposed on library and document structure, user privileges and searching capabilities. These procedures are the interface used by other components accessing metadata.

Different types of servers serving specific types of objects can be used to store objects. In our installation we used the following servers:

- Oracle Video Server for storing digital video objects,
- Progressive Networks RealAudio Server for storing audio objects,
- Oracle Web Applicaton Server for storing all others file based objects.

The last of these servers has an application for the presentation and searching of library documents through the web interface. This application is also written in the PL/SQL language. Based on metadata stored in the database forms are generated for searching library content as well as web pages presenting library content. For presentation purposes a graphical three dimensional interface using VRML scenes was developed which allows simple and fast browsing through the library structure and content.

A very important component of this installation is the GUI application supporting users with a functional interface to library content. The application is written in the Java language using JFC (Swing) graphical components. This allows it to be platform independent. The application does not present library content, but supports only the content load and management. The application uses system access control rules implemented in the database, which allows restricted access by particular users to specific library branches or documents. This allows for distributed content management, where each user interested in publication can be granted his own branch of the library for which the content he is responsible.
The application allows the loading of new documents. The document can be assembled by putting together objects of different types (text, images, video, audio) and defining the structure of the document manualy dividing it into chapters and pages containing selected objects. Objects are then described by simple metadata

such as: author, title, description or keywords. Defined in such a way a document is presented in a standard form on web pages. But "standard form" does not always fulfill our required needs. This problem is solved by using HTML as way of presenting library documents. With this concept a user creates an entire publication using any HTML editor and stores it on a local disk. After pointing its localization document is analysed by the application. All objects included in the document are described by metadata and sent to content servers and data describing the whole document and individual objects are sent to the database. Links contained within HTML pages are fixed in such a way that they point to new physical locations of used objects. The document is then presented using its own HTML, not automatically generated pages.
The application uses SQL*Net protocol and JDBC driver for communication with database. But content has to be placed on different servers depending on its type. In the cases of the RealAudio server and the Web Application server standard FTP protocol is used to transfer content onto them, but the Video Server required an agent to copy video files to realtime file system and tag them.

This system responds to all of the requirements specified earlier and allows the realization of services it was developed for. But shortly after its implementation requirements increased vastly. This was caused by new services appearing which were supported by digital libraries and new user expectations. This system was not so open or scallable to allow further development.
Most important flaws are:
- closed metadata subsystem
- use of proprietary protocols

New services, new requirements caused new design principles. The most important of these are presented below.

Distributed library and interoperability. Especially in the broadband network spread over the whole country an important aspect is the possibility of creating multiple local digital libraries serving local users, but allowing their global integration as well. This requires a new mechanism for exchanging information on library content between libraries, so a user can see all of the content through one entry point. In the future, intereoperability with other libraries should also be provided.

Quality of service. New methods for the presentation of multimedia objects according to a user's requirements and technical possibilites need to be developed. This is especially true for access network bandwidth and streaming media.

Performance and resource management. For mass usage of new services we need a new model of performance and content servers resource management. We also have to develop content caching and network multicasting to improve network usage.

Access control. We also have to develop new methods for access control. Creating new mechanisms assisting digital libraries is a mistake. It forces users to remember another password and creates new problems in existing security policies.

Based on the above requirements a project of a new digital library system addressing all of the mentioned problems is now developed. Some of the new project principles are:
- component based system design for allowing more flexibility in extending library functionality by simple addition of new components
- use CORBA middleware for inter-component and external communication and IDL for component interface definition
- use RDF standard as a consistent way of storing, exchanging and managing library and documents' metadata; this particularly requires new schemas especially for the description of the library structure and user privileges
- use LDAP based directory services as a central place for user authentication and authorization for easier integration with other IT systems
- use of models describing particular content servers performance and agents monitoring and reporting servers load for peformance management and admission control

The new system has to provide a common platform for digital library systems deployed in POL-34 network and provide interoperability between these libraries and other libraries. It should also deliver new mechanisms to support new services in the broadband network in particular, distance learning services.

3. Usage Scenarios for Digital Library

A digital library system was designed as the framework for several multimedia service scenarios, which will be realized within it. The main topics addressed in this area are:

- The management of different types of data including stream based data,
- The creation of multimedia publications,
- The storing of documents and objects contained in these documents,
- The possibility of describing objects and documents by simple metadata for searching,
- Access control for content.

The above mentioned problems are covered by different multimedia services which are developed in the POL-34 network. The digital library framework is foreseen to be the operational environment for these multimedia services (Figure 2).

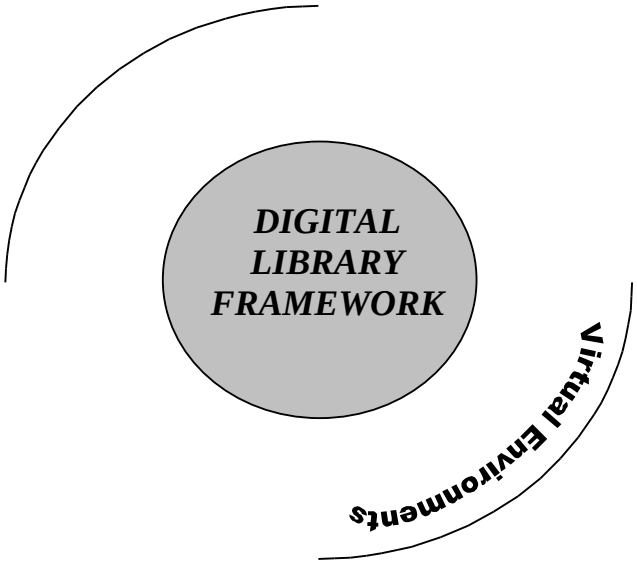

Figure 2: Usage scenarios for digital library

The first of the mentioned services is the *distance learning system.* It is planned to realize the distributed teaching environment composed of three different levels: offline lectures, interactive on-line lectures and remote exercises in virtual laboratories. In the scope of off-line lectures, there is projected to provide a set of lectures stored in the database. The digital multimedia library system is the natural environment for preparing, storing and distributing the content. Having assured scalability and flexibility of the system the content can be easy prepared and managed. The video broadcast extended with some content-depended information is stored in the digital library environment and served by it to the listener synchronously. The Internet access to lectures makes this service easily accessible but the quality of media will be decreased. Especially when the content will be served in multicast groups. Regarding this we assumed such a form of accessing the lecture to be used additionally to standard lectures being given. Students can access these lectures when they study a subject at home for the purpose of knowledge consolidation. It does not put high requirements as far as quality is concerned but only aims at helping students with home exercises. Another approach is to prepare an environment for distributed on-line lectures. The transmission infrastructure over the ATM countrywide network provides a good facility to develop advanced forms of teleteaching.

The second example of service, which will be implemented in the digital library framework, is *the digital edition of a book.* The original printed text form will be extended with parallel multimedia events. An animation and sound served by specific content servers will be synchronised with text presented by management applications on Web pages. The content will be created with the usage of specific applications for data input. The publication decomposed into basic multimedia objects will be formed when data will be accessed. The digital library will be used to digitize the work, store it and finally provide it to the user. The whole content will be served via IP as well as ATM network in dedicated VN. Both cases will have the assured QoS required for each specific media.

Both mentioned implementations will be developed in 1999. Pilot implementations will be used as testbeds for multimedia delivery techniques in the national backbone network.

The scenarios for our environment concerned additionally are in the project phases. Especially two of them are interesting in the scope of the advanced digital library system in the national network treated as a high performance infrastructure for multimedia. First project considered aims at developing collaborative virtual environments, which can be embedded in the framework of a distributed digital library. The second example is a Media on Demand server. The designed and implemented structure will meet requirements for different media distribution. More attention will also be paid to network performance issues for this service.
As one can see in the examples presented above great importance is put on problems regarding performance of the interface between the digital library and communication means. The national ATM network will be the basis of these tests.

4. Conclusions

The high performance computer and networking infrastructure is crucial for the development of advanced services compliant with IST. Pilot projects have already been developed and now, in several cases, the final stage will be entered. The most important thing is to concentrate on the implementation around the digital library concept as a framework for other services based on media transfer to an end user. The operating framework is going to be a considerable testbed for communication related issues, especially QoS, CoS and DiffServ communication.

Support of DE by the Digital Libraries

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Abstract

The article deals with the problem of recommended readings for the lonely students in the distance education teaching/learning processes. The distance education is accepted as one from the life-long education starting from the former correspondence study and in the recent time and thanks to the rapid development of ICT, there is more and more of inter-activity, partly based on the new ICT technologies. The basic study materials are delivered to the student in the form of learning package. Part of the learning package are usually recommended readings. Readings must be accessible to every student, to keep identical conditions for all students (democracy in education). Readings must accept copyrights and bring real added value for the student. The role of digital libraries in the delivery of recommended readings could be in the near future important, because of the access to ITC connection all over the world. The article discuss the potential use of digital libraries for the students in distance education.

Distance Education Learning Packages

Distance education is the *pedagogical technology*, how to support the student in the self-study process. The major difference between face to face study and distance education is in the separation of the teaching and learning process. To ensure this process successful, there is a lot of supportive tools, which are organised by the DE delivery institution.

The DE student had to obtain the learning package including not only text or other media as a holder of information for self-study, but also the concomitant information about the time schedule of study, , deadlines for his assignments and exams, timing of presence seminars (if any) and tutorials. The part of learning package ought to be the recommended *readings*. The usual structure of learning package is following :

- General information about the institution and study programme
- Study guide for distance education
- Time schedule of study programme
- Introductory to the study module
- Contact list of institution staff (course manager, tutor, administrator etc.)
- Electronic links for inter-activity in the self-study process with the institution
- Study materials for self-study
- Supportive multimedia (audio-, video-cassettes, discs, CD-Roms,
- Forms for Tutor_s Assessed Assignments
- Evaluation forms
- Readings (books or extracts from the books)

Position of readings in the DE Learning Packages

The problems of readings is done by the accessibility for each student. There are the problems with copyrights if there are only extracts from recommend professional literature or with the cost of the whole books added to the learning package. The theoretical way how to solve the problem is to address the student to the public or professional library. But in this situation we create the different condition of study for students from different regions. The advantage of Distance Education is in the independence on the study place and time of study. If we strictly recommend the visits of public libraries, there is the problems with students, who have not access to the such a library in the region and they had to cross to long distance, spent time and pay additional expenses

connected with their study. From this reasons (democratic and comparable study conditions for all students) , the obligatory visits of libraries are not the part of DE generally. The problem is solved at the DE Universities in EU by the selected study literature located in the study centres or by the post service of the university library.

Ways of on line study

The recent time is significant by the growing application of Internet (or other electronic networks) for transfer of information and delivery of study materials. Of course that without strict keeping of the principles of DE the final effects are usually very modest. But the institutions in the EU are dealing with the various ways, how to apply the learning via Internet and there are (especially in France) already models how to provide it successfully. The on-line study is well possible and the amount of information can be sufficient. The problem is only with the „overloading" of student by the non-relevant information. This tendency is typical for academic, who are not able to separate the relevant and non-relevant information for practical use. The DE student looks for study to improve his position on the labour market and no to accumulate huge amount of its say useful, but not relevant information.

If we will be able to cross and accept all this in fact predicted conditions and limits, there is a good opportunity to recommend to the student the readings via Internet - in the digital library. The technical problem with the storing of whole library in the net is in the hands of ICT experts. From the point of view of DE technology, there is a good perspective to use the digital libraries for all students, because the access to Internet is practically in each place. The French model of electronic distribution of education presents good balance between self-study via Internet and face to face contact of student with the DE delivery institution. The transfer of learning package to the electronic form is saving a lot of costs and the additional readings could be included there as well. The recommended readings must exist in the electronic form as well and digital libraries could play the crucial role in this point.

Shifting perspectives

For the serious discussion about application of ICT in the distance education is necessary to consider the approach of con-temporal students of secondary grammar schools and universities, These groups of /nowadays young people) are the potential students of Life-Long-Learning programmes including distance Education . This target group of client will accept in fact only up dated technologies for communication and learning. Also the approach to the LLL changed in the recent time according to development of learning society. The conventional study programmes are more and more substituted by the flexible and *taylored* study programmes. The learning society will give more and more emphasis on the individualisation of study opportunities with the growing share of interactive contact with the teaching institution. Already now we can observe the huge interest for electronic delivered teaching. The problem of near all of this marketed models is in the weak acceptance of DE technology and over-assessment of the electronic distribution channels possibilities. The best electronic links cannot substitute the motivation to the study or the individual approach of good tutor. Electronic links are only new way of information transfer, but definitely it is not a new teaching/learning technology. Flexibility in the educational processes must be supported by the corresponding learning environment and this is the good chance and challenge for digital libraries.

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Specifics of Adult Continuing Education

Jan Gadus, Zdena Gadusova, and Alena Haskova

Abstract

The paper presents some issues of continuing education in view of current needs of sustainable human development. Each learner brings his/her own unique learning characteristics to learning situations. Teaching process and guiding of learning process must recognise and reflect these characteristics in order to make teaching/learning instructions effective. Adults as learners display different features from those of common undergraduate students. The authors deal with principles of good educational practice, with the determined specific features of adult learners and with various types of continuing education programmes.

Continuing Education - Consequence of Sustainable Human Development Requirement

Living in an information age we must think of education as an industry. We may call it a *knowledge industry*. Knowledge has become a power, a determinative element of competitiveness. The growing clamour and move to revolutionise the educational sector with the aid of computer technology is clearly a part of an overall desire to be globally competitive. To qualify for global competition, it has been suggested that human power must be sustainably developed. Human development has been defined as the process of widening people's choice and the level of well-being they achieve. An inseparable part of this process is to ensure permanent opportunities to acquire knew knowledge and to have access to adequate information resources. Here we can distinguish between *two sides of human development*: between the formation of human capabilities and human potential development, and the use that people make of their acquired capabilities and developed potentials.

There is no doubt that changes in the industry structure, and economy and business organisation have called for greater personal investment in education. Skilled jobs have increased, job functions have diversified and the needs of labour market have changed. Many aspects of our social, cultural, natural, etc. environment are changing from day to day. The motors of this dynamics are the globalisation of communication and information processing technologies, and the globalisation of industry, business and trade. People are faced with the need to retrain themselves, as existing workforces, to ensure that their skills are relevant and meet the needs of the current technological, cultural and social changes. In contradiction to the needs of the past a cyclical retraining becomes now-a-days non-sufficient and there has arisen a need for *permanent further education possibilities*, so-called *continuing education*.

Various emerging information and computer technologies dramatically expand options for opening up a space that support the development of full human potential by challenging the rigidity and conservativeness of traditional schooling as well as by empowering learners to be engaged in diverse processes of learning. These technologies force us to rethink our education systems, giving more attention to adult learning, reshaping preparation of young people for adult life, stressing the autonomy of a learner, shifting the focus of the systems and processes from teaching to learning, and redefining the ways in which people get access to information and knowledge. The new information and computer technologies raise quite new questions about how knowledge is created and who owns it. Educational institutions, schools and universities, which used to have control over knowledge and over its dissemination now find themselves in mediatised environments where schooling is simply one of many different cultural experiences.

A previous objective of education was to produce individuals who knew a lot, and, if possible, to produce specialists who knew very much about something particular. It was assumed that the more one knew the better he or she would be to deal with the practical problems of the real life. Education was traditionally conceived as a fairly one-way street where knowledge travelled from a teacher and textbooks to students who tried to memorise all they could remember. Students were expected to store information in their mind, but not necessarily to use their mind to process the information. The technological advances that characterise our current age have changed everything and we have to reconstruct the cognitive map of education. To remember information and systematically repeat skills has been not enough in current epoch. The world no longer needs human databases or robots, such people are dysfunctional in it. It needs learners who can adapt their activities to what is happening each new day. *Learning to know* and *learning to do* must be replaced *by learning to become learning oriented*. Actually this is an orientation with which we are born - because learning is a never-ending experience taking place with different intensity from the cradle to the grave - but later we tend to lose it.

Continuing Education – Necessity to Ensure Diverse Learning Opportunities for Adults

Traditionally individuals have tended to begin and end their formal education within defined segments of education systems in their early years. Today ongoing movement calls for life-long learning and in its frame for continuing education. *Continuing education* is a broad concept which includes all of the learning opportunities all people want or need outside of basic education and primary education. It extends well beyond the completion of formal studies and into the less formal area of adult education. People involved in adult education undertake courses for many reasons. It may be for mental stimulation, personal growth, acquirement of new knowledge and skills, for social interaction and self confidence. Regardless of a person's reasons for studying, one thing is certain, continuing education makes a major contribution to the well being of society.

The various information and communication technologies present dynamic new opportunities to support the diversity of learners and learning processes. However, serious questions must be raised around the discourse and practice of new technologies and education. The information and communication technologies are conceived as alternative delivery mechanisms which facilitate mass broadcasting of information to learners in a low-cost way. Usually there is little concern about whether the learners actually understand these broadcasts. Oftentimes a mistaken assumption is that information is in a sense neutral and that all receivers will extract the same meaning and ideas that the creator intended. The challenge then that lies before us is to link the information and communication technologies and their applications to a new set of reference points around learning.

What was said in general about the necessity to form individuals capable of responding effectively to rapidly changing environments, and to educate *learners* instead of *knowers* is fully valid also for continuing education of adults. These two categories can be characterised by the following contradictory features:

Knower	*Learner*
❑ consults information of the past	❑ projects information into the future
❑ accumulates facts and concepts	❑ applies and experiences knowledge
❑ stores concepts without relating them	❑ creates and elaborates concepts nets
❑ applies knowledge to specific problems	❑ creates specific solutions for each problem
❑ modifies external stimuli to fit understanding	❑ modifies understanding to explain stimuli
❑ is passive, waits to be given information	❑ is proactive, eagerly seeks new experiences

In order to produce learners knowledge and skills must be seen as means through which one's capacities for learning are exercised and extended. And subject mastery should be viewed as an implicit consequence of the process, attained as a result of learning to become learning oriented. In this context it is very important mainly for adult learners that such a system should provide learning environments within which everybody could create his or her own learning ecology establishing personalised relationships with the aspects of his/her life and information background.

To meet all adults' needs and demands continuing education must offer a broad range of diverse learning opportunities, diverse in both kind and content, too. There can be distinguished *six types of continuing education programmes* (UNESCO APPEAL Programme, Kasaju, 1977):

1. *Post-literacy programmes.* Aim of these programmes is to maintain and enhance basic literacy, numeracy and problem solving skills, giving individuals sufficient basic working skills, and enabling them to function effectively in their societies. Their objectives are retention of already acquired literacy skills, improvement of existing literacy skills, and application of literacy skills for individual and community development.
2. *Equivalency programmes.* They are designed as alternative education programmes equivalent to existing formal, general or vocational education programmes. They share similarities with formal education programmes, but should be designed in a more flexible way.
3. *Income-generating programmes.* These programmes try to help their participants to acquire or upgrade vocational skills and enable them to conduct income-generating activities.
4. *Individual interest programmes.* Individual interest programmes provide opportunities for individuals to participate in and learn about their chosen interests. They are aimed at promoting and strengthening learning activities which promote leisure utilisation, life improvement and self-actualisation.
5. *Quality of life improvement programmes.* They aim to equip learners with essential knowledge, attitudes, values and skills to enable them to improve their quality of life as individuals as well as members of the community.

6. *Future oriented programmes.* This type of continuing education programmes offers people an opportunity to acquire new skills, knowledge and techniques, and to adapt themselves - and in this way also their organisations they come from - to growing social and structural changes, in particular to the rapid technological development.

Continuing Education – Learning Process Respecting Specifics of Adult Learners

Instructional designers creating continuing education programmes must be aware of the specific characteristics of adults as learners. Adults are often likely to display characteristics quite different from those of children (Knowles, 1973; Westmeyer, 1988). These particular characteristic features of adult learners can be designated by the following notions, as P. R. Ference and E. L. Vockell (1994) use them: skill-seeking, problem-centered, task-centered, life-centered, solution-driven, value-driven, externally motivated, internally motivated, active learners, hands-on, experts, experienced-based, independent, self-directing.

Skill-seeking. Adult learners often need to attain new or improved skills in order to better meet and solve work and real-life problems. To acquire these concrete skills they intentionally actively look for the adequate opportunities of further education.

Problem-centered. Adult learners prefer to deal with problems, which are meaningful and known for them, it means with such problems which they encounter or might encounter in their particular life situations.

Task-centered. Very important is to give adult learners tasks directed towards reaching some specific goals or solving particular problems, because it is typical for adult learners to be more active in performing just such kinds of tasks.

Life-centered. Adults are special learners with a great experience background, they are people used to be faced with different matters of everyday life. As a result, the adult learners tend to focus their attention on real-world situations, on solving real-world problems and on finding applications of newly gained knowledge and skills in the real-world and everyday life situations.

Solution-driven. As it was already mentioned adult learners operate actively in the real world and must deal with real-life problems. That is why they prefer to solve problems related to their environment, to solve tasks directed towards reaching either specific goals or solutions. It can be said that they very often actively seek out solutions to their concrete problems.

Value-driven. If the adult learners did not select directly the subject matter which they are supposed to deal with, it is very important just in case of adult learners to explain them why they should learn it so they know what benefit they can gain from the learning experience they are going to undertake. Given the rationale for learning something, they will often invest considerable energy into learning only recommended and not chosen by them topics.

Externally motivated. Adult learners usually come to continuing education programmes very highly externally motivated by such factors as better jobs, increased promotional opportunities, and higher salaries.

Internally motivated. Very often there are also strong internal motivation factors bringing adult learners to undertake and to use continuing education opportunities. Such factors of their internal motivation are e.g. self-esteem, recognition, confidence, career satisfaction, the overall quality of life.

Active – learners. Adult learners are usually willing to participate in the learning process. They come to the continuing education programmes usually highly motivated either internally or externally, or both internally and externally, too. Given the opportunity they prefer to be actively involved into the learning process.

Hands-on. As active learners adults appreciate learning by doing rather than learning by listening. That is why they should be offered opportunities to acquire skills and knowledge through concrete, hands-on experience.

Expert. Adult learners are people actively practising as experts in many different fields. Real-life experiences have contributed to their wide areas of expertise. These experiences are brought by them to the learning process and are influencing, many times only in a hidden unconscious way, their learning progress.

Experienced-based. This specific feature is connected with the previous one. Adult learners bring a wide variety of prior educational and life experiences to a new learning situation and either consciously or unconsciously they use them in many different occasions and ways.

Independent. For adult learners it is typical to be more self-reliant. Adult learners operating as independent individuals using previously gained knowledge, skills and work and life experiences tend to accomplish things for themselves. It is very common for them to rely on their own personal experiences and knowledge to seek answers to questions and to solve problems.

Self directing. Adult learners usually perceive themselves to be independent and responsible for their own activities. They have a need to be directly involved in planning and directing their learning activities. This feature used to be connected with some aspects of their motivation.

For creation of continuing education instructions there can be identified similar basic principles as are those for good educational practice (Wilson, 1997). These principles are as it follows:

· *Well-structured and effective learning only occurs when a connection is made between the learner's needs and the subject under study.*

This principle has much to do with learners' motivation and with gaining learners' attention. Adult learners used to be motivated to some extent forward before instruction begins. They often come to continuing education programmes with a clear concept of what they need to acquire and with a strong willingness to learn something new and also useful for them. If the content of a programme is unknown for them the adult learners want to know how the newly acquired knowledge and skills will benefit them. They value learning much more if they believe that the new skills or knowledge will improve the overall quality of their life. Many motivational theories suggest that individuals prefer activities involving an optimal level of challenge. This is a very important fact in adult education which instructional designers must deal with. They must very carefully consider an appropriate, not non-estimated, level of such a challenge. Motivation can also be used for gaining adult learners' attention. Learners must pay attention to what is being presented but adults are more likely to attend a presentation if they believe that the presentation will help them to solve a problem that they care about. Other possibilities are to utilise multiple senses, to arouse learners' curiosity and to use relevant real-life examples.

· *Humans only learn best if they are presented with meaningful materials based on the skills and knowledge already acquired and mastered. Poorly structured learning that ignores the background and knowledge of the learning group eventually leads to frustration and poor overall results.*

Making use of this principle is based on stimulating recall of prerequisite material. Adult learners bring to the continuing education a vast amount of real-life experience in addition to formal education. On the one hand they want to examine their own experiences and on the other hand they want to test the newly acquired concepts and skills against their existing experiences. It should also be clear how clear objectives are important for the adult learners. These objectives should be relevant to the real world and clearly state the end-results or benefits of learning.

· *Humans demand to be active during the learning process. They need to be engaged both mentally as well as physically with their learning.*

The adult learners are usually willing to take an active part in the learning process. To support them to be active it is very important to present them adequate stimulus material. Since adults tend to be problem-centered, skill-seeking, independent and active participants in the learning process, clarity and relevance are the key principles in presenting information to them. It is also very important to engage the adult learners in the tasks with a very strong necessity to attain a relevant goal. Life-centralisation of adults causes that they are willing to invest considerable time and energy in determining the benefits derived from learning and in trying to remove the consequences of not learning. Another aspect of this principle is adults' tendency to act independently. That is why continuing education should offer them as much freedom as possible, to allow them to work at their own pace and to adapt the instruction to their own goals and interests. Adults have a need to be directly involved in planning and directing their learning activities, and they want to accomplish things for themselves. They do not need to be dictated how they should learn the new skills. But on the other hand they need a learning guidance offering them hints and suggestions that require them to uncover an answer, solve a problem, or acquire a new skill.

· *Effective teaching and learning requires structured opportunities for repeated practice in a supporting environment where trust and constructive feedback is available to the learner.*

In a case of adult learners it is very important that the repeated practice promotes retention and transfer. They should be provided with mental tools and techniques for retaining and effectively using the newly acquired knowledge and skills, about their practical applications. They should be given ample opportunities to practice working on the problems connected with their work and everyday life, because for most of the adult learners their new skills will be used to address issues found in their workplaces or personal use.

· *Effective teaching and learning processes should be multi-sense ones. Humankind demands that all of our senses be included in any teaching and learning process.*

There are many individual differences among learners that interact strongly with kinds of teaching. These are called learning styles or strategies. These terms are used to describe identifiable individual approaches to learning situations and are relatively stable indicators of how learners perceive, interact with, and respond to the learning environment J. M. Reid (1987) identifies six major style preferences generally studied: the first four are

preferences for visual, auditory, kinaesthetic, and tactile styles of learning, and the last two are preferences for individual or group differences. The more senses are involved in learning the more effective is the learning process and the higher number of learners is addressed. However, adult learners are more likely prefer visual and tactile learning, as opposed to auditory learning which is favoured by undergraduate learners.

- *Feedback is seen as essential for the learner to ensure that the goals and objectives of a learning sequence are being achieved. Feedback needs to be honest, constructive and encouraging so that the learner is empowered to continue the process.*

Providing feedback is a critical step in the training process. The learners need to know whether the learning objectives have been met. For adult learners, this phase of the instruction is especially important. For most of them, the simple awareness that performance is on target is usually sufficient to maintain their motivation. It is better to give feedback frequently for small steps rather than large chunks of learning. The key concept is to let learners try out their knowledge and to debug errors before serious misconceptions arise. Learners who are highly motivated and actively involved can often respond almost constantly while learning.
For adult learners it is important to feel that they are effectively learning new skills. So they welcome questions through which they can confirm their progress.

- *Rewards need to be developed and negotiated with learners on a range of levels, from the immediate to the long term.*

To compare with providing feedback performance assessment is more formal. Moreover, the real true performance assessment of adult learners takes place in their workplaces or the home environments when the learners attempt to solve problems or reach personal goals. Nevertheless it should not be forgotten that unlike the educators who love education the students usually love what education can bring. And this can be applied also in the case of adult learners.

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Education Software for Courses on Theory of Information

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Key Words: Information Theory, Source Coding, Channel Coding, VHDL Modelling, Noise-Channel Model Simulation.

Annotation:

A new ways in Information Theory education are practised at the VŠB Technical University of Ostrava, Czech Republic. The courses have a conception of the both theoretical lectures and practical exercises. The simulations of digital systems bring a new look into theory and practical application of the information theory as a classical discipline of discrete mathematics. The both textbooks [6,7] arouses on the basis of the university courses which started four years ago for the students of Communication and Computer Science. The courses are oriented to foundations of discrete mathematics and its applications, as well as to communication and testing of electronic circuits and systems.

INTRODUCTION

The aim of courses on Information Theory is to introduce the methods and procedures, how to describe and evaluate the properties of processing and transmission of information. On the other hand, the author makes an effort to give a practical view to design of circuits for encoding and decoding. The text is written for designers of electronic circuits, who must build the coding and decoding equipment and for the communication system designers who must incorporate circuits into a system for message transmission. Texts uses only basic mathematics relations.

The classical mathematical presentations in theorem/proof are avoided. In spite of that: coding is extremely mathematical subject and it was an impossible task to present the matter without mathematics at all. The practical designers are mostly interested in using mathematics but not in constructive rigorous proofs. The applications of digital technique in computers as well as in memory medium become decisive matter of course and a condition of growth of computational power. Digital data transmission within computer systems are intolerant of even very low error rates usually, because a single error can destroy a computer programme. Error-control coding is becoming important in these applications.

DESIGN METHODOLOGY

Some parts of the courses are dedicated to description of circuit implementations of encoders and decoders. To be technology independent, the descriptions are done in VHSIC Hardware Description Language (VHDL), which becomes the universal description mean of digital circuits. The hierarchical structure of VHDL is ideally suited for description of extensive electronic circuits and systems, which are needed with the requirement of high speed of communication. Without exaggeration it is characteristic, that coding is necessary to

functioning of satellite communication links, optical memories of computers, and for example mobile communication. Other aspects of applications, which are not visible: the support of testing of circuits and systems.

Courses on VHDL are lectured at the Technical University of Ostrava from 1993. The giving of lectures started from the co-operation with the Technique High-School of Gent in Belgium in the frame of TEMPUS Project in 1993. The courses are prepared for students in the 2nd period of pre-graduate studies. The fundamental lectures are divided into three specific areas: i) the state of the art in circuit and system design, ii) the VHDL like a programming language, and iii) the BSDL programming in design for test and self-test systems.

The content of this three specific areas can be illustrated in some sentences. The first explanation is devoted to the reasons which give rise of the VHDL (Very High Speed Integrated Circuits Hardware Description Language). The very complicated situation was in circuit design, implementation of VLSI (Very Large Scale Integration) and its technology innovations required radical changes in verification and testing of designed circuits and systems in the middle of 80th. The complex process of design must deal with the test designing.

DESIGN SUPPORT MEANS

The content of the three specific areas: i) Circuit design, ii) VHDL Description, and iii) Design for Test can be illustrated in some sentences. The first explanation is devoted to the reasons which give rise of the VHDL. The very complicated situation was in circuit design, implementation of VLSI (Very Large Scale Integration) and its technology innovations required radical changes in verification and testing of designed circuits and systems in the middle of 80th.

The complex process of design must deal with the test designing. The high level design methodology is applied thanks to System GALILEO, which is used in exercises in Workstation Lab. New designs can be captured quickly, and existing designs can be quickly re-targeted to a new FPGA architecture. The time explorer gives very detailed view to all time responses, and allow to analyse the quality of the design. A lot of students' designs was done in the four years of giving the lectures. More then ten of the designs was implemented in the frame of diploma projects by ANTI-FUSE FPGA of Actel with co-operation of the enterprise PHOBOS in Frenštát pod Radhoštěm.

The specific design language properties of VHDL allow the designer to use the routines results in average two times improvement in the logic capacity of the programmable devices. The CPLDs and FPGAs architectures assume the technology specific optimisation techniques, including algorithms for state machine and glue logic, and module generation for data path and arithmetic logic, to take maximum advantage of unique architectures for significant speed and area reductions. The variety statements is given in the VHDL behavioural level for optimal compilation, which is different for so called "fine grain" or "coarse grain" FPGAs. The truth table constructs, which are optimal for description of CPLDs architectures can be arbitrary combined with the behavioural description of other parts of architecture by the entity declaration. The global as well as local variables can be used for hierarchical description [2].

An arbitrary modelling level can be used interchangeably. It is possible to present a system at virtually any level of abstraction [6]. The VHDL provides a very broad of data abstraction capabilities, such as user defined types, enumerative types, and composite types. The simulation uses a behavioural model of the major functional elements of the architecture,

combining many parts of the circuit into logical elements that perform some overall function. The RTL-level modelling is one step closer to hardware implementation. The advantage of this step is the close continuity to gate array library. The disadvantage is the limitations in re-targeting of model to new FPGA types.

The design methods must be versatile and technology independent for of CPLDs (Complex Programmable Logic Devices), FPGAs (Field Programmable Gate Arrays), and CMOS ASIC design. Students as well as professional designers can quickly efficiency, and economically consolidate multiple designs into one larger design, retarget a design, and use VHDL to accomplish their designs. The programme packages can optimise the designs for area and/or speed. The VHDL accepts designs described as equations, truth table descriptions or interconnection descriptions.

THIRD COMPANIES ROLE

A lot of the third companies products can synthesise VHDL register-transfer-level (RTL) descriptions into FPGAs. New designs can be captured quickly, and existing designs can be quickly re-targeted to a new FPGA architecture. High level design allows one to use the same design methodology regardless of target technology. It generates the specific FPGA netlist. This ensures present and future compatibility with design implementation systems from FPGA suppliers. The designer can describe a top level design by top level schematic. Behavioural descriptions have two basic forms: algorithmic and data flow. The difference between these two forms can be illustrated by means of examples. The both examples have the same entity [3]:

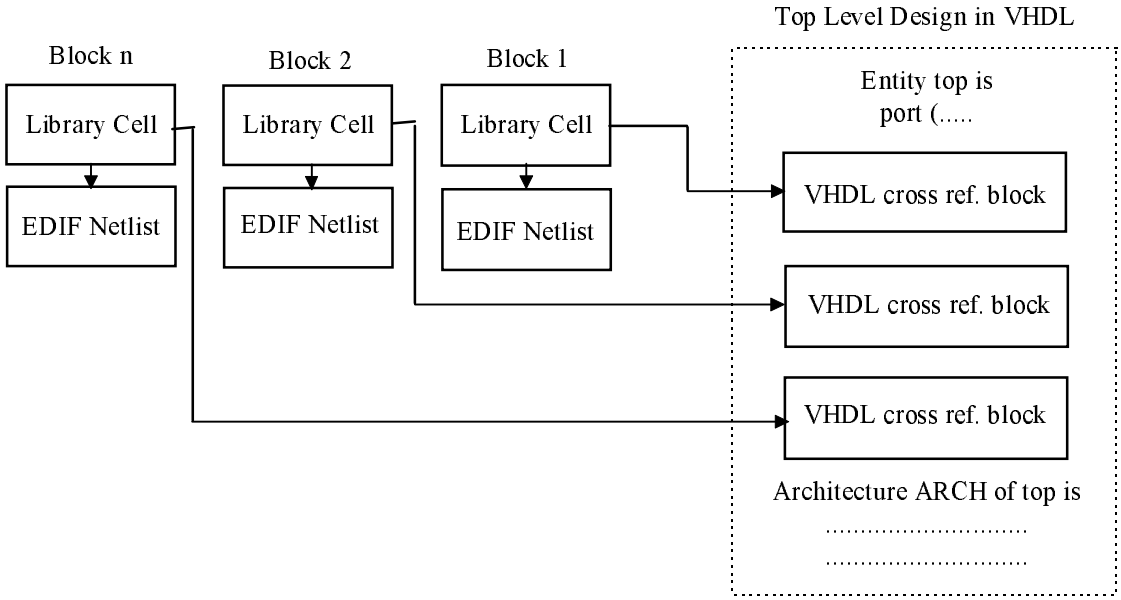

Figure 1: *The VHDL Top-Down Design Methodology*

Determining of FPGA performance requires knowledge of the functionality, branching of signal wires, and specific routing [1]. Exact timing is done by implementation of the logical function in the gate array. The top level design can be done by VHDL source file or a top level schematic. When the VHDL file is used as the top level design source, one can reference hierarchical design blocks in addition to VHDL architectural description blocks. The description blocks can be mapped incorporating the information from these external sources

into the top level design netlist [2]. The VHDL top level design with hierarchical blocks represents the design information from the "external" input sources.

IMPLEMENTATION TARGET

The design methods must be versatile and technology independent for of CPLDs (Complex Programmable Logic Devices), FPGAs (Field Programmable Gate Arrays), and CMOS ASIC design. Students and designers can quickly efficiency, and economically consolidate multiple designs into one larger design, retarget a design, and use VHDL to accomplish their designs. The programme packages can optimise the designs for area and/or speed. The VHDL accepts designs described as equations, truth table descriptions or interconnection descriptions.

The specific design language properties of VHDL allow the designer to use the routines results in average two times improvement in the logic capacity of the programmable devices. The CPLDs and FPGAs architectures assume the technology specific optimisation techniques, including algorithms for state machine and glue logic, and module generation for data path and arithmetic logic, to take maximum advantage of unique architectures for significant speed and area reductions.

The variety statements is given in the VHDL behavioural level for optimal compilation, which is different for so called "fine grain" or "coarse grain" FPGAs. The truth table constructs, which are optimal for description of CPLDs architectures can be arbitrary combined with the behavioural description of other parts of architecture by the entity declaration. The global as well as local variables can be used for hierarchical description.

ERROR-CONTROL LIBRARY

The construction of Meggit decoder is based on the property of the cyclic codes: We can concentrate on the last position of each received word w, which we correct or not, according this syndrome.

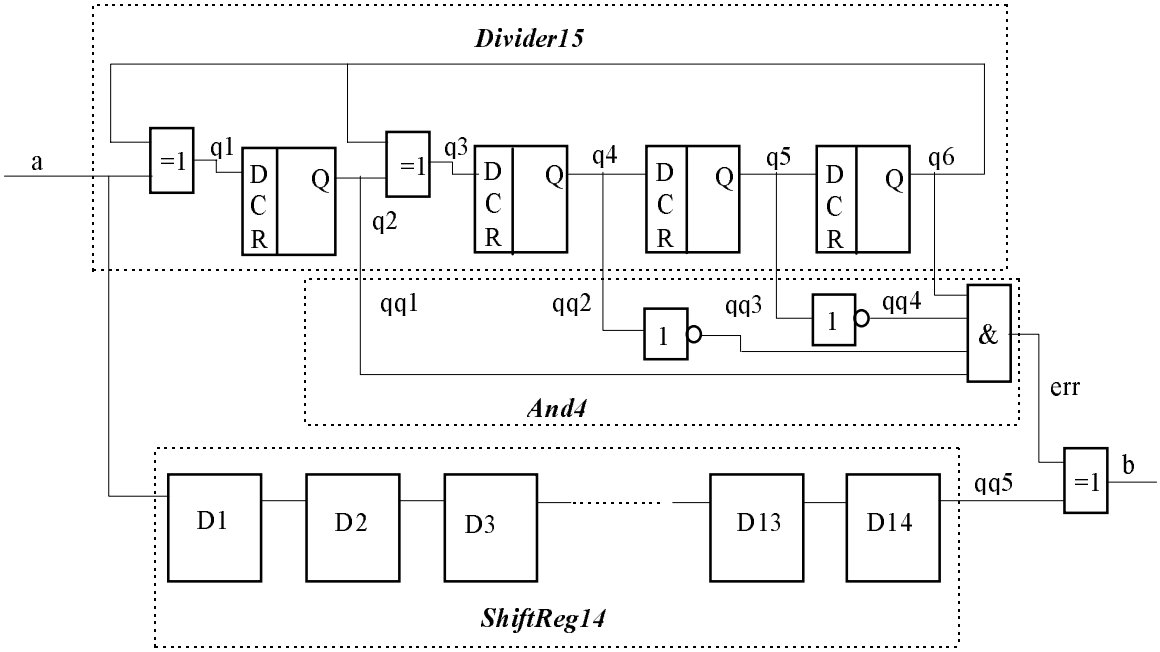

Figure 2: Block diagram of (15,11)-code decoder circuit

Then we make a cyclic shift of code word *w*, and again study the last position, etc. After *n* cyclic shifts, all positions will have been corrected. For the generating polynomial $g(x) = x^4 + x + 1$ we can compose syndrome computing circuit for the systematic cyclic Hamming (15,11)-code.

To correct an error we will use the syndrome value 0001. To be the received word corrected it must be delayed 15 steps. This delay is realised by the shift register with 15 flip-flops. For generating an correcting bit it is used the circuit completed by two inverters and one four input gate with AND function and concatenated gate with EX-OR function.

MODEL OF DECODER CIRCUIT

The modelling is defined by description of behavioural models of elementary parts of circuit. There are defined entities of flip-flop, EX-OR gate, inverter, and AND-gate:

```
entity hamdec15o1 is
   port (a, cl, rr: in bit;
              b : out bit);
end hamdec15o1;

architecture hd15a of hamdec15o1 is
   component Ex_or
    port ( In1, In2 : in bit;
              Out1 : out bit);
   end component;
   component ShiftReg14
    port (in1 : in bit;
          cl,r: in bit;
          out1: out bit);
   end component;
   component And4
    port ( in1, in2, in3, in4: in bit;
          out1 : out bit);
   end component;
   component Divider15
    port (a, cl, rr: in bit;
          m1,m2,m3,m4: out bit);
   end component;
   signal qq1,qq2,qq3,qq4,qq5 : bit;
   signal err: bit;

begin
   n2: Divider15  port map (a,cl,rr,qq1,qq2,qq3,qq4);
   n5: And4       port map (qq1,qq2,qq3,qq4,err);
   n6: ShiftReg14 port map (a,cl,rr,qq5)
   n7: Ex_or      port map (err,qq5,b);
end hd15a;
--------------------------------
```

The example of Meggit decoder is composed as the interconnection model. The partial models of interconnection are described in the library.

CONCLUSION

The Meggit decoder is realised as an structural model composed from behavioural models of components. Some components "`Divider15`", "`And4`" and "`ShiftReg14`" are modelled by structural models too. The model was verified by functional simulation using the software suite V-System. Decoder corrects one error when two errors occurs decoder detect error but it cannot be corrected.

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Virtual Learning Environment in the Age of Global Infonetworks

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Abstract

The paper is focused on educational process in the era of global infonetwork world. It addresses education as an important part of Electronic Commerce infrastructure and its content for digital media market. Changing universities' role and personalized education are examined in the context of IT multimedia tools and virtual organisation model. The second part describes some of the software applications being developed at the Institute of Informatics, Technical University of Brno, as a part of international EU projects. The concept is available on the Virtual Info Park site, http://www.park.cz, the WWW center for Internet strategies, E-commerce and virtual education.

Education in the network era

In the information, as opposed to the agriculture or industrial, economy, ... people prosper less according to what they ***have*** *in their hands or bank accounts, and more according to what they can* ***do*** *with their minds. ... Education is just about the most important job a community can do. (*Esther Dyson, Release 2.0*)*

In the last decade, the widespread introduction of personal computers led to their use in training. As computers became more powerful, sophisticated multimedia computer based training allowed learners the freedom to work on their own, much as they might with a traditional correspondence course. However, this form of training isolates students in that there are usually no support mechanisms in the form of an instructor or fellow students to turn to with questions or to discuss issues.

The training and education requirement today has changed radically from the past, in particular because of:

- Increasing training costs
- The need for continuous reskilling
- Shorter product life-cycles

Education is a broad term. We define it on the basis of three primary processes of an educational institution

1. *Teaching & Training & Coaching* - disseminating general knowledge and skills, one-way or two-ways communication with learners
2. *Consulting* - concrete problems solution, applying theoretical background into practice
3. *Publishing* - bringing new ideas, enriching the content, resp. know-how fund, communicating with other colleagues

E-education in the E-commerce context

If we think of E-commerce and network digital economy as trends that will affect almost every area of our work and life, consider education in this line too. In the world, where the king is information value, continuous learning and reskilling will be necessary. The classical way of attending classrooms will have to be replaced or combined with distance education. Let's look at several reasons why no business should forget the online form

- education is one of three basic presumption for a mass E-commerce market (with demonopolized telecom infrastructure and legal environment)
- education is also a new approach to current or potential customer support
- knowledge market will be led by those who succeed to explain the principles and benefits of their products and services and who succeed to teach their clients how to exploit their competitive advantage

Internet or generally public information network brings to the side of supply an effective tool for educating the customers and to the side of demand a chance to decide more by real information rather than by advertisment slogans. Moreover intranet or other form of corporate information system is a suitable tool for an organization to provide employees with cheap and efficient education and to maintain corporate know-how.

Changing universities' role

Schools have to prepare for a fundamental change of their society role. Regarding IT development they can not compete as encyclopedic information sources anymore. Their unsubstitutability is especially in performing as training and live communication centers, in providing space for such activities that can not be virtually. What the Czech educational system is missing on the way to information society is well described in Agenda 2000 by European Commission [3]:

- diversification of financing of higher education institutions
- diversification of higher education supply (private education, life-long learning, etc.)
- development of the non-university sector
- integration of research and education
- development of new curricula in key areas to increase awareness on EU issues (e.g. European Studies)
- accreditation and quality evaluation

What can E-education bring

- open access, improved quality and reduced costs
- shift the style from a didactic to a more project oriented work
- enabling new kinds of learning (Internet as an interactive media and as a new education tool)
- learning process individualization (approaching the ideal one-to-one teaching with individual studying plan)

Cost needed to start online courses usually include

- concept and concrete educational services forms (orgware, software, data)
- technology (hardware, software)
- content creation and maintenance (data)
- operational support - technical and communicative (people)

Next to advantages in operating online courses you need to take into account higher investment necessary for primary building a course and potential market size limited by the language barrier.

ACCEL model

The probability of effective learning outcomes can be improved by designing with the following ACCEL model that builds on learning principles and learner characteristics:

- *Active* - Learners participate in a learning program that requires thoughtful and engaged activity
- *Collaborative* - Learners engage in discussions, activities and projects with fellow students
- *Customized and accessible* - The learning program is designed to fit the needs and requirements of students in terms of time, career goals, levels of preparation, and learning styles
- *Excellent quality***.** Courses are designed with a learner focus, enabling learners to achieve desired goals and objectives. This learning generally includes communication with faculty members and other students, and it includes quick and easy access to high-quality instructional resources.
- *Lifestyle-fitted***.** Interactive distance learning accommodates the lives of students, affording cost-effective educational opportunities anywhere, anytime, and at a reasonable speed

Czech Internet Commerce market overview

The Czech Republic offers an emerging market accessible effectively also through Internet infrastructure. Although Internet penetration can be hardly compared to Scandinavian or US figures it is becoming seriously considered media reaching the attractive part of the population. The number of Internet nodes (DNS servers) in CZ domain has exceeded 80,000. The recent GfK representative survey is showing a figure of 7,3% Internet users in our population (over 700,000 people). The Net advertising market is estimated to 35M CZK (about 1M USD) annually (that is about 0.15 % of the total advertising market). In May 1998 Expandia Banka started to provide a complete Internet banking in the Czech Republic. Nowadays it is the major force to push forward E-commerce in the country - see also eCity (www.ecity.cz), the unique Internet game helping to build Net shopping attitudes (with more than 25,000 users).

Country	**IP addresses (5.1.1999)**	**IP addresses per 1000 inhabitants**	**Order in Europe**
Iceland	*24 794*	*93,2*	*1*
Finnland	*459 568*	*90,7*	*2*
Norway	*318 993*	*73,9*	*3*
Germany	1 449 915	17,9	13
Ireland	55 859	15,8	14
Czech Republic	86 482	8,3	19
Italy	386 632	6,7	22
Bulgary	10 250	1,2	30

Source: RIPE

A lack of Internet user demographics in the Central Europe is one of the major barriers slowing investment into Internet and preventing further development of on-line business and electronic commerce. In 1996 DirectNet Consulting and the Institute of Informatics, Technical University of Brno, started to conduct the Internet users survey in the Czech Republic and Slovakia. The goal was to define users of Internet services in the Czech Republic and Slovakia and their demographic profile to find out reasons, ways and preferences in Internet usage

to clarify attitudes for online marketing and business transactions on WWW. So far four survey rounds were conducted, each of them took about 5 months with the total number over 6,300 participants.

A typical Internet user can be described as a young man with strong right wing political preferences who is finishing/has just finished college/university with a technical orientation. He usually works in a large urban area and in organisations dealing with IT or general/trade services. He uses Internet 1-2 hours a day (especially WWW and E-mail) - mostly at his workplace. The major motivation is retrieving information for both personal and work needs, further education and communication. He prefers access speed and up-to-date information provided on WWW. He is interested in entertainment (including culture and sport), professional information from his field and online news. Experience with buying online is still rare (but continuing to increase), but results show a significant interest in trying it. The major barrier in buying online is often absence of payment cards and fear of transaction fraud by merchants. He is especially prepared to buy online travel/admission tickets, books, software and video/audio products.

Virtual Education Environment

A virtual course is in our concept (developed by Institute of Informatics, TU of Brno) represented by the following services:

- Hypermedia content divided into modules (consisting of WWW pages with standardised navigation scheme) based on an incremental opening access to them
- *Online tests* (questionnaire based)
- Mailing list or Newsgroup serving as a forum (a commercial product can be used)
- *Personalised E-newsletter*
- Educational event calendar (could be also a part of Brokering service with the only type "Supply" and with the only class "Educational event", see http://vip.fce.vutbr.cz/kalendar)
- Virtual Consulting Center (expert system basis)

In general, the content may be served using combination of different media types: text, images, sound, video. Three kinds of interaction may occur: user-to-content, user-to-user and user-to-teacher in two communication modes: asynchronous and synchronous. The simplest form that a course may take, is a series of statically web pages, organized in a common navigational structure. The course content is mostly delivered as a combination of text and images. Basic asynchronous communication tool like web-board may be supplied.

The more sophisticated course may include one or more online sessions, in which the teacher synchronously presents lecture materials using some form of whiteboard, coupled with audio and/or video streams. In addition the process of the course delivery involves other issues including user and group management, performing and evaluating tests, etc. In the both cases, the capabilities of the web browser can satisfy the user interface requirements. In the more complicated situations, browser functionality should be extended in a standard way using plug-ins, external helper applications or Java applets.

Online tests

An application serving databases of questions and possible choices generates a form where subscribers fill (usually tag) their answers. The total result is shown and stored in the database. Questions can be selected randomly by given topic and difficulty in the way they are different for each of students.

This kind of test is not supposed to be used for examination purposes. The test provides a user with feedback about his/her knowledge level (if he/she is ready to do another task). Moreover the course leaders receive information on which questions are more difficult than others (that affects the Web course material).

This application could be used also for the help navigation facilities. Clients feedback enables us to redesign the system. A high potential can be also seen in developing an analytical tool providing data mining and knowledge management in the future as more research oriented work.

E-newsletter publishing

Another service is a personalised E-newsleter accompanying Web publishing and using data from other virtual education services. E-newsletter communicating specific market and providing a platform to develop a community represents always an effective way to deliver a value on the Net.

The solution is based on the database of E-mail addresses and a mailing list like application. In the personalised version it is necessary to respect preferences in terms of the content and the character set. The application should also handle unsuccessful attempts to deliver messages in order to reduce the number of addresses not valid anymore. The application can also support building teachers's own E-newsletter with their own content defined in advance.

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Internet as the Effective tool for Managers Education

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Abstract

The aim of this paper is to present a new approach in the managers education - the use of the Internet. The Virtual Learning Environment (further VLE) could be created under the umbrella of the Internet services . This VLE is going to be used as an support tool for the managers education within MBA study at the Brno Business School. The paper shows the current stage of the VLE development, namely the Internet based marketing strategy game The Global Marketplace and The Virtual Tutorial service. The paper also summarises other IT services supporting the MBA study.

Introduction

Internet has lately become a widely used tool. Undoubtedly can this tool be used very effectively for education purposes. Compared to the traditional models of education which have their limitations (see Fig.1) it is interactive, it supports virtual and team co-operation and last but not least offers the possibility of sharing data.

In the last three years we worked hard on preparing a special module within the MBA studies which would be using these trends.

The Global Marketplace as an new SW tool

Many people are fond of receiving new information but only a few of them are willing to get the information from books, learning them by heart. It is more pleasant and efficient to learn in real situations or in the form of a game. For this reason the strategic marketing simulation ”The Global Marketplace” was created by the team of specialists under the leadership of Prof. Ernest R. Cadott from The University of Tennessee, Knoxville USA. This game is designed for people who want to study in a new way.

The Global Marketplace is a comprehensive business simulation which illustrates and integrates all functional areas of business. In the Global Marketplace, students start up and run their own company, struggle with business fundamentals and interplay between marketing, manufacturing, finance, accounting and management. The consequences of the decisions which students make are quickly reflected in the simulated marketplace. By studying end user opinions, smart competitive moves, and their own financial performance, the students learn to adjust their strategy to become a stronger competitor. Over the course of the entire exercise, the students understanding of the linkages among the functional areas of business grows at an exponential rate.

The Global Marketplace provides hands-on learning. As such, it is a confidence builder. Students have more ideas and concepts to consider and they understand more of what is said in the primary text and by the instructor. It also prepares them for more advanced courses because it enables them to understand how the pieces fit together as a coherent whole. And, it may reinforce the students’ decision to pursue business as a career because they understand better what a business does and what their role in it might be.

The GMP as a tool for Changing Corporate Culture

- Learn how to be business competitive.
- Develop a bottom-line, customer driven mind-set.
- Create new ways of working together across function and location.

Key Benefits

- Develops strategic planning and execution skills within a rapidly changing environment.
- Instils a bottom line focus and the simultaneous need to deliver customer value.
- Develops financial management skills.
- Develops teamwork across functions and locations, opens up new communication links.
- Promotes better decision making by helping individuals see how their decisions can affect the performance of others and also the organisation as a whole.
- Facilitates learning of basic business concepts, principles and ways of thinking.
- Builds confidence through knowledge and experience.

The game description

During The Global Marketplace simulations the participants are trained in creation, realisation and monitoring of the business strategy. This simulation is practically oriented. The application of business concepts, principles and methods is far more important then any definitions and theory.

Within the game 4-6 firms are created which produce, distribute and sell computers. They start on the market at the beginning of PC production in the USA. The individual firms are competitors.

In The Global Marketplace the participants can work as businessmen. Their task is to investigate the market, identify and evaluate the market opportunity, suggest and realise the production programme, initiate the production operations, monitor both their own performance and those of their competitors and also adjust the strategy and policy to market development. All the decisions are made in relation with limited financial resources. The cash flow management is the crucial condition of the success.

This simulation is so complex that it requires team work to reach the success. The basic tasks of the individual teams are to get and to maintain a certain market share within the given market segment (according to the structure of customers and the location). The next task is to influence the quarterly demand for products.

Game process

At the beginning the players are entrusted with the power and responsibility and they choose the name of their company. The firms have disposal of their own funds to start with. These serve for the company establishment and for the basic steps. The team builds a factory, locates it within the USA, decides about the fixed and operational capacity and then places an order for a market research to an external company (game administrator). Then it is necessary to suggest the strategy of the company according to the market research and to apply it in other tactic and operating suggestions.

What does that mean? The team has to design a product which would meet the customers' needs, open certain number of shops, determine the price policy, focus on the optimal markets and suggest promotion.

In the next stage the firm needs more financial funds for the further development of business activities. The team of managers must therefore make a business plan which is then used for negotiating with investment companies. These companies invest money into the business according to the business plan and the results of negotiation.
After that the team of managers can invest these funds to further company development. For their company it means especially an increase in industrial capacity, possibility to open new shops, promotion investment, further rise in productivity of labour, development of new technologies and of course investment to the quality of products.

Game administration

The data exchange within the simulation is also very interesting. In practise there are three ways of data exchange between the teams and the evaluating centre. The easiest way is to swop diskettes. Another possibility is to use a local net. The last and at the same time the new way is to exchange data by Internet. Using Internet within the simulation brings new features which result in real internationalisation of the game. In this case, the teams are not just from different countries but even from different continents.

Thanks to current possibilities of Internet (and in the future especially its most progressive service World Wide Web) there appears the possibility to continue the development and to run the simulations in networks.
The Global Marketplace game is a very complex simulation which produces quite a large amount of data. A model in SW Executive Information Systems (EIS) is prepared for the analyses support. In this case two types of SW "Forest & Trees" and "Media" are tested. The usage of specialised SW for the evaluation data support seems to be an effective direction of simulation development. According to the experience teams can save some time while doing analyses with the support of this tool. This form of EIS usage also helps the managers to understand the importance of SW support.

We have been using this game for the past three years within our MBA programme. It is notable that according to our student survey this particular module is one of the those with very high scores

The Virtual Tutorial as the first part of the VLE

During the last year we also started to implement the first part of the future Virtual Learning Environment.
This decision was also based on our own survey among the MBA students at the Brno Business School.
There is an interesting change between last two years surveys.
Only 10 per cent of the students from the two groups in which we carried out the research does not have any access to the Internet. However, 92 per cent of our informants are familiar with the services of e-mail. It is also interesting to look at the comparative diagram below (see Fig. 1) in which the present students strongly indicated their interest concerning information about individual modules as well as tools and articles.

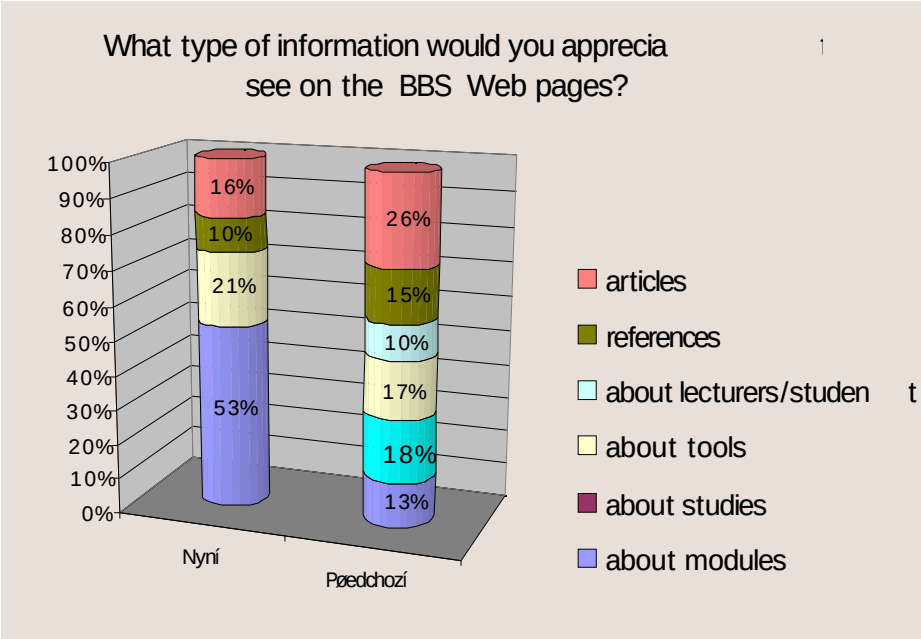

Figure 1

According to the next diagram it is clear that the students have deeper understanding for this kind of information and for this kind of WWW support (see Fig.2). At the same time they are not more conservative about the communication with the help of the WWW pages and/or e-mail. 82 per cent of them gave an positive answer on the question whether or not they combine both services.

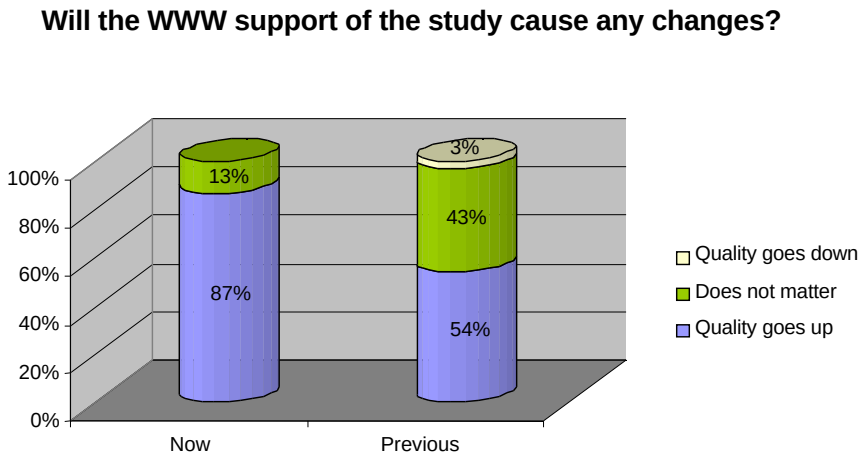

Figure 2

The following figure shows clearly what potential needs students have when communicating virtually (see Fif.3). They have shown most interest in the FAQ and also the abstracts of the individual modules which supports my argument about meaningfulness of the whole WWW support of the MBA study.

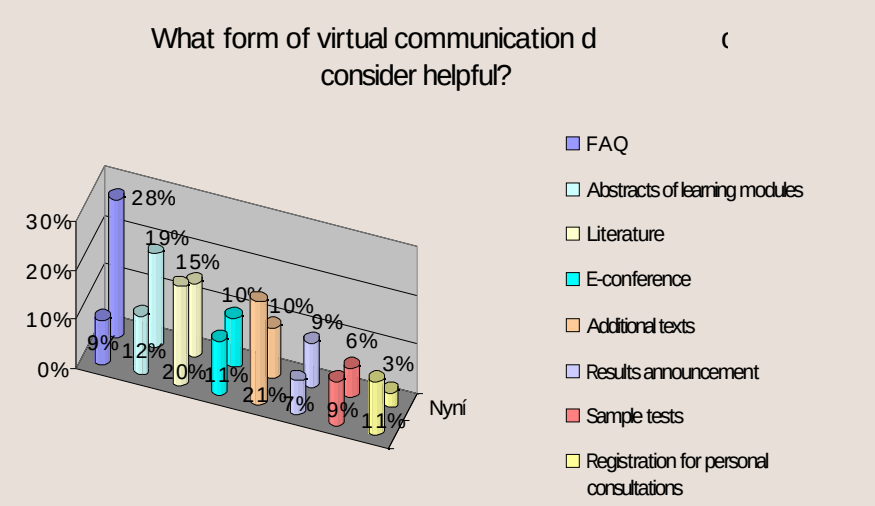

Figure 3

The Virtual Tutorial - interactive service

We decided to create a new service named the Virtual Tutorial. The service supports communication between the lecturers (administrators) of MBA studies and the students. This service integrates two of the Internet services: WWW and e-mail. Its fundamental feature is the database application in MS SQL. On this basis the database of questions and answers will be generated which provides the user with a number of possibilities. Using the service will save time (both of the students and the lecturers), will reduce the administrative costs, and will also increase the goodwill.

Virtual Tutorial - the principle of the service

Each MBA student and each lecturer have their name and password in the system. The student will log in the system through the WWW service. There they can look for answers to their questions (answers sorted by the year of studies and modules or with the help of browsing). If they do not find an answer they can send the question to the lecturer/administrator right from the system). The question is then included in the database of questions and the lecturer is informed about the question through e-mail.

The lecturer will start the application in an easy way. They will log in the system and can answer the question. The answer is then also included in the database and sent to the student through e-mail. The lecturer can choose whether the answer is to be included in the database or not. Once the answer is in the database the lecturer can alter it or even erase it.

Summary of other IT services

- The methodology of making multimedia case studies has been further improved and the first case study ”Jerez” – implemented in the studies
- The WWW presentation on http://bbs.fbm.vutbr.cz has been improved – it supports marketing

- The support of orgware has been formed (MS Outlook, MS Project standards- it is used by the whole Faculty
- The methodology supporting production of CD ROM has been made (the first CD ROM was made on the occasion of the Faculty Conference) – it is being distributed
- The new software for the MBA studies administration ”MBA Student” was made – and is in a daily use now

Documentation of outcomes

The development of the strategic simulation The Global Marketplace is successfully going on along with the project. The project has been in use in the DMS module BPSM for the third year now and it is also a pilot project testing an intensive support of the studies with the help of IS/IT. The outcomes are properly documented, several articles were published in expert magazines, presented at international conferences as well as in final reports of some projects . Five diploma papers were devoted to the project solution.

Possible way of implementation

- Training of lecturers (on their computers when necessary)
- Presenting the service to the students during modules in February 99
- Distributing handbooks and providing a permanent support

Conclusion

It is obvious that VLE could be used as very interesting educational tool. Also the excellent experience with usage of the simulation within MBA at Brno Business School and the international experience with simulations supported by Internet qualifies us to say that this form of education is very suitable for managers. The simulation of virtual enterprises also enables - similarly to flight simulators - to train behaviour in critical situations while working in teams. This experience can prove to be very useful in problematic situations. The simulation itself can become an important part of a complex educational system.

The simulation can be realised in a form of an intensive weekend lecture but also in a form of a long-term project. Within this project other specialised courses are also included such as team formation, information management, marketing, quality control, control of production, usage of internet, formation of business plans and strategies.

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Interactive Learning with a Web-based Digital Library System

by John A. N. Lee[1]

Abstract

With support from the National Science Foundation, the Faculty of the Department of Computer Science at Virginia Tech has constructed a number of on-line courses in support of the undergraduate program. Almost 75% of all courses in the department have a Web presence, and a growing number regard the Web as their primary resource. Starting from the concept of a passive Digital Library, the course offerings are now moving towards a much more interactive mode of learning, utilizing on-line testing systems and collaborative learning, and incorporating elements of active learning. Starting from "local" Web-Based learning, the site is preparing for the advent of "distance education". The presentation will be a progress report on one aspect of this project and the plans for future development and dissemination.

Introduction

Key concepts of the 1994-1997 NSF-funded Education Infrastructure (EI) project[2] were to improve CS education by increasing interactivity and use of a digital library. The main objectives/accomplishments were to:

1. Expand the content and software (especially interfaces initially developed with NSF support of our »Envision" digital library project, »A User-Centered Database from the Computer Science Literature"
2. Develop/apply algorithm visualization tools
3. Incorporate use of specialized digital library systems into related courses,
4. Add new courses related to human-computer interaction, multimedia, and a freshman level introduction to Networked Information,
5. Significantly change courses like »Computer Professionalism", to make use of interactivity (e.g., asynchronous on-line debates) and digital library support (e.g., adding to a large History collection), and
6. Apply the key concepts to improve other courses.

The resulting changes have far exceeded our expectations, as exemplified in the »Professionalism in Computing" course described here.

The Opportunity

Teacher preparedness to manage a learning experience in almost any subject is a function of the readily availability of support materials and their abilities to make the best use of those resources. At the same time there is a need to extend the curriculum of all computer-related learning experiences to include a study of computer ethics and social impact, while educational technologies are changing and the teaching/learning environments are reforming rapidly. The most successful teacher is frequently the one that has the best access to background resources and, in the case of ethics and social impact, keeps up-to-date on contemporary issues. Textbooks can provide the core resource for a course, but current topics require an on-line reporter, analyst, and librarian to add new materials as they become available. As new topics arise (such as the repeated US Congressional attempts to develop a Computer Decency Act and the challenges to freedom of expression) they initially receive a great deal of attention in the press and frequently corresponding commentary in newsgroups, but there is rarely a responsible observer who will maintain a on-going summary of the status of the incident and ultimately to produce a closure statement. Even in cases where there is a definitive end to the event, such as the resolution of a dispute through the US Supreme Court, the story of the development of the outcome is an important part of the understanding needed in the study of ethics and social impact. While threads in newsgroups collect the commentaries into a single line, the analysis and evaluation of arguments and situations is necessary to create a learning environment regarding the subject. The fluidity of the topics in ethical standards and social impact in computing creates an opportunity where students can use non-terminated collections of reports to develop their own analytical, evaluative, and presentation skills.

Incorporating resources into meaningful learning experiences and developing active learning scenarios by which students can be involved in their learning opportunities is a process that has not been a part of the training of most computer science professors. The newcomer's major expectation is that given knowledge of the topic, their transformation to teacher from learner is straightforward. Consequently in

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providing a topical resource today there is a distinct need to go beyond the provision of a knowledge base for information identification and coalescence, so as to provide an appropriate means for the disseminating that information. The system must be able to support the »traditional" lecture class, though distance learning presentations, to self-learning situations.

The Initial Work

Starting in 1994 the EI project commenced its work contemporaneously with the "opening" of the World Wide Web and quickly turned its attention to the use of the Web as the delivery mechanism for digital libraries. Since that time the principal investigators and associated research assistants have applied digital library and Web technology to the presentation of course materials for 75% of the courses in the curriculum of computer science majors at Virginia Tech. The work moved from the use of a passive system to provide an alternative means to paper hand-outs and references to professional publications, to a system with much greater interactivity. Initially this involved the integration of World Wide Web presentations with Internet tools, and expanded to take advantage of the CGI and form capabilities of second generation Web browsers (using PERL and C++), and later to Web Applets implemented in Javascript and Java. Among the tools developed and given limited application were an on-line testing mechanism and an on-line debate system.

Starting in Fall 1994, a digital library in support of a junior-level major's course entitled "Professionalism in Computing" was developed and used as the vehicle for a number of experiments in the use of the Web for course support.[3] This development continued throughout the term of the NSF project, eventually resulting in a collection of over 3000 Web pages. The collection is organized into a number of directories and into two major sections corresponding to topics of general interest and those specific to Virginia Tech. From the beginning, the applicability of the resource to a variety of environments was of paramount importance. The NSF project involved three institutions who expected to benefit from the results, and it was realized that it would not always be the same faculty member at each institution who would have the responsibility of managing the course. Moreover it was recognized that the number of topics to be covered in class could only be a subset of the topics available. A more complete coverage of the topic then required that not only could the course manager select those subjects that are to be used in face-to-face encounters, but those same resources could be used as the crux of (say) take-home assignments or on-line discussions.

From the beginning it was expected that these materials would be used by different faculty at Virginia Tech who would put their own »twist" on the course. No matter how good the textbook, how extensive the resources, how detailed the notes, every faculty member has their own way of presenting materials, adding their own imprimatur and incorporating their own experiences. It was important therefore to modularize the digital library so as to allow each teacher to organize the materials according to their own desires. However, it was realized as the library developed that in moving from a lecture presentation mode of learning to a self-paced, Web-based learning environment, the peculiar influence of the librarian/Webmaster diminishes and the needs of the learner could be fulfilled better with a less structured strategy. This approach also has the advantage that, by eliminating a fixed structure, the contents can be readily updated as new problems arise, new laws are promulgated, precedents are established in court cases, or international diversity is recognized. On the other hand within each module there is structure in the form of a sample class outline, a set of class notes, a bibliography, and a collection of in-class projects.

Each module is currently organized to include seven major files composing the nub of a learning experience:

- *class.html*: the introduction, giving the goals and objectives of the class, links and references to basic readings, and a link to a set of class notes
- *notes.html*: the class notes in a form that can be used for overheads for a lecture[4] or as a set of notes for student self-paced learning.
- *bibliography.html*: a bibliography relevant to the topic especially emphasizing links to on-line resources so as to provide additional reading materials in support of the class. As far as possible, the majority of the on-line references in this file are contained in the same directory as the bibliography, though copyright restrictions have limited the accessibility of some material.

[3] At http://ei.cs.vt.edu/~cs3604

[4] The notes exist in several different formats; some are in the form of HTML pages requiring no further application than the standard browser, others are in PDF and thus requiring the auxiliary use of an Acrobat reader. This was used in the prior project to evaluate the efficacy of each methodology. The former has the advantage of not requiring the second application, but is limited in formatting (pretty-printing) by HTML capabilities. However it is easy to modify the notes and is amenable to on-line editing through special agents. The PDF style allows the conversion of materials gathered from other sources to be presented is a very attractive format. However the ability to modify the materials is much more complicated.

- *projects.html*: a collection of class projects. Some require groups of participants to review the pertinent materials and then prepare a class presentation on some particular aspect of the topic, while others are active learning projects, including those from the USF workshop (see below).
- *scenarios.html*: a collection of synthetic and real-life scenarios for use in in-class discussions or for use in the debate system.
- *examinations.html*: examination questions. This section is being modified into an on-line self-testing area, with a view of using it as a means of providing self-testing for learners, and eventually as a means of managing learning progression through modular testing.
- *current.html*: the current topics area is maintained as an attempt to keep up-to-date in the area of concern. This area provides an opportunity for students to be involved in the maintenance of the site by providing links and reports. In fact, our management of the course provides opportunities in each assignment for the expansion of the site through student contributions.

Active Learning

Typically active-learning approaches involve mutual learning projects. Karl A. Smith said of the more traditional style of teaching: "When students attend a college class, they typically expect to sit passively and listen to a professor 'profess'; they expect to be evaluated based on their individual course work—exams, papers, and quizzes—and they bring with them a set of norms for interacting with their classmates. Based on their past experiences with school, many students believe that they are in competition with their classmates for scarce resources—good grades"[5] Active learning reverses these roles and attitudes. The responsibility for learning is shared by both the learner and the learning manager.

In support of this distribution, the University of New Hampshire Center for Academic Resources advises students: "Active learning means taking responsibility for your learning and developing habits of mind and study strategies that will be
the means for accomplishing your academic goals. Responsibility is the toughest part: know that college expects that you will take charge of your learning -- that you will go to class, do assignments, and embrace confusion and "wrong answers" as opportunities to try again...If it hasn't occurred to you yet, know that from here on in you are THE responsible agent for your learning and life."[6]

To the faculty member the High/Scope Educational Research Foundation suggests that active learning is a methodology that:

"1. Exercises and challenges the capacities of the learner that are emerging at a given developmental level.
2. Encourages and helps the learner to develop a unique pattern of interests, talents, and goals.
3. Presents learning experiences when learners are best able to master, generalize, and retain what they learn and can relate it to previous experiences and future expectations."[7]

The challenge then is to overcome the propensity to easily adapt the web to be a simpler purveyor of reading materials and to develop an interactive learning environment.

Steps toward Discovery

Each active-learning project is intended to focus on five steps:

1. The discovery and realization of the problem;
2. The identification of the tools and resources to solve the problem;
3. The examination of alternative strategies for solution;
4. The implementation of a chosen solution; and
5. Reflection on the solution, assessment of the outcome, and reworking of the process of solution identification.

These steps can readily be divided into pre-, in-, and post-class activities, or assigned to individual explorations, group collaborative efforts, or whole-class undertakings. There is no restriction on whether the work is done synchronously (in-class for example) or asynchronously (pre- and post-class, or as a take-home assignment). It has been our common approach to assign steps 1 and 2 (discovery and identification) as a pre-class, individual activity. The identification of tools and resources is perhaps best done outside the classroom, though in a laboratory setting it is possible to undertake »scavenger-hunts" on the Web to locate resources and solutions. Step 3, looking at the alternatives, lends itself easily to a (possibly in-class or pre-class) group activity. Implementation and reflection are excellent topics for an in-class discussion, though the reflection element can be extended into a post-class assignment for individual thought and cogitation.

One of the simplest tools that we have found to be extremely useful is a on-line count-down clock! Within a class when students are working on individual or group projects it is essential that they have some guide to the time that is left for their work. To manage the in-class activities to conform to the

[5] Karl A. Smith, quoted at http://www.unca.edu/et/br120996.htm
[6] http://www.cfar.unh.edu/activelearning.html
[7] http://www.ecdgroup.com/guestdoc/hspc.html

allotted requires careful timing and adherence to a schedule. Keeping activities on time and restricting activities to a set time span can be used as a management tool to get to the point and to ensure that decisions are made. Later reflection will confirm (in our experience) that given the resources available an appropriate decision was made even under time pressures. Obviously it is the responsibility of the manager to ensure that there is sufficient time. The movement of portions of a project to pre- and post-class activities effectively extends the in-class project time allowance. Written in Javascript it can be easily ported to any course Web-site[8]:

There are two major elements of the course where it is essential that participants develop »community standards". The first of these is associated with peer-evaluations that take place as part of the oral-communications segment of the course. Through a time-restricted decision-making exercise, the class decides on the criteria for evaluation of their fellow students in individual presentations. Breaking down the categories for evaluation into content, oral-presentation, and supporting-graphics, the class (often in excess of 60) creates a set of mutually agreed metrics for evaluation.[9] The technique of decision-making[10] is simply that used in many large group decision-making projects, starting with having individuals choose three criteria for each category, then working in groups to choose four, through sub-committees of group leaders who select five, and finally representatives of the subcommittees who select the final six criteria. For most students this is the first time that they have ever been placed in the position of having to make large group decisions and are surprised that it can be accomplished in a short time. The same technique is used a second time in the development of community standards for the conduct of the on-line debates. As a part of the class period on Netiquette (with a pre-class activity planned to recognize the problem and the resources for solution) the class decides on the rules of conduct in the forthcoming on-line debates. A similar preparatory exercise is the Behavioral Analysis activity that is used to organize students into groups. In this case students have a pre-class activity to determine their behavioral characteristics through the use of a forty element questionnaire. Classified into one of four categories (controller, analyzer, promoter, or supporter), clusters of like temperament explore their likes and dislikes in preparation for a presentation that will eventually lead into a broader discussion of interpersonal relationships in group settings.[11] From the results of the pre-class analysis the instructor attempts to establish groups that will work together effectively for the remainder of the course.

The pre-class discovery is also a lead-in to the class on »Rules We Live By" [12] where students explore the driving forces in their life and ballot on the »values" that influence their decision making.[13] The top five choices for the past several semesters are shown in table 1.

Once developed prior to class, this survey makes an excellent tool for an in-class discussion of the differences between laws and ethics, and between codes of conduct and community values. This mechanism can also be used as a course or module pre-test for assessment purposes in other topics.

Ask almost any student on the first day of a term what he/she considers to be the primary concern of a course in computer ethics and the most likely response will be »hacking". This topic is a prime candidate for an active-learning exercise. Using two readily accessible articles on hacking to be read in advance of

[8] http://ei.cs.vt.edu/Clock/Countdown.html

[9] Generally students are peer-evaluated for performance in their first presentation but the results do not affect their grade, it is simply for direction. Thereafter, the group evaluation determines their score. Other faculty have graded all oral presentations.

[10] http://ei.cs.vt.edu/cgi-bin/cs3604/debate.decision.pl

[11] http://ei.cs.vt.edu/~~cs3604/support/Groups/class.html

[12] http://ei.cs.vt.edu/~cs3604/support/IntroClass/class.html

[13] http://ei.cs.vt.edu/cgi-bin/cs3604/Survey.Values.pl

the class, the class activity centers around exploring the answers to twelve questions that the students have explored by their groups for ten minutes:[14] See Table 2.

A succeeding class can then concentrate on security as a tool for systems administrators and complete the strategies, implementation, and reflection elements of the activity.

Spring 1997	Fall 1997	Fall 1998	Spring 1999
Family	Family	Honesty	Integrity
Honesty	Happiness	Family	Family
Religion	Religion	Religion	Responsibiliti
Education	Friendship	Trust	es
Friendship	Compassion	Friendship	Friendship
			Honesty

Table 1: Driving Values

Read the articles entitled "Reformed Crackers Reveal Their Secrets To Paying Audiences of Former Victims", *New Dimensions International*, 1997 and NOW HIRING: HACKERS (TATTOOS WELCOME), Special to the *Chicago Tribune*, April 12, 1998. Then answer the following questions:

1. What is the difference between a hacker and a cracker?
2. What is a sniffer?
3. Can a consultant who has not been a "true hacker" actually provide any advice to potential targets for hackers?
4. Is there a difference between benign and malicious hackers?
5. In Virginia Law, is there a difference between benign and malicious hackers?
6. Is it appropriate for "criminals" to benefit from their previous misdeeds?
7. Is hacking becoming an industry?
8. Should hacking tools, such as password crackers, be controlled by the government? If not, why not?
9. Should a university computer science such as ours have a course on hacking?
10. Is it not better to have enough knowledge about hacking to protect your company against it? How much knowledge is sufficient?

Table 2.

Ask the participants in the class to spend a minute defining ATTITUDE and ACTION in the context of LOVE and HATE. Then review their answers looking for key words such as thoughts, feelings, behavior, disposition, manner, feeling, temperament, spirit, sensibility, perspective, viewpoint, point of view, response, deed, act, conflict , encounter, etc. Create a listing of keywords for each on the board.

Table 3.

1. Is love an attitude or an action?
2. Is hate an attitude or an action?
3. When does feeling of love lead to action? What causes this change?
4. When does feeling of hate lead to action? What causes this change?
5. Does attitude eventually develop into action?
6. Can attitude be acceptable and action not?
7. Is there a boundary between acceptable attitude and unacceptable action?
8. Is the statement of hate without action acceptable?
9. What is the difference between toleration and acceptance?
10. Is the statement of hate an action?
11. How do "community standards" control hate?
12. Should "community standards" control hate?
13. How does this apply to Freedom of Speech?
14. How does this apply to the Internet?
15. Is posting hate material on the WWW an expression of attitude or an action?

Table 4.

Freedom of Speech is a topic that has many scenarios that can lead to active-learning projects. The sample project is based on the George Orwell book »1984" and the US Constitution, supplemented by

[14] http://ei.cs.vt.edu/~cs3604/lib/Hacking/projects.html

visits by the participants to »cyberhate" sites intending to explore the gray area between offensive and tolerated speech.[15] Using pairs of key words groups are led through comparisons between narrowing extremes of concepts - love and hate, attitude versus action, and finally the differences between acceptance and tolerance. Typical of the activities is the suggestions in Table 3, followed by the following questions that will provoke further discussion shown in Table 4.

Using examples from the Hate Directory [16] it is possible to study the differences between these terms and how they are applicable to the question of freedom of speech on the Web. Discussion can evolve around the statement:

ideas have consequences

and the question »at what point is it necessary or appropriate in a democratic society (the antithesis of Oceana in '1984') to take action to limit free speech?" The recent Oregon court case that awarded damages to a group of abortion doctors against a Web-site that named them and appeared to promote hostile actions against them is a noteworthy case for discussion in this context.[17]

As noted above, the primary impetus for the inclusion of active learning activities within the site came from the NSF sponsored workshop at the University of South Florida.[18] A major portion of that workshop was spent in the development of projects that could be used in Computer Science courses. The work on developing activities has continued and in particular has been incorporated into the lesson plans for most topics. The *projects.html* page of most directories now contains back links to the USF compendium as well as additional local developments.

In general, experience shows that it is essential that students have a pre-class activity prior to a class that will involve active learning so that they are prepared to participate. The task of attempting to not only provide the fundamentals of the subject and motivate participants to be involved in an active-learning experience, followed by a summary and assessment, simply does not fit into a single class period. On the other hand, the pre-class activity imbues a commitment on the part of the students to learn more about the topic and to be more involved in the activity.

Collaborative Development

The digital library has been expanded by collaboration with faculty at several other institutions. From Spring 1995 a collaborative arrangement with MIT Computer Science Laboratory has allowed the two institutions to share resources, some of it in the form of links from the general interest section to pages stored at MIT and the mirroring of some pages so as to ensure the preservation of the materials in one place. An agreement with Florida Atlantic University provides a directory on "Netiquette" to both institutions. The class notes on the Y2K problem were provided by the Naval Postgraduate School in Monterey, California. As part of the 1998 NSF-funded summer workshop at the University of South Florida under the direction of Kevin Bowyer, twenty colleagues were recruited as collaborators in the development of active learning scenarios in support of the individual topics. The primary repository of this collection is located at USF[19]; the individual scenarios are linked from the projects.html pages in the Virginia Tech library, augmented by bibliographies of readings and current events.

Among the goals for the inclusion of two other institutions in the use of the materials was twofold: (1) to evaluate the ability of other faculty and students to assimilate the course library, and (2) to expand the discussion population. On the latter point, it was recognized that the student population at Virginia Tech is primarily white and conservative; Norfolk State University is a traditional black institution in Tidewater Virginia serving an urban community of students with a very different social background from those at Virginia Tech; Heritage College is a unique liberal arts college located where no other four-year college exists. Fifty percent of the college's undergraduate students are either Native American or Hispanic Americans. Eighty-five percent are the first persons in their families to attend college and sixty percent live below the poverty level. Many Heritage students are farm workers and/or single mothers; women make up 70 percent of the undergraduate student body.

Each institution used the course library in a different manner. While Virginia Tech had moved to a Web-based course style using classrooms with Computer Assisted Teaching Systems (CATs), Norfolk State and Heritage used a seminar format in which students studied topics using the Web-based materials (in an order of their own choosing) and then met once a week with a faculty member[20] to discuss their findings. An attempt was made to involve the three groups of (roughly 100) students in joint debates, with the hope that these three disparate populations would come down on different sides of certain issues. Three debate topics were chosen for these joint debates dealing with current issues in computing — a case of the appropriateness of minority representation on the Board of Directors of a major computer

[15] http://ei.cs.vt.edu/~cs3604/lib/Freedom.of.Speech/projects.html
[16] http://www.bcpl.net/~rfrankli/hatedir.htm
[17] http://www.lawnewsnetwork.com/stories/feb/e020899h.html
[18] http://marathon.csee.usf.edu/~kwb/nsf-ufe/index.html
[19] http://marathon.csee.usf.edu/~kwb/nsf-ufe/exercises.overview.html
[20] It should be noted that at both institutions other faculty participated occasionally for the pleasure of it!

corporation (based on actual correspondence between the company's President and a stockholder, with permission of both parties), cryptography and the clipper chip, and a charge of plagiarism against an unnamed student who copied the format and background of another student in preparing a home page. While the debates were well subscribed, the differences in student backgrounds did not emerge as vividly as expected. This may be partially the result of a more restricted access to terminals at Norfolk State and Heritage than is common at Virginia Tech. It is hoped that through this project, this experiment can be repeated with improved access facilities.

In evaluating their involvement Richard Barnhart of Heritage College reported:

> »It was interesting over the course of a couple of weeks to see the class's attitudes changing over the plagiarism/copyright/'look and feel' question. Their initial reaction was 'get a life'. They came to understand that there are many such issues that they will face, especially since most of them will be 'the' computer person for some company or department, and that people will have questions and issues come up constantly. These students very frequently will have network privileges into all parts of the corporation; many of them had never thought of this in the context of ethics."

Unsolicited responses were received from other institutions who had used the materials but had not »registered" with us as participants in the experiment. Typical of these (and most interesting) is the comment from the United Arab Emirates:

> »Just a quick note to say that I really have enjoyed visiting your site, and in particular reading the student responses to your ethical dilemmas.
>
> I am trying to build a similar (if lower level) course on computer ethics for some Higher Diploma Information Administration students in Abu Dhabi, United Arab Emirates and think that your idea of creating an on-line discussion group is an excellent way of making the students come to grips with ethical dilemmas in a way which extends far beyond a listing of the 10 commandments...
>
> This should be interesting as my students are all women, have very strict Muslim social codes and have in many cases have led very sheltered lives."

Collaborative Learning and Managed Discussion

The development of a digital library to support teaching and learning in computer ethics and the social impact of a computer through the earlier NSF grant has now reached the point where it is moving from an primarily passive system to a much more interactive arrangement. Initially interaction was provided through the development of an on-line debate system[21] modeled after the CERN product WIT.[22] Prior to the development of Web-based resources, this course had used an »Oxford Union" style debating system to discuss ethical scenarios and current issues. With restricted class time, this provided the opportunity for only a limited number of students to participate, and much of the discussion relied on spur of the moment reactions in order to contribute to the argument. A survey of student participation revealed that the debates were dominated by extroverted white males, while more thoughtful women and students whose first language was not English were at a considerable disadvantage. By putting the debate on-line and allowing several days for asynchronous participation, it was immediately apparent that there was a wider diversity of opinion and more reasoned contributions. The latter benefit was partially instigated by the requirement that the price of participation was the inclusion in each contribution of either a (preferably Web-based) reference or a conjunction of the argument with an ethical principle. Moreover »me-too" statements were outlawed and negative contentions were required to be accompanied by a rationale. Initially the debate system was organized as four tree structured threads, the initial node of each branch being one of four primary position statements developed by the student-led debate management team, followed by the point and counterpoint statements from the class participants. As other courses began to use the system as a collaborative development methodology, it was modified to permit a number of different arrangements basically varying from the strict discipline of the debates to the »free-for-all" of a chat room. The system has also been used by other courses as a collaborative development tool, and in other situations as a decision-making vehicle.

Changing Pedagogy

With our new infrastructure becoming available, use has been made of laboratories and networking to better accommodate student preferences and to add interactivity to the learning experience. Certain courses shifted from lecture-only, to having occasional sessions in a laboratory, or half of the classes in a lab, or (in select cases) all sessions in a lab. Even though Virginia Tech Computer Science majors have bought workstations as entering freshmen since 1985 and use them extensively in both standalone and networked modes, students find the laboratories to be of great value, and benefit from the interactive learning that takes place in both »open" and »closed" laboratories. Results from a survey of students in the spring 1996 course on multimedia indicate a strong consensus that more time in laboratory is preferable, and less time is desired for lectures. Similar comments came from many students in the

[21] At http://ei.cs.vt.edu:8000/

[22] Laughton, 1996, and Luotonen, 1994.

freshman Operating System Tools. A survey administered to both the classes, as well as focus groups conducted for those courses, confirmed the earlier informal observation that students vary widely in their beliefs regarding where they learn best (e.g., in lecture, laboratory, or at home). It was also found that though students differ in their rankings of the value of online resources and services (e.g., old quizes, email, LISTSERV®, newsgroups), most wanted information with clear practical use (e.g., lecture notes, assignments) plus some combination of passive and active communication mechanisms (e.g., WWW pages, email).[23]

The retention of student contributions in the library is an integral part of this project. This will help in not only expanding the content but also creates a model for others to emulate in their own research, study and writing.[24]

Conclusions

Web-based learning is a growing phenomenon that has yet to reach its full capability. Much has been made of the Web simply as a passive searchable resource, and our experience already records that many learning opportunities have been satisfied through this mechanism, but data »mining" is truly only a precursor of data analysis and refinement. Substantive learning can only be achieved through the management of data acquisition, and the collaborative development and reinforcement of concepts. The general tenets of Computer Aided Instruction (CAI) can now be implemented in a Web-based learning environment built and maintained on the basis of a digital library.This paper is a progress report on the road from an almost obsolete technology of 1993 to the learning environment of the 21st century. What we accomplish here will be a model for other university courses, and eventually for classes at other levels. The study of the social impact of the computer and computer ethics should not be limited to post-secondary computer education, but should be available to all users of computers. Through this system perhaps we can find ways to incorporate elements of computer ethics into many courses.

In conclusion, besides the course discussed herein, we have worked on a wide range of objectives around the theme of improving learning by increasing interactivity and by applying digital library concepts, content and systems. As a result, a new infrastructure has emerged, our pedagogy has been transformed, utilization of the courseware we developed has grown rapidly both locally and remotely, and many tools have been constructed. Students learn new topics, often in new ways, and we have continued to progress in developing digital library content, systems, and interfaces.

Related papers can be found at:

http://fox.cs.vt.edu/FIE96.pdf (Project Overview, 1996 Frontiers in Education Conference)

http://ei.cs.vt.edu/~cs3604/CWRU.html (Professionalism in Computing: A Web-based Learning System, prepared for the *International Conference on Ethics in Engineering and Computer Science*, Ethics Center for Engineering and Science, March 1999.)

http://ei.cs.vt.edu/~cs3604/FIE99.html (Incorporating Active Learning into a Web-based Ethics Course, prepared for the *1999 Frontiers in Education Conference*, San Juan, Puerto Rico, 10-13 November 1999.)

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[23] http://fox.cs.vt.edu/FIE96.pdf

[24] As an ongoing project, student essays and reports on aspects of computer history have been added to the supporting notes of the PBS video series »The Machine That Changed The World" to provide background information for »further reading" by the viewers.

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An International Digital Library for Distance Learning

Research issues for the UK Open University's International Centre for Distance Learning (ICDL)

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Abstract

The paper describes the International Centre for Distance Learning which is located in the Open University's Institute of Educational Technology. An essential resource of the Centre built up over 15 years is its digital library which includes information on 1,200 distance education institutions, 31,000 courses and 10,000 abstracts from the literature of distance learning. It is available on the WorldWideWeb and receives over 10,000 hits a day from 25,000 users in over 130 countries. Services promote research collaboration, the exchange of experience, course development and learning opportunities. This paper outlines the research issues for ICDL, set in the context of the Open University and current developments in its teaching system, which is undergoing fundamental change. It is hoped that ICDL's digital library and its research programme, will assist in developing new paradigms for distance learning and through its contribution to the OU's MA in Open and Distance Education provide a test-bed with implications for other discipline areas.

What is ICDL

ICDL promotes international research and collaboration by providing information based on its library and databases; it reaches other audiences through publications, including ICDL Update, compilations and reviews; teaches both face-to-face and online in the UK and abroad, undertakes international consultancy; and conducts its own research. An essential knowledge resource of the Centre built up over 15 years is its distance education library and databases:

Library - literature

The mainly paper based library is the largest collection of literature on distance learning in the world. There are over 15,000 items - books, journals, journal offprints, conference proceedings and papers, research reports, surveys, dissertations, and newsletters - so-called grey literature. ICDL aims to obtain copies of all new books and monographs published in English on distance education, open learning and related fields. It subscribes to all the specialist distance learning journals and receives newsletters published by institutions and organisations involved in open and distance learning. Most of the collection is in English, but there are significant numbers of documents in French, German, Spanish and Chinese.

Library - institutions

It also has the largest repository of information about institutions across the world including prospectuses, calendars and course handbooks. Included are institutions dedicated to distance teaching, open universities, institutions which have distance teaching departments and conventional, eg. dual mode; or have programmes or courses taught at a distance. Coverage includes all education and training levels.

Databases

Information is provided online through the WorldWideWeb (http://www-icdl.open.ac.uk/)

- literature on distance learning - 10,00 entries
- distance teaching institutions - 1,200 entries
- distance taught courses and programmes - 31,000 entries

The databases are searchable by subject, author, country, region, date of publication, subject, educational level, institution and in a variety of other ways. Every item listed (and abstracted) in the database is also held in the library collection.

To support the teaching on OU online courses and the MA in Open and Distance Education restricted access sites providing a database of selected distance learning literature with links to full text versions of papers. Currently these resources are classified under 60 main headings with up to 10 items under each. ICDL also contributed to a database and is a partner in the World Bank Global Distance Education network, which has been established to provide core and regional information online for development policy makers and project managers (http://wbweb4.worldbank.org/disted/).

In order to extend the knowledge base ICDL coordinated the ManageLearn SOCRATES project with partners from institutions in Spain, Portugal, Germany and France. The project established a database of literature on open and distance learning for higher education in Europe (Harry, 1997a). Also a prototype multi-lingual thesaurus of key words was developed which provides a multi-lingual search facility (http://www4.open.ac.uk/Managelearn/). Links to the distance education databases of other partners have been set up.

Who uses ICDL

The largest group of users are those online. Currently ICDL receives up to 10,000 hits a day from 25,000 users in over 130 countries which adds up to 300,000 hits per month. Approximately 90% of requests are for institution and course information, with 10% using the literature database. The build up since the databases went onto the WorldWideWeb has been extraordinary. Prior to November 1966 the databases were accessible on the Internet but through an interface involving passwords and had an average daily use of around 300 from 150 registered users.

Where do users come from? - The main countries from which users log on from are shown in the table below:

Table 1 Top 20 countries where log-ons originated (figures for one month)

Country	Total hits	% of total
US	85591	27.56
UK	33414	10.76
Canada	16506	5.31
Australia	6246	2.01
Singapore	4995	1.61
Malaysia	4958	1.60
Japan	3573	1.15
Germany	3405	1.10
Netherlands	2927	0.94
Greece	2758	0.89
New Zealand	2504	0.81
Brazil	2204	0.71
India	2144	0.69
South Africa	2056	0.66
Hong Kong	1922	0.62
Italy	1825	0.59
Sweden	1776	0.57
Belgium	1669	0.54
Spain	1629	0.52
Ireland	1406	0.45
		(59.08%)

Regarding the European use of the databases, the hits by each country, grouped by east and west are given below.

Table 2 Number of hits per month from East and West European countries

E Europe	Hits	W Europe	Hits
Czech Rep	686	UK	33414
Russia	556	Germany	3405
Croatia	372	Netherlands	2927
Poland	361	Greece	2758
Hungary	317	Italy	1825
Latvia	190	Sweden	1776
Romania	181	Belgium	1669
Yugoslavia	154	Spain	1629
Bulgaria	114	Ireland	1406
Slovakia	108	France	1345
Estonia	84	Norway	1272
Bosnia	83	Switzerland	1261
Slovenia	58	Denmark	830
Lithuania	41	Austria	690
Ukraine	22	Finland	666
Albania	6	Portugal	559
		Cyprus	362
		Malta	311
		Luxembourg	137

Summary figures for western Europe excluding the UK, eastern Europe and the UK are given in the table below as well as the US figures for comparison.

Table 3 Summary of hits for East and West Europe, the UK and US

	Hits	% of total
W Eur (ex UK)	24828	7.99
E Europe	3333	1.07
UK	33414	10.76
Total Europe	61575	19.83
Total US	85591	27.56

While the content of ICDL's digital libraries are distance learning and its methods involve collaboration and networks, it is not a distance learning system in the same sense as an open university or other programmes of distance education. This is mainly because it does not provide teachers or a tutorial system, nor does it accredit the learning it promotes. However, it does operate key functions which promote and support distance learning. It collects and creates knowledge resources, which are organised in a structured and systematic form; makes these resources accessible at a distance and delivers to individuals wherever they are; provides tools to assist users in identifying their needs and engaging with the resources; furthermore it is open to all and not restricted to fixed times or dates.

ICDL is used mainly by:
1) distance learning researchers, scholars and students engaged in the field
2) distance learning specialists who are developing opportunities for others to learn
3) potential students or their advisors seeking appropriate distance learning opportunities.
It promotes collaboration between creators and users of knowledge and is part of a global knowledge network.

Research

ICDL not only supports and disseminates the work of thousands of researchers worldwide and promotes their learning, it also conducts it own research on comparative distance learning, knowledge networks and pedagogy. The research issues focus on:

· Knowledge base
  - *the field of distance learning*, its key words and concepts, structure, boundaries, research agendas, authors, and changes; on the institutions and courses, their nature and subjects, comparative research, trends, reviews.

· Users and uses
  - *ICDL users*, who they are, where from, what they want information for, their role in the field of distance learning.
  - *how ICDL is used*, what information users access, their pattern and frequency of use, growth, social geography of distance learning, who is accessing whose information, user and producer overlaps, international cooperation, globalisation.

· Evaluation
  - *the impact of knowledge about distance learning*, how used, what effect, benefits - further research, quality of research, use to produce more information resources, use in distance learning, impact of ICDL, ICDL's role in field and as part of a global knowledge network.

Knowledge base
Attempts have been made to represent the knowledge structure underlying distance learning as a discipline and its boundaries with other related disciplines. The classification system used by ICDL is one example from a library tradition and there are other classification systems applied to the field. Changes over time to the topics of research have been documented (Harry, 1997b; Panda, 1995) and studies involving citation analysis have been carried out focussing on geography (Calvert, 1995) and over time Bunker 1998).

With digital libraries the potential for computer analysis of their contents can be exploited. There is a long tradition of research into information retrieval (see Sparck Jones and Willett, 1997) and knowledge modelling (eg. Doyle, 1962; Schvaneveldt, 1990). To address the general question about the nature of the field of distance learning various analytical tools and software can be applied, these include:

- Concept analysis: word frequencies, keywords, co-occurrences, clusters, structures
- Author analysis: number of entries, productivity, key figures, co-authors, citation analysis, active period
- Document mapping: proximity, similarity, profile matching, linkages

The procedures for analysing the word frequencies, establishing key words and concepts are well documented and software is available (CTI, 1999; Berber Sardinha, 1996). Measures of proximity or association between the main concepts include the frequency of their co-occurrence. This data can be used for creating matrices showing the strength of association between pairs of concepts and provide the input for network and modelling software (Schvaneveldt, 1990; Chen, 1998). The resulting structures can give an overview of the conceptual structure of the field.

Similar work has been carried out on citation analysis in other disciplines to show networks of referral, influence patterns and the social structure of a field of knowledge (Reid, 1997; Chen and Carr, 1998).

The extent that documents share key words and concepts can also be used as a measure of their proximity and in a similar way the strength of association between pairs of documents can be used to give an overall structure to the main writing in a field (Fowler and Dearholt, 1990).

A collaborative project is underway involving ICDL, the Open University's Knowledge Media Institute and Brunel University's Department of Information Systems and Computing. The intention is to apply knowledge modelling expertise developed by the collaborators to entries in the ICDL literature database to model the domain of distance learning and install navigation tools. The analysis will also be applied to H801 a post-graduate distance learning course - Foundations in Open and Distance Education. The research aims to assess the potential of knowledge modelling for:
1. Monitoring, reflecting on and facilitating the advancement of the subject area of distance learning
2. Curriculum and pedagogic developments for courses in this domain
3. Course development in other subject domains

The pedagogic implications of this work for distance learning are considered in the final section of this paper.

Users and uses
Analysis of user searching and browsing can be carried out from computer logs. Collection and analysis of user defined search words gives an indication of their perspectives on the field, and their searching by author

suggests the most popular authors which can be compared with the authors of frequently visited entries. Whether the most frequently visited entries are related to the most productive authors is also being investigated. A measure of the number of visits per entry shows a distribution from the most popular - visited 267 times in 1998, through to the majority of entries visited less that 10 times. Work on users interests in particular institutions and courses is also underway.

Measures of association or proximity between entries can be established by analysing the pairing or clustering of entries visited. In addition to frequently visited pages, their nearest neighbours to which users often go onto visit can be assessed. Matrices showing the frequency that pairs of entries are visited can be constructed and used as the basis for modelling the structure of the key entries, and provide an overview of users' perceptions of the core writings in the field.

As an indicator of ICDL's contribution to international collaboration, analysis of records can show the extent that users are requesting information about their own institution - as is the case in some African institutions where the database entries are the most comprehensive available - or about institutions elsewhere in the same country or from other countries. We expect the patterns to depend on the particular countries concerned and show whether ICDL is being used to access knowledge internationally or if the field is largely nationally and regionally biased as was shown by Calvert's (1995) study of journal citations where authors tended to cite others in the same country or region.

Evaluation

The main elements for the analysis of the contents and use of a digital library are represented in table 4 below. The main actors are authors and users. Authors apply the words and concepts of their discipline to construct documents which are entered into databases, the entries include author names and over time represent the productivity of each author in the field. Users access documents using search words and author names, and some documents and authors are more popular than others.

Table 4 Main elements and main actors

Element	Authors	Users
Key words/concepts	word frequencies in entries	frequently used search words
Names	productivity	popularity of authors
Documents	number per author	frequency of visits

To model the contents of a digital library it is necessary to use a measure of association between the items under each of the main elements. Generally used measures are based on either author or user behaviour (ie. what authors write and how and what users access) give values of co-occurrence and proximity between pairs of items. Table 5 shows the main elements and measures that can be used to draw up association matrices which provide the input to networking and modelling software.

Table 5 Measures of association between the main elements

Element	Authors	Users
Key words/concepts	co-occurrence, pairings, linkages, models	search word sequences and pairings, clusters
Names	citations, co-authoring, networks	authors search sequences and pairs
Documents	key word matches, proximity, clusters, mapping	next visited, pairs, clusters

These analyses can be applied to the whole database and user behaviour over a specified period. Also the database can be segmented to show the changes over time in the main concepts, authors and documents and in their relationships. In this way the development of the field can be plotted and areas of new and rapid developments identified (eg. Web-based teaching since 1994).

One way of looking at research projects and publications is to regard previous documentation as inputs to the process of knowledge creation and new documents as the outputs. Of course there are other inputs (eg. discussions with colleagues, research data, observations and experience etc) but citation analysis is one way of considering the inputs and outputs of knowledge creation. However, the role of a particular library in enabling the connections is not clear cut and authors may have found out about and obtained documents from

many sources. User surveys can gain some information regarding the contribution of a particular digital library.

Research on the utilisation of information has shown that this is a complex process. It is rarely a matter of simply finding information and applying it. A distinction has been drawn between 'instrumental' (immediate and directly observable) and 'conceptual' (delayed and diffused impact and less observable) and this might reflect the difference between 'information' and 'knowledge'. All forms of information are not the same and there is a need to specify typologies of information and uses and the conditions and circumstances under which various types of information can be employed for different types of problems (Rich, 1991). In other words to take a contextual and contingency approach in order to assess the use of information and the impact of what has been learnt (Farnes et al, 1994). Knowledge does not exist in isolation, its use depends on contextualisation both upstream (ie. where it comes from) and downstream (what it is to be applied to). Consequently research and evaluation studies on the use of ICDL's knowledge resources need to relate who users are, their circumstances, and the task - and recognise that any action taken will be subject to multiple factors and not determined simply by a single item of information.

The role of digital library support for distance learning can be assessed through content analysis of transcripts of online collaborative learning and students assignments. Also end of course feedback surveys can ask explicitly about the use and usefulness of digital library services (Farnes, 1993; Jelfs, 1998). In general the benefits of such services depend not just on the nature and scale of the online resources available, but also on the pedagogic context of students' learning. If the library is simply an 'add-on' feature rather than integral to the mode of study, then its usefulness will obviously be less. However, this simple point is often overlooked in the haste with which distance teachers introduce digital resources to courses, without establishing an adequate framework for students to engage with the resources (and each other). The pedagogic implications of digital libraries are considered in the next section of this paper.

Distance Learning

A comprehensive review of libraries for distance learning concluded that two universal themes emerged from the 518 works cited in the bibliography - 'the recognition that distance learners in every country require access to appropriate library and information resources and the genuine desire of librarians to assist distance learners in obtaining access' (Slade and Kascus, 1996). However, the review suffers from an unintended bias, in that all the documents are written by those with an interest in library services for distance learners. The strong case for providing distance learners with all the materials and support needed for successful independent study without library facilities does not come through. For example, the teaching system for the world's pre-eminent open university was originally conceived explicitly to exclude the requirement for library support of any kind.

The British Open University, established in 1969, was originally designed as a mixed media teaching system, using the mass media - broadcast TV and radio; structured print study guides; set books and a student support system of tutors, counsellors, local study centres and short residential schools. It depended on huge upfront investment of academic and professional staff, working in course teams over a period of 2-3 years. The University created, assembled and delivered all the teaching materials students needed for their studies, except for a limited number of published set books which they were expected to purchase. There was no need for students to have access to libraries. Furthermore the students were distributed throughout the UK and their access to public libraries could not be guaranteed, and only a few would have been able to reach an academic library. The OU did not follow the smaller scale Australian dual mode universities which set up their own mail order library services.

This model of distance education has been described as second generation involving the industrialisation of education with mass production, division of labour and economies of scale. Second generation represents a step change in cost, scale and complexity from first generation which tends to operate on a small scale with courses produced and taught be a single teacher, using a single medium (eg, print, and sometimes radio). We are currently witnessing the forging of a third generation of distance teaching based on electronic media and a different teaching paradigm (Bates, 1991; Nipper 1989).

OU distance learning courses can be seen as representing a knowledge domain constructed from the collaborative efforts of the course team drawing on their knowledge and other knowledge resources. Furthermore students' knowledge is the product of interaction with the course, other students and their tutors (and others) and is represented in their assignments, projects and examinations.

Increasingly the teaching model is moving towards resource based learning within a pedagogic framework and the use of online conferencing (and assignments) to enable students to engage with resources (including each other),

construct knowledge and produce assignments, with electronic submission and feedback. The knowledge embodied in second generation structured course materials is more explicit than that contained in resource material and arising from students' interactions (eg. collaborative learning). Moving towards a less firm knowledge base, makes it more difficult to assess the quality of learning and assignments. More flexible, resource based and student centred approaches also require appropriate structures. The success of the OU system would be undermined by open curricula, unstructured pedagogy, subjective assessment. Structure is necessary in the relationship between knowledge resources, acquisition, construction and production/reproduction. Knowledge modelling techniques applied to resources, students' interactions and assignments might assist in providing structure and the promotion of effective learning.

Digital libraries and new technology generally are *not* distance learning systems. They can provide a means of facilitating learning but do not provide the value added by a learning system. Value added functions include:

- Entry, admission, registration, a learning contract of some kind
- Definition of the curriculum, knowledge and skills, what is included
- Series of tasks, instructions, learning activities
- Motivation, progression and commitment
- Feedback, support and guidance
- Accreditation, certification

To organise these services a learning system with infrastructure, management, operational logistics, resources and scale is required. The idea that all that is needed for resources can be loaded onto the Web and learners can simply access this material is attractive to policy makers. However, it fails to recognise that structured learning requires more than clicking on Web pages. In particular there needs to be a human element to provide support, feedback and guidance - and most important to judge and award recognition of achievement. In essence a learning system must provide an appropriate degree of structure. With too little structure sustained progress and success are more difficult, too much and rigidities and inflexibilities create barriers for participation, increase possibilities of failing to meet deadlines and induce frustration in learners.

The work on the analysis of the content and structure of a field of knowledge is important for monitoring the development of the discipline and its coverage in a digital library. The resulting measures of association and structures can be used to help users navigate the field, either to find related documents, or to explore related concepts. Incorporated into a distance learning system a digital library can have a central or supporting role. The crucial issue is to provide appropriate structure for the curriculum and pedagogy for successful distance learning.

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Design and Implementation of a Teleteaching Environment

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Abstract

The ever increasing need for education combined with the recent advances in communication technologies, have encouraged the introduction of numerous remote learning systems and services. In this paper we describe a distance learning system we have developed at the University of Geneva. We also describe the experience we have gained by using the system for conducting telelectures during a period of three academic years.

1. Introduction

The ever increasing need for education combined with the recent advances in communication technologies, have encouraged the introduction of numerous remote learning systems and services [WCT] [LSP]. Educational institutions that once provided education via correspondence are now offering network based distribution of courses and seminars, ranging from off-line non-interactive courses to real-time interactive attendance at a class [Ara98]. At CUI (Centre Universitaire Informatique) at the University of Geneva we have started an incremental development of a telelearning environment. The environment is used for a series of real-time interactive telelectures between CUI and GMD (the National German Research Institute for Information Technology) at Bonn (750 Km away from Geneva). Telelectures started at the academic year 96/97 and continue up today on a regular weekly basis. The main difference of our system from other systems lies on two points. The first is the integration of ISDN-based services and Internet-based services in one consistent environment. The second is the "two-site educational scenario" supported by our system. These features can be found independently in different teleteaching environments [Tele] [Pus94] [Leve] but not as an integrated set.

The two-site educational scenario is the following: there are two lecturers, one located at GMD and one at CUI. The audience (the students) is located at CUI. We will designate the lecturers from the point of view of the audience at CUI, calling the lecturer at GMD "*the remote lecturer*" and the lecturer at CUI "*the local lecturer*". Telelectures are given for two university courses: "Systems Programming" and "Internet Tools". The duration of each lecture is two hours. The remote lecturer is not necessarily the same person in every session. He or she is an expert on a particular area and presents a subject in the area of his expertise by means of a presentation. He may also make comments on the local lecturer's presentation and participate in discussions with the local lecturer and the audience. The local lecturer is responsible for the course administration as a whole throughout the academic year. He or she invites an expert to be the remote lecturer depending on the subject being taught. For each lecture a script is agreed between the two lecturers in advance.

In this paper we give an overview of the developed system and describe our experience in using it. More precisely, section two describes the hardware and software components of the telelearning environment while section three describes the experience gained from using the system. In the last section we describe our conclusions.

2. The telelearning environment

CUI and GMD are currently connected with an ISDN line for transmitting the audio and video signals. We can chose the bandwidth of the ISDN line to be either 64 Kbps, 128 Kbps, 256 Kbps or 384 Kbps. The ISDN connection allows us to exchange good quality audio and video images between the two main sites involved in a telelecture. Video images can be projected on projection screens or monitors big enough for classrooms containing approximately up to 50 students. The left picture in Figure 1 shows the classroom at CUI and the right picture in Figure 1 shows the control room at CUI.

Figure 1 Classroom at CUI(left) and the control room at CUI (right)

Besides the ISDN connection we have also tested two other types of network configurations. In the first configuration we used a 25Mbps ATM line. In the second configuration we used a 250 Kbps satellite link. Among the three alternative set up that of ISDN was the most appropriate for our purposes. Even though the quality of the video images that we can transmit over ISDN is lower than that over an ATM connection, it is sufficient for our purposes. Furthermore, the hardware infrastructure and transmission costs for ISDN are much lower than for ATM and satellite. Finally, the procedure for establishing the network connection is much simpler for an ISDN connection than for the other two types of connections. That is, while for an ATM and satellite connection we need to specify 3 to 5 days in advance the exact required connection times, with ISDN we can dial up at any moment.

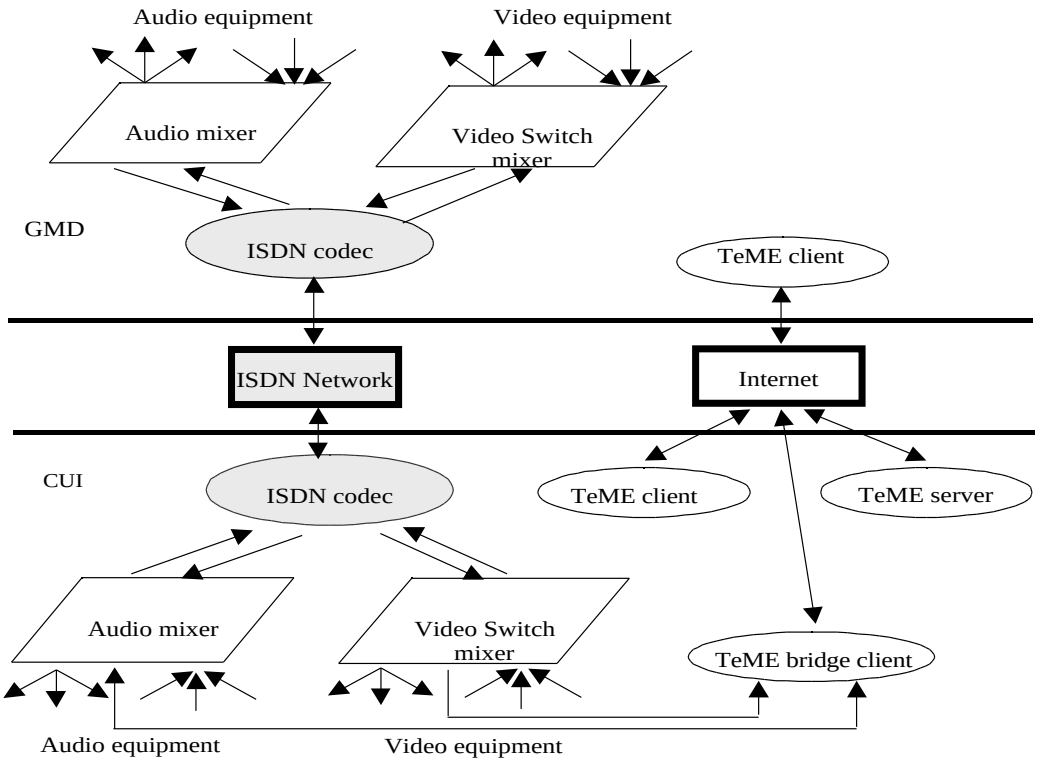

Figure 2 GMD-CUI audio video stream flow

Figure 2 shows the hardware and software configuration we have set up for running telelectures. In each site, audio devices are connected to an audio mixer and video devices are connected to a video switch. The audio mixer and the video switch are connected with an ISDN codec. The ISDN codec compresses the audio and video signals and transmits them to the other side. At the other side, the ISDN codec decompresses the data coming

from the ISDN line and feeds the audio signal to the audio mixer and the video signal to the video switch. Our set up allows us to easily switch from one network configuration to another. The parts that should be changed are drawn in gray color in Figure 2. For example, if we want to use an ATM connection, the audio mixer and video switch should be connected with ATM codecs.

The lecturers' presentations are performed using a telemeeting/teleconferencing system which part of TeME (Telemeeting/Teleconferencing Management Environment) [Ara99]. TeME's teleconferencing system is a client/server application. Client programs running on each user's PC communicate with a server. The main task of the server is to broadcast the data received from one client to all other clients, restrict access to the telelecture session to authorized users and enforce a floor policy for performing telepresentations.

TeME clients run in CUI and GMD; a TeME server runs at CUI. In fact, the purpose of using TeME is not only for assisting the lecturers' presentations: TeME provides real-time access for users willing to follow a telelecture over low bitrate lines, for example, students in their homes connected to the Internet via a home modem over an analogue telephone line. In other words, the rationale of combining ISDN and Internet is that a few "privileged" sites where several users are sharing the teleconferencing equipment are connected over ISDN while "individual" use is performed over Internet.

TeME includes six basic services: *telepresentation*, *audio connection*, *webcam broadcasting*, *electronic mail*, *text chat* and *telelecture archiving*. The telepresentation service of TeME is based on the web browsing capabilities of the SUN's HotJava component [HotJa]. One of the participants can become a *presenter*. The WEB pages that the presenter displays on her/his screen are displayed on the screens of all participants. The audio connection allows users to have full duplex audio communication with all other participants. The webcam broadcast service provides similar functionality to that of webcam client/server programs. It allows users to broadcast to all other participants images refreshed at low rates (few images per minute). Figure 3 shows the interfaces of the telepresentation service and image broadcast service. The electronic mail allows users to broadcast messages to all the participants of a session. The text chat allows users to broadcast a line of text to all the participants of a session. Finally, the "telelecture archiving" service records telelectures into files. More precisely, the data recorded are of two types: events and the mixing of all participant's audio streams. Events include URLs of WEB pages broadcast during a telelecture, the broadcast of an email, the broadcast of a chat line, the arrival or departure of users from a telelecture and the change of presenters. The recorded telelecture can be accessed at a later time through the WWW. More precisely, users can enjoy a synchronized replay of the telelecture: listen to the audio stream and at the same time view the slides they have been presented during the telelecture with the same chronological order and duration [Tedu].

The integration between the two types of networks, ISDN and Internet, is performed by executing a "TeME bridge client". The "bridge client" is a TeME client that receives a video signal coming from the video switch. The "bridge client" also receives an audio signal coming from the audio. This way we provide TeME users the audio and video signals transmitted over ISDN. Note however that the video stream transmitted over ISDN is "sampled" at a few images per minute and is made available to the telelecture participants as webcam images.

3. The user's feedback

An essential part of a real-time distance learning system is the software and hardware components establishing the audio communication. Indeed, in the absence of audio communication telelectures simply cannot be conducted. Users that attended telelectures from their home acknowledged that the audio communication is the most important service and ranked in the second place of importance the telepresentation service. The webcam image broadcast service has been judged contributive but not essential: participants acknowledged that they could follow the telelecture without the webcam service. The text chat service and the email service were rarely used.

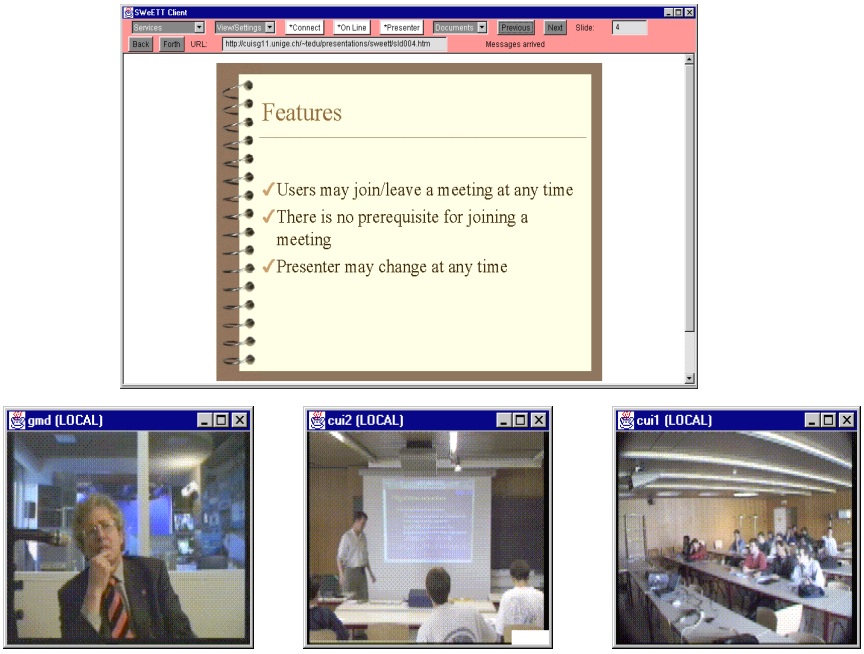

Figure 3 Telepresentation and image broadcasting facilities of SWeETT

Access to the telelecture archive was one of the most appreciated services from both lecturers and students. Lecturers accessed the telelecture archive either for ensuring themselves that a particular subject has been taught during a lecture or for recalling the level of detail in which a particular subject has been taught. Lecturers have also accessed the telelecture archive for re-listening those parts of a lecture for which the presentation were judged not satisfactory. Students have used the telelecture archive either because they have missed a course for some reason or because they may be looking for additional information/explanation on a given subject. This usually happens when students review their courses. Even though the student might have been present at the course, her/his notes might be incomplete. Re-listening to the course allows students both to clarify points that were misunderstood and review points that had not been considered worth paying attention.

Tuning the audio hardware and software components of the telelecture system was the most difficult task. A source for many of the audio problems was the bad design of TeME's audio interface: the user has to explicitly select the audio I/O ports in her/his machine for listening and speaking. Most users expect TeME to open audio default ports. Establishing the audio connection was also difficult for many users. Audio problems were difficult to solve since the majority of users are not used to the chat service to get assistance. But even when the audio connection was established, it was sometimes difficult to get the right audio record and play levels.

Following a lecture from home using a 14.4 Kbit/s modem was problematic. Since the audio connection requires 13 Kbit/s bandwidth there is a shortage of bandwidth when the telepresentation service requests a new Web page to be loaded. The consequences of this bandwidth shortage are audio cuts and slow download of web pages. When the lecturer changes pages at a fast pace, the student's TeME client may be several pages behind. To remedy this situation, we plan to replace the actual audio compression algorithm with an algorithm achieving higher compression probably at the expense of audio quality and higher processing power.

The classroom where the lectures were given was not designed for conducting teleconferences. As a result the acoustics at the room were very poor and the recording of students' questions was problematic (wide range sensitive microphones were capturing high background noise). Wireless portable microphones required the students to wait for getting the microphone which they were forgetting to do. As a consequence the remote lecturer could not hear the question and when the question was addressed to him the student had to repeat it a second time. A possible solution to this problem is to provide an audio installation with several microphones covering the whole area of the classroom.

Lecturers expressed several criticisms concerning the telepresentation service. Many of the telelecturers were using multimedia authoring software packages for producing their course material and they had to convert it to HTML format, required by the telepresentation service. Even though most authoring software packages do provide converters form their native format to HTML, the converted documents loose many presentation features. For example, fancy slide transition such us “fade”, “wipe” and “dissolve” are not reproduced in HTML. On line changes of fonts and in general scaling of web pages may not work since many converters convert a document into GIF images and then include the images inside Web pages. Lecturers also expressed the wish to be able to write/make notes on their course material during the lecture much like the way notes can be made on a transparency shown with an overhead projector.

4. Conclusion

In conclusion, our distance learning system allows a remote lecturer to give his presentation using either a high quality ISDN connection (which requires specialized material) or a normal PC with a simple camera and microphone, and Internet connection. As a result the remote lecturer can give his presentation from almost anywhere in world. One the other hand TeME allows the interactive transmission of the course and (audio, low quality video and course material) and supports interactive discussions with the remote users over the Internet with low bandwidth requirements. In this way users can follow the course from their location using standard low cost material, ask questions and in general have an active participation in the lecture. Furthermore, users can make interactive presentations from their home to the classroom using TeME and standard WWW technology.

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Distance Training in Information Literacy for Students of Telematics

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Abstract. Case study is presented on how training in information literacy is integrated in a study programme of Telematics students of Faculty of Radioengineering and Telecommunications of Riga Technical University. It is very important to educate young people in an environment that will be widely used in Information Society. Information literacy distance course has been developed in the framework of DEDICATE project.

Introduction

In Information Society significance of knowledge and education is tremendously increasing. Economic competitiveness and prosperity of the countries will depend firstly on the developments in the fields of education and training. Traditional education system will not be able to cope with the increasing demand for retraining and updating of knowledge. Distance learning as a tool of lifelong learning and new approach in education is recognised to be an efficient mean for human resource development in the European Community.

Telematics study programme

One of the definitions of telematics is convergence of telecommunication and information technologies. It is becoming more and more difficult to differentiate between these two technologies. Just few examples, personal computer can be used as TV receiver and TV set can be used as an Internet terminal, the same networks are used as telecommunication networks and as computer networks, Internet is used for audio and video broadcasting. At the same time in education there are separate study programmes in telecommunications and computer technologies. Following the practice of several universities we are introducing telematics training programme in the Faculty of Radioengineering and Telecommunications of the Riga Technical University from the next academic year. It will be an engineering two year study programme after bachelor degree. The aim of the programme is to give students basic professional knowledge and skills in the fields of electronics, telecommunications, information technology, lifelong learning and management needed for implementation of telematics application projects.

Training needs analysis was performed and demands of labour market determined. It shows that besides professional engineering skills, command of foreign languages (mainly English), project planning and management , communication, collaboration and team work skills are of high importance.

Developing this study programme we came to conclusion that the framework of traditional university education is not consistent with the aims of the programme. Therefore it was decided:

- to introduce flexible learning methodology combining traditional face-to-face lectures with open distance learning approach;
- to stress importance of information literacy enabling independent information search by telematics means.

Distance Education and Training

What is modern distance education? It is an open and flexible, learner centred approach in education. It is a new philosophy in education. It does not mean that there is no face-to-face contact. Just these contacts are not so often. Approach is based on some general principles but is very particular in every application. Distance courses could differ greatly from paper based study materials with face-to-face tutorials up to satellite TV lectures with Internet based study materials and computer-conferencing study support systems.

There are also different definitions of distance education. One of them, pointing to DE as something special, is given in /1/:

> *Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organisational and administrative arrangements.*

Two basic principles, the distance education philosophy is based on, are *openness and flexibility*. Openness means access to education for all people neglecting their age, previous formal education, social status, occupation and place of living. It is also freedom in choice of subject, place, time and pace of learning. Openness could be reached by flexibility in choosing the most appropriate learning media and education strategy to reach the goal in each particular case.

Study materials are specially prepared for independent studies to compensate missing face-to-face contact with tutor. Therefore we call it materials-based learning. Self-assessment questions and activities with comments involve student in active learning and maintain feedback. But distance learning is not a self-instruction, because it is specially organised and *study support* is available to students. Counsellors and tutors are available for face-to-face, mail, telephone, E-mail and other forms of contact.
Distance education is learner centred. It means that needs of learners are to be analysed. Objective must be set to fulfil needs of learners providing them with necessary skills and knowledge. Telling and lecturing turns out to be very inefficient strategy for transfer of skills and knowledge. Learning by doing is the best option to acquire needed skills. Teacher must only motivate and support students in their active studies.
Is it possible to train people in engineering subjects at a distance? Very common opinion is that it is impossible because student's presence is crucial in problem solving and laboratory practice. Appropriate application of distance education methodology and modern telematics technology can help us to solve this problem. In many engineering subjects computer simulation is used and it could be easily done at a distance. The same applies to laboratory practice. Measurements are performed mostly by computer controlled equipment and it makes no problem to control process at a distance. Environment for simulation and virtual experiments is already created and tested [4,5].
The rise of modern DE in Latvia started in 1993. For co-ordination of the development of DE in Latvia, the Latvian Distance Education Board at the Ministry of Education and Science (the Chairman E.Bekeris) was created in 1994. With the support of the EU Phare Programme ''Multi-Country Cooperation in Distance Education'' basic DE infrastructure has been created in Latvia, awareness raised and more than 100 people trained in the basics of DE. Project was executed by the Latvian National Contact Point created in the framework of the Phare programme and approved by the Ministry of Education and Science of Latvia.
Distance Education Study Centre at the Riga Technical University is located in the Faculty of Radioengineering and Telecommunications. It was established by decision of Senate in May 1997 with support of the Phare Multi-Country Programme in Distance Education. Phare Programme fosters also distance course development in co-operation of institutions located in three or more countries. For development of 28 projects 4 MECU are allocated and course module development is in progress. Leading in one project and being a participant in 3 other projects RTU was among the most successful universities in Europe in this tender. Most of the projects are based on application of modern telematics technology in course development and distribution. We hope that it will be good resource for new Telematics study programme.

Information Literacy

It is very important to educate young people in an environment that will be widely used in Information Society. Information literacy distance course has been developed in the framework of DEDICATE project. Students will be trained to use electronic resources available.
How to survive in the situation when funding for education is not sufficient and to improve the quality of learning process. One solution is to use more cost effective and flexible distance learning strategy to achieve Information Literacy. There are various terms used to describe this new philosophy in education. One of the terms used is resource-based learning.
According to the "Nine Information Literacy Standards for Student Learning" accepted by American Library Association and Association for Educational Communications and Technology,
the student who is information literate:

- accesses information efficiently and effectively;
- evaluates information critically and competently;
- uses information accurately and creatively.

the student who is an independent learner is information literate and:

- pursues information related to personal interests;
- appreciates literature and other creative expressions of information;
- strives for excellence in information seeking and knowledge generation.

the student who contributes positively to the learning community and to society is information literate and:

- recognises the importance of information to a democratic society;
- practices ethical behaviour in regard to information and information technology;
- participates effectively in groups to pursue and generate information.

Of course, the basic goal of information literacy is to enable students to become lifelong learners. Information literacy is a process related to different subjects and learning experiences. So we must integrate information literacy courses throughout the curriculum. Development of information literacy courses is shared responsibility of faculty, librarians, and administration. Faculty should provide a basic understanding of importance of gaining information literacy skills in our technological age.

Information literacy and resource-based learning are two processes which should be used together. Resource-based learning means that the student, not the teacher is central to the learning process. Teachers show direction, but not provide all information needed. But they guide students in finding, evaluating and using information. In such a way we are refocusing education away from lecturer centred model where the lecturer is the expert on a teaching subject and study materials are lecture contents or study guides in the case of distance education.
Now students should use:

- paper-based resources (course guides, manuals, textbooks, lecture notes);
- computer-based materials (computer-based tutorials, on-line multimedia);
- networked-learning resources (on-line tutorials, networked study programs, computer conferences and seminars);
- media-based materials (audio tapes, video tapes, transparencies, slides).

Now there is such an abundance of information available that students cannot be expected to remember everything they are taught in lectures. They must be able to find information as and when it is needed. Students must have information finding skills to enable them keep up to date. Students learn better when they are interested in a topic and when they actually need specific skills and knowledge to solve some problem. From such a point of view the best results in acquiring the Information Literacy skills could be achieved by subject based Information Literacy courses.
The first step toward Information Literacy Courses in Electronics is course developed by Riga Technical University Scientific Library team together with Radioelectronics faculties staff member participating in DEDICATE Project (Distance Education Information Courses with Access Through Networks). As the final result was Information Literacy Course in Electronics. This course is meant for the second year students of the Faculty of Radioelectronics and Telecommunications. This Information Literacy course is a part of the subject "Introduction in Electronics **".** In this transition period the course will be introduced in Telematics study programme with some modifications.
If we divide all the process of acquiring Information Literacy skills in three levels, then this course is covering the first two levels:

- Library procedures as circulation and special services;
- Introduction to classification and shelving, the catalogue, reference sources, information formats;
- Use of computerised catalogue, use of journals, techniques for searching for information.

During the next Information Literacy courses students should cover the third level:

- Advanced information searching;
- Scientific reference techniques, selection, analysis, interpretation, systematisation of information;
- Storing compiled information for reference.

So, starting with basic library skills and developing toward cognitive skills such as synthesising and evaluating information students would achieve Information literacy goals.

Goals of the Information Literacy Course

There are goals of the Information Literacy course defined in cognitive, affective and psychomotor domains.
Cognitive goals are concerned with understanding various concepts of the process of scholarly communication and information retrieval tools and types. Cognitive goals could be described through cognitive objectives. These objectives are telling what the students should obtain after the completion of that course:

- a life long need for information obtaining;
- knowledge of different types of information retrieval;
- knowledge of different tools for information retrieval;
- ability to use different information retrieval tools;
- ability to compare and evaluate the information obtained;
- ability to use obtained skills for information retrieval in another subject field.

Affective goals are concerned with the student emotional behaviour throughout the life-long learning.
These objectives are telling how the students should behave after the completion of the course:

- students should have desire to use RTU library for information searching (library resources);
- students should have desire to use RTU library for information searching using RTU Internet Classroom;
- students should have desire to use Radioelectronic's faculty Computer Centre for Internet searching;
- students should have desire for life-long learning.

Psychomotor goals are concerned with co-ordinated physical activity. Psychomotor objectives are telling what ability they should obtain after the completion of the course:
ability to locate information in RTU Library;
ability to use RTU Librarie's Internet Classroom for information retrieval;
ability to use RTU Radioelectronic's Facultie's Computer Centre for information retrieval.

Conclusions

As on the eve of Feudal Society new terminology, opportunities and attitudes emerged, the same is happening now on the eve of Industrial Society. Telematics, information literacy, resource-based learning and lifelong learning are good examples. Modern information and telecommunication technologies are opening new opportunities. Integration of lifelong learning skills with telematics will lead to the delivery of education services right to the customer's home or work-place world-wide. Remote delivery of multimedia study materials in electronic form, electronic information resources, study support via Internet are future applications of telecommunication networks.

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Technological support for continuous training

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Abstract.

The continuous evolution in all technological fields asks the personnel of enterprises to keep up to date their knowledge, that is, to carry out a continuous learning process. As it has been already noted, network based training systems can offer an efficient solution to this problem.
On this basis, the European Community launched a series of initiatives to support projects aimed to explore the possibility of helping SMEs, which constitute the core of our economy, to adopt these kinds of training models.
Our work is framed in this context. In particular, we developed Qualification 2000, a project partially funded by the European Community under the Adapt initiative, aimed to analyse, from an operative point of view, the potential of new technology for realising effective continuous training in SMEs. The target of the project are staff of SMEs, which are to be trained on the changes that new information and communication technology has brought to the office.
Within this context, we developed a net-based training model endowed with two main features: 1) the methodological guidelines of the model are based on a need analysis, to give effective response to training needs; 2) two different implementations have been realised, in order to adapt the model to different technological situations. The model will be analysed in this paper.

1. Introduction

Information and communication technologies are a driving force behind innovation, both in processes and outcomes. It is therefore important to raise people's awareness of technology and to train them not only in its use but also in the transformation of the job world brought about by technology [5,6]: this is vital to personal grow and to the development of innovation in small and medium sized enterprises.

Consequently, effective training models must be designed to help enterprises to improve technical and cultural understanding, permitting them to meet the challenges of technological development and to adapt to the changes this will bring about in the organisation of work and production [7].

Several problems underlie the design of these models. On the one hand, employees have to learn new contents, as automation and communication tools, working methods, as collaborative and team work, and to change their working habit, as to show initiative and flexibility, to be able to take responsibility. On the other, the production obligations of the enterprise greatly affect the possibility of planning traditional training activities.
In this context, multimedia and networked educational tools seem to be a valuable answer to these opposite needs [3].

According with these ideas, we developed a project, called Qualification 2000, supported by the Adapt initiative of the European Community and by the Italian Ministry of Labour and Social Security. Italian partners of Qualification 2000 are Ligurian associations and enterprises. The project, ended in February 1999, focuses on the use of advanced educational technology for continuous training on the changes in information management and communication that new technology has brought to the office [8]. The target are staff members of small and medium enterprises (SME) who face redundancy, in particular women.

Within this context, we developed a net-based training model endowed with two main features: 1) the methodological guidelines of the model are based on a need analysis, to give effective response to training needs; 2) two different implementations have been realised, in order to adapt the model to different technological situations. The model will be analysed in the following section.

2. The educational project

In the literature several experiences regarding the use of communication technology for training are described [1,2,4,10,11,13]. These experiences, which mainly concern large and technologically advanced enterprises and higher education centers, are quite promising and show the potential of new technology as a means to give impulse to continuous learning. Thus, it is of great interest, at least in the European realm, to explore the feasibility of extending these kinds of training models to small and medium enterprises (SMEs), which constitute the core of our economy. This extension is difficult to realise for several reasons, mainly variety and economic situation of SMEs. Consequently, training project based on the use of network resources and devoted to these kinds of enterprises require a careful analysis of their problems, in order to determine solutions which respond to effective needs.

With these ideas in mind, we carried out a series of interviews to both employers and employees of SMEs. We interviewed a number (20) of enterprises, representatives of the economic situation of Liguria, a region in the north-west of Italy. The interviews aimed at knowing the expectations and attitude of both employers and employees towards training on advanced technology and its applications into the office. The results of the interviews, which are analysed in detail in [9], highlighted a core of common problems, in particular: the limited resources (in time and money), that can be dedicated to training; the necessity of individualising the learning path and that of tailoring the teaching strategy to the personal attitude of the trainee, the need of training people to use technology as a means to co-operate and to develop initiative. These problems form the experimental basis of our educational project.

Accordingly, the methodological guidelines governing the proposal are as follows:

1. *To integrate different teaching/learning strategies*, in order to take into account the personal attitude of the employees towards the machine and their personal problems of relationship with colleagues, to help employees to develop autonomy and initiative, and to acquire the capability of interacting and co-operating with colleagues, to limit problems of time. Notably:

   - To guide and give motivations for self-learning, by combining self-learning activities with a distance training system.
   - To give the trainees the possibility of establishing personal relationships with the trainer (exchange of one-to one messages, possibility for the trainee to ask questions privately, etc.). To allows all participants to share the problems come out of these individual activities, the trainer has to create and manage a list of frequently asked questions; moreover, if it is the case, an electronic forum for discussion can be organised.
   - To develop a collaborative approach to learning, in order to help employees to develop autonomy and initiative, and to acquire the capability of interacting and co-operating with colleagues. Co-operative activities (problems and exercises) regarding specific contents are proposed adopting distance learning techniques (learner to learner, group to group, general discussion etc.). These activities are designed to increase flexibility in working strategies, promote innovative work methods, stimulate learning, and develop comparative skills and constructive communication with the outside world that will encourage creativity.

2. *To teach content using a design and problem-solving approach*, in order to render people aware of the potential of technological innovation in their job. Notably*:*

   - To introduce topics in the form of problem-solving tasks; these lead to the identification of practical and conceptual tools which can be used to solve the task via sequential abstraction. This helps develop thinking skills and promote active and responsible participation.
   - To present specific applications as practical examples of conceptual tools; this makes acceptance easier and facilitate the autonomous transfer of skills acquired in one application to another.
   - To encourage a strategic approach to all tasks, including routine ones, by placing stress on the decision-making process and giving practical examples of how technology can support this process. This helps to increase motivation, as well as promoting awareness of the new technology and a confident approach to it.

3. The computer based model

To realise the above ideas we designed a computer based training model organised into two parts: a set of multimedia courses and a communication environment. These parts are integrated in a distance learning environment.
The set of courses helps trainees acquire knowledge and abilities about information management in the office, while the communication environment allows them to get in contact with one another and with the (distant) trainer in synchronous or asynchronous mode.
By integrating these two parts, the distance learning environment allows trainees to develop, with respect to a given content, different learning paths in a unique context: self-learning, collaborative learning and distance learning with the guide of a trainer (see Figure 1).

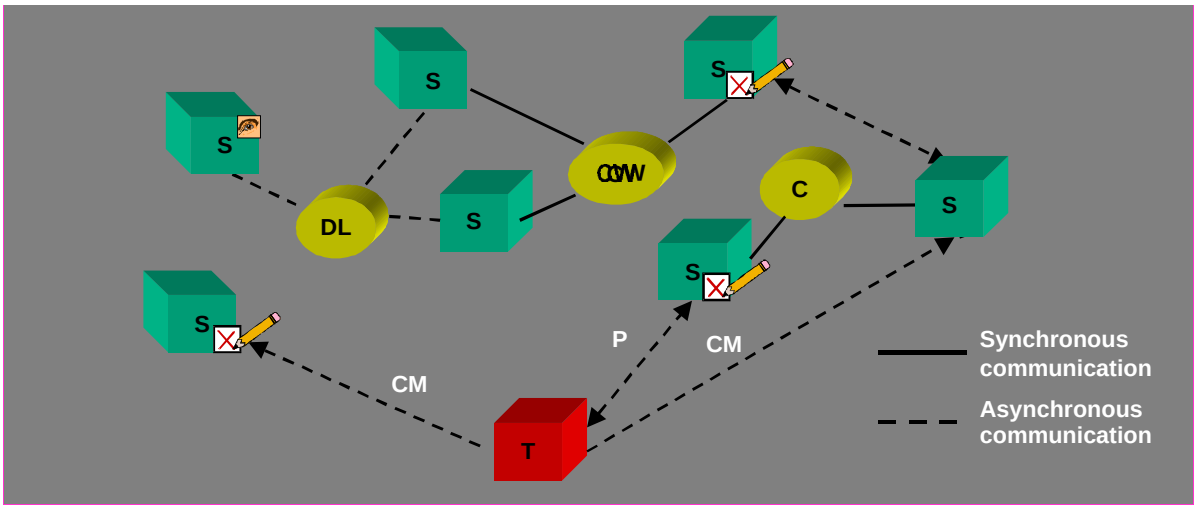

Figure 1 - The scheme represents the learning activities carried out by students (S boxes) and trainer (T box). Each student joining the course (seated at his/her PC), may read a text or solve a problem Moreover, he/she can communicate with the distant trainer T privately (double arrow labelled P) and to get new course material and assignments (arrow labelled CM). Finally, each student can carry out collaborative activities ("oval" boxes): co-operative solution of problems and exercises (CW), participation in discussion lists (DL), or on-line discussion (C).

3.1 The courses

Five multimedia courses have been developed, regarding, respectively: graphic management systems, spreadsheets and numeric data management, database, development and presentation of textual information, the network and its organisation. The topics of the courses were chosen to meet a dual need: a) giving participants the kind of general knowledge that will help them gain awareness of technological evolution and its impact on the social-economic situation; and b) providing tools and practical knowledge that allow participants to integrate new skills with those already mastered, so that they will be able to manage transformation in the workplace brought about by the introduction of advanced information technology.
The teaching/learning philosophy of the courses takes into account the results of the interviews and the observations about previous training experiences. Accordingly, in our courses:

- Concepts are introduced starting from typical problems of office world, gradually deepened during the solution of the problem itself and independently, as much as possible, of a particular application software.
- Demos are provided showing solution steps of problems.
- Activities in group and individual exercises are proposed. The exercises are mainly meant to be used for self-evaluation.

· Exercises are highly interactive. They mainly consist in problems, which must be solved manipulating objects on the screen.

3.2 The communication environment

The communication environment consists of a computer conferencing system made of two components: the learner component and the trainer component.

· *The learner component* aims at being used for distance learning with the guide and assistance of a trainer and for carrying out collaborative learning experiences. It includes a synchronous conversation module, which allows interaction among many persons online at the same time, and an asynchronous communication module, which allow to deliver private and public e-mail.
  Synchronous conversation is used to encourage learners to carry out co-operative during consultation of a course (to discuss about a specific point, to solve an exercise, to ask for an explanation, etc.). To facilitate co-operation, when the user asks for connection, the screen is horizontally divided in two parts: the first one is used to type in, while, on the other part, the user can see the contributors to the on-going conversation and their messages, sequentially.
  Asynchronous communication is mainly intended at being used for assignment feedback, to ask questions to the (distant) trainer, to take part in discussions with the colleagues, etc. Accordingly, asynchronous communication comprises the possibility of delivering private messages (via an electronic mail facility) and that of sending contributions to public discussions, moderated by the trainer (via a discussion list facility). Via public discussions the learner can ask for off-line help from the trainer and the colleagues, send (or answer to) requests of material, propose the exam of topics of particular interest, take part into the general discussion of specific points proposed by the trainer, read a brief explanation – given by the trainer or a colleague - on a topic of particular difficulty, think about and propose its solution to a problem, etc. Via e-mail the learner can establish a personal relationship with the teacher, for example he/she can ask the trainer for a particular explanation, enter in detail in specific difficulties he/she does not like to communicate to colleagues, send the trainer his/her solution to exercises; he/she can receive assignments, feedback and suggestion tailored to his/her specific needs. Via e-mail, moreover, the learner can keep in touch and work with a selected group of colleagues, for example to carry out group work, to prepare reports on a shared activity, to exchange material, etc.. Finally, e-mail allow learners to receive the classroom material, such as the text of a lecture, explanations, assignments and solutions of previously proposed exercises.

· *The trainer component* is to be used for the management of the multimedia courses: the trainer organises the trainees in virtual classrooms, independently on each other or interconnected, according to their needs. The control of the educational activity is carried out via a graphical interface which allows the trainer to monitor (in both synchronous and asynchronous mode) the consultation of the multimedia packages, to manage the discussion lists, to send and control exercises and tests.

4. The implementation

Two different implementations of the model have been realised, the first one aimed mainly to be used locally, the second one aimed at being used in a context of distributed training.
The first implementation consists of four multimedia packages, which can be used stand-alone on a PC, for self-learning, or on a PC LAN, to carry out collaborative learning and guided
The packages share the organisation of the interface and the general structure. In particular:
activities, in synchronous or asynchronous way (see Figure 1). In fact, from each package, the trainee in every moment, can display the list of all the users which are working on the same course and enter in touch with them. Moreover, he/she can exchange e-mail with the trainer or other colleagues.

· The interface is very simple. Its elements are very few, all of which are self-explanatory. Each screen is divided into two parts: the working space, and the bar of the buttons which allow navigation and communication with the outside. To proceed through the course and access the various possibilities the user only has to push buttons and «hot» words.
· The working space is divided into two parts: the *lesson space*, and the *simulation environment.* The *lesson space* always contains a brief explanation, and two buttons, named DEMO and PRACTICE, one which

displays a demonstration and the other the text of an exercise. The *simulation environment* is used to show the demonstrations and to carry out the exercises.

- Feedback is always provided.

Figure 2. An interaction during a self-learning session

The second implementation consists in a web-conference framework which supports the delivery of courses via Internet, and of a course, developed within this framework, aimed at being used on an heterogeneous network, for self-learning. The course regards the concept of network of computers and focuses on Internet/Intranet technology (see Figure 3). During consultation, the learner can access to the communication module by means of Java applets contained in the HTML pages visualised. Java applets are also employed to implement the processes simulating the activities showed in the course.

These different implementations aim to give answers to different enterprise needs. In fact, as it has been already observed by other authors [12,14], although technology plays a key role in the realisation and delivery of computer based training, educators must remain focused on learning outcomes, not on the technology. The key to effective educational technology is focusing on the needs of both enterprises and learners, on the requirements of the content, and on the constraints faced by the environment. Using this integrated approach, the educator's task is to carefully select among the technical options, meeting the needs in a manner which is instructionally effective and economically prudent.

Our technical choice was made accordingly. In particular, it allows us to employ the same model in different technological situations to solve different educational problems. On one hand, we realised a local application on a PC LAN to give an answer to the need of learning office automation concept to be applied in a PC/Windows environment, taking into account that this need was mainly expressed by enterprises with a limited level of technological resources and which cannot effectively access the web. This choice, moreover, does not limit the application field of our training product. On the other hand, we propose distributed training for a heterogeneous computer network for educational topics, such as networking, which are intrinsically general with respect to the hardware/software platform, and are supposed to be of interest for enterprises oriented towards a net reality.

Figure 3. Co-operative learning using discussion lists

5. Conclusions

Human resource development and constructive collaboration between research and production world are fundamental in order to maintain the occupation level and to increase competition of SME. Qualification 2000 constituted for us a valuable occasion to work in these directions. The topic of the project, that is the analysis of the potential of new educational technologies for continuous training in SMEs, allowed us to transfer research ideas and results on both learning problems and teaching methods to the enterprise world. The involvement of enterprises in the project was for us an operative occasion to orient research towards innovation and to build a training model which adapts research ideas to actual needs. This co-operation was fruitful also for companies: the comparison between their experience and the approach to problems typical of the researchers helped enterprises to recognise the aspects of the research proposals which help to increase productivity and improve quality of their work.

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Web learning environment evolution: integration and open problems

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Abstract

This paper focuses on the requirements in the evolution of learning environment, as driven by increasing demand of technological integration. Two main directions are identified: the integration between computer mediated communication (CMC) and multimedia technologies and the interaction between web information sources (digital libraries and multimedia information systems) and web training environments. A brief description of our experience, in the integration of web learning environments with digital library technology, introduces the discussion on open problems and new research directions.

1. INTRODUCTION

The many approaches we met in the realization of a web based training (WBT) environment enlightens the enormous shift provoked on distance learning performance by the advent of the Internet and the World Wide Web. Nevertheless, in spite of the flexibility reached to fit different user needs, pedagogical styles are still not adequate to take full advantage of the changes the technological development has produced.
Today, a new evolution of training environment performance is to be expected, due to the integration of different types of technology, and our attention is addressed to the directions that more will be able to improve learning process.
This paper, after a brief outlook of the state of the art of distance learning evolution, tackles its central issue on learning environment requirements, envisaging that their further evolution, from today situation, will consist of training environments open to further technological integration. Two directions are considered:

- the eventual integration between computer mediated communication (CMC) and multimedia technologies
- the interaction between web information sources (digital libraries and multimedia information systems) and web training environment.

A brief description of our experience, linked to the integration of web environment with digital library technology, introduces problems still open and new research directions.

2. THE STATE OF THE ART

In the last decade the widespread introduction of personal computers led to their use in training. Furthermore, the increase of their performance allowed the use of multimedia tools by which to develop interactive courseware, and enabled students to learn at their own pace and in their own time. Nevertheless, some disadvantages of the Computer Based Training (CBT) paradigm were:

- the isolation of students
- the lack of feedback with the instructor and the other students
- the difficulty to distribute up-to-date educational material.

Internet and the World Wide Web (WWW) today help to resolve many of the issue inherent to the previous training paradigm improving:

- easier delivery systems
- distribution of educational materials and on-line revision
- interaction between players.

The Internet provides, in fact, a flexible way to distribute educational material world-wide instantaneously, and the web may represent an obvious medium for delivering just in time (JIT) training to students; resources are

available by clicking on the links of the hypertextual navigational model and a web page can be realized just to represent an integrated and coherent working environment.
Independent cross-platforms allow one to use powerful tools such e-mail, newsgroup, IRC, etc. enabling, through a variety of formats, student-student and student-teacher interaction. When integrated within an appropriate management system these tools can provide collaboration between students and instructors, student progress tracking tools, and individually customized course materials.
Furthermore, the dynamic and interactive nature of WWW has reinforced the capability to interact with multimedia materials, enabling new ways of conceiving course to fit educational goals; the recent advent of second generation browsers, like Hot-Java makes WWW interactive by incorporating multi-media applications that can be programmed, run live and distributed in a portable manner [1].

Three issue have been involved in the main changes Internet and WWW have provoked on distance learning paradigm.

- The technological pull

Internet has promoting a powerful shift in many research areas including interaction. In educational communication field, Computer Mediated Communication (CMC) tools, allowing people to interact each other both synchronously and asynchronously in private, broadcast, and group discussion communication are Internet-based electronic communication technology. Browsers are typical WWW-based tools, shifting versus synchronous capabilities.

- The pedagogical issue

The pedagogical paradigm, stressed by the infusion of technology into the learning environments, requires a shift in teaching/learning styles. The problem to face now, is how to exploit the new technological potentiality for more advanced learning environments, where WBT tools are applied and combined only when they enhance the learning process [2]. This means for trainers to work in team to optimize resources for a given target and to be acquainted with new technology capabilities. In most situations WBT courses are still delivered as in traditional classroom setting, taking poor advantages of the new Internet capabilities.

- The role of players

The mission of teachers, supported by sophisticated authoring tools, do evolve from the role of lecturer to that of guide and facilitator. They remain responsible of the didactic choices, but will spend much more time in applying tool capabilities to create learning situations, to provide further communication opportunity, and to support student diversity.
Students, on the other side, free of the traditional control on their study time/place, can better organize how to spend their time choosing under their own responsibility studying and learning styles. They can share time among the study, the search of supplementary material, the collaboration with other students and the teacher, 'choosing for themselves a range of different communication and presentation paths enhancing their understanding".
The increased flexibility of studying/learning activity and the real- time feed-back are, indeed, the effective advantages the players meet approaching a web training environment

3. LEARNING ENVIRONMENT REQUIREMENTS AND THEIR EVOLUTION

In general terms, a web training environment can be conceived as a virtual space where user interactions are performed using a combination of tools offered by the environment, with the purpose of enhancing the learning process. Some conditions, indeed, must be satisfied. A pre-requisite is the availability of a suitable infrastructure enabling the use of Internet technologies, such as network connections, student access equipment, technical support personnel, and administrative capabilities. A general condition for a successful use of WBT is to endow the training development environment with publishing technologies and the essential communication and interaction systems for courseware delivering [3].
In this context, particular Computer Mediated Communication technologies, both asynchronous and synchronous, may be used by the target developers to enable specific functionality, within their economic, environmental, and pedagogical constraints. Sometimes hybrid systems are preferred combining courses delivered on CD-ROM with data streaming from the Internet. In most cases, the set of WBT functions are implemented by specific authoring tools, interaction and collaborative tools, and multimedia repositories.
Recent WBT tools, entirely web based, aim at a flexible development space, where user needs and tools are evaluated, implementing a strategy for an effective tool exploitation. Unfortunately, the range of Internet tools used in these systems is relatively small. The number and type of components and tools that can be used in a learning environment is much larger than what is available in today WBT systems, making impossible to follow a veritable strategy when designing a learning environment.

The further evolution we envisage from today situation is the realisation of open training environments able to integrate technologies coming from technological areas not directly focused on training and education. Two directions, in our opinion, will characterise this evolution and change the web training scenario: on one side,

the integration between Computer Mediated Communication technologies and multimedia technologies, and, on the other side, a stricter interaction between web information sources (digital libraries and multimedia information systems) and web training environment.

3.1 INTEGRATION BETWEEN CMC AND MULTIMEDIA TECHNOLOGIES

Computer Mediated Communication and multimedia technology integration, in fact, is far from being realised. Multimedia technologies have a growing role in the training process: multi-format data embedded into didactic material; repositories archiving multimedia educational objects; multimedia systems fostering information streams toward learning environment. CMC components, instead, (almost the synchronous ones), are not yet fully exploited in the most known WBT systems, and an effective integration process among Multimedia and CMC technologies, inside learning environments, didn't take place.
Some examples of integration like the video education on demand services and the interactive and dynamic software visualization, are the result of advanced researches, but they shouldn't hide other integration perspectives much closer to the current players expectations. We refer to the necessity to carry out the conversion of conventional courses into multimedia, to enrich existing CMC technology by means of multimedia tools, and furthermore to realize a distributed multimedia software environment supporting players in their production and use of multimedia courseware.
Such integration is also a challenge from a socio-economic point of view: predictions are of a growth of the market of multimedia in "training and education", pushing to the combination and integration of Computer Mediated Communication technology with multimedia technology. The synergy of both technologies will determine the future of the WBT industry.
This last consideration leads to point out the need of some guide to select tools and applications: at first, precise user requirements have to be stated, than, the creation of a sound and robust classification of tools features and technical requirements will help companies and developers.
The accessibility of information about new products is, indeed, a precondition for increasing competitiveness. We look, however, at the competition level where products aren't chosen for their brightening visibility on the net, but for their correspondence to the most granular user needs.

3.2 INTEGRATION BETWEEN DIGITAL LIBRARIES AND WBT ENVIRONMENTS

The requirement of a stricter interaction between learning environment and web information sources**,** relies fundamentally on two facts: first of all, on the consideration that all teaching and learning activities have always been improved by the access to a variety of information sources; and secondly on the fact that the search of appropriate sources of information throughout the net is today possible by means of gathering tools and digital libraries technology, which constitute the highest effort made to organise the information on the net for an easier search and an effective manipulation.
In fact, formal, informal, and professional learning [4] necessitates to interact with different domains of information, both general and specific; this opportunity is now being offered by the enormous quantity of information one can access browsing the web, and by the increasing availability of digital libraries, providing to satisfy many facets of the information requests "breaking down the physical barriers between resources".
The experience like that held at Virginia Tech [5], where courses have been integrated by an hypermedia digital library of Computer Science Literature, demonstrates the effectiveness of using digital libraries improving learning, and reducing the time/place distance between players and appropriate information. Furthermore, the growing range of input formats, lets digital libraries offer more granular information than users have never acquired before.
Adding digital library capability to a learning environment means for the players to be inserted in an international circuit of scientific information, with the opportunity to access material directly from their educational posts; to accelerate the dynamism of education; to allow for more integration of the different styles of learning and teaching. [6]

4. OUR EXPERIENCE

This last aspect was considered in our experience developed in the context of a project for the technology transfer towards Mediterranean Countries, funded by the Consiglio Nazionale delle Ricerche (CNR). Our work was essentially concerned with two kind of technologies: the digital library technology for the diffusion of specific scientific and technological themes of interest for the Mediterranean Countries, and the Web Based Training applications. Furthermore, we considered the case of web training environments where education and digital libraries technologies were considered together.
An implementation of a learning environment was, in fact, realized around a course using TopClass by WBT Systems, where the educational system server and a digital library server, previously installed, were integrated [7].

At first, it was considered the elementary need of students, instructors, and administrators to access reference material to deepen the understanding of questions raised during their work sessions. TopClass learning environment was then provided with a link to the digital library server previously installed, allowing teachers and students, in every instant (both at course composition phase and reading phase), to ask the local repository any kind of questions. The link provides the whole visibility of digital library functions, allowing users to formulate consistent queries.
Furthermore, since digital library logic allows for forwarding questions from local repository to the regional repositories and then at world-wide level, the chance to have a pertinent answer is expected to be reasonably high. In addition, another connection with the digital library, directed particularly to the students, was implemented enabling immediate and transparent access to the new material added to these repositories: a query relating to the topic of the course was formulated and entered by the instructor, then made persistent in the system, enabling students to get all news of interest just clicking a button. In this case, given the total transparency of searching execution, no knowledge of digital library is required.
We were interested also to extend the functionality of learning environment relating to the labs creation, by naming and annotating them for an easy retrieval and reuse, but our trial surprisingly failed because of the poor capability of the full-text search system, able to work on the lecture units only. This lack of prevision leads us to understand how search and reuse problems are not still sufficiently taken into account inside the training environment, and the need of an integration with multimedia content retrieval technology.

5. OPEN PROBLEMS AND FUTURE RESEARCH DIRECTIONS

In fact, to look at the world wide educational material, as a virtual distributed archive of courses interacting with digital libraries is today only an attractive hypothesis: the educational information domain has not yet benefited of the digital libraries research efforts and requires a qualified and adequate indexation: some researches in this sense are however in progress [8]. The problem is burdened also by the fact that even the basic terminology and concepts for representation, organization, and management of knowledge are still unsatisfactory. The reason is that a great part of the distance education information domain has been upset by the Internet advent, so the Information Representation (IREP) tools can't be repackaged but expect to be redefined starting from the current situation.
Traditional media disseminating knowledge have yet concepts and techniques to guarantee quality of information they carry, and methods for classification, retrieval and query to ensure relevance of search results. In some of these cases the problem may be how to repackage these tools on the net.
On the contrary, educational information throughout the Internet consists only on a part of traditional media such as textual information or static multimedia documents; from now on, prediction are of course material constituted "of video-clip presenting the lecturer and a sequence of slides that may involve pictures, video, animation, simulations with spoken or written explanations". This kind of dynamic TMDs (truly multimedia documents) has a 'temporal dimension', depending on the streams of information concurring to their composition. Multimedia authoring represent current dynamic TMDs area; investigations are in progress on the structure of such documents, but not adequate retrieval techniques have till now been exploited.

Reasoning on this emergence in order to focus some open problems and several aspects of research directions requires to distinguish three main questions: the access aids, the kind of repositories to collect TMDs and the reuse problems.
On a pragmatic and methodological level we envisage two types of initiatives concurring to facilitate the access to the educational hypermedia.
The first care concerns the terminological issue. Technical natural terminology represents, indeed, the first and more effective vehicle of communication inside a new information domain, when concepts aren't yet not fully operative. Today, the lack of specific classification schemes on web educational topics goes together with the inadequacy of the most known and authoritative classification schemes to incorporate systematically the most significant aspects of distance learning issue. Elsewhere, the appreciable efforts of the WBT systems evaluation centres to individuate the main topic aspects to be rated, didn't take useful results from a terminological point of view.
To proceed with terms standardization along with a categorization process, capturing the multifaceted aspects of the educational domain (covering features, course development, and course administration), means to endow users with a pragmatic IREP tool, to be used when other retrieval techniques couldn't be employed. In particular we refer to the use of index terms to select an information domain of interest (search starting query) against which to exploit other IR techniques or a combination of them. In addition, we have in mind the case of searching files containing software or labs, that necessarily relies on the use of technical terminology, whether controlled vocabularies, or taxonomies.
In our concern, all the initiatives supporting this aim, like that promoted by the Galaxy Scientific Corporation, Georgia, USA, in order to provide a classification scheme for the web training environment, must be strongly sustained. Great efforts are also expected from corporate institutions like, ACM, ASIS, INSPEC etc..

The lack of visibility of the sites where educational material are delivered is another problem to face and may be considered preliminary to that of the veritable information access. Such a question, depending upon the inadequacy of current Web structures to support easy paths to reach sites of interest, inhibits users to get the more common information they need (i.e. where, and which courseware are delivered on-line) and represents a different case from the more specific user need to access information even by content. To distinguish the specific requirements of the two situations, may lead to suggest different methodological paths to satisfy them.
In fact, the former aspect, we are now concerned with, relies on the necessity of 'grouping' information about material on the net: not single document meta description will be in question thereby, but an automatic generation of a network of meta-data expressly developed for the infrastructure they serve. This low-cost support will conduct users, interested to the on-line courseware, directly to their web page; not more it is expected to obtain. The more costly effort to create veritable educational digital libraries are not in question here.
What we need for a similar support is a set of meta information to improve visibility of collections, notifying the sites where distance learning is effective and courseware are delivered on-line, along with other information user requires to locate preferred sites. To do it, we envisage a combination of meta-information added on the top of the author-generated material to facilitate grouping (recent XML managing meta information may help to do this), linked to an ad hoc structure deserving, such as an organized index, to drive user to satisfy the meta-information they need, world-wide.
This kind of application will be fully based on the hypertextual model of web using HTML, XML, augmented by an auxiliary database structure of links enabling forwarding requests.
The logic of the hypothesis is inferred from librarian experience, where it is usual to distinguish data necessary to locate documents supporting associative search, like the set of data enabling to construct directories, from all others including auxiliary data that deserve to create true catalogues, searchable even by content. Furthermore, the utility to create structures of link separate from documents, instead of over-structuring hypermedia in order to diminish the abundance of 'go to' inherent to hypertextual model, is heavily and authoritatively sustained [9], [1].

To search for information on the net throughout well tagged collections of courseware capable of cross-search by means of suitable indexes requires, indeed, an other kind of effort. The path seems to be similar to that being performed within the Digital Library Project, sharing the paradigm of federated database architectures. Queries will be submitted against the federated schema and transformed into transparent requests interoperating among the databases involved.
Therefore, digital libraries experience deals with material such text-image and graphics; in the web educational domain, indeed, documents are composed by media (such as text, graphic, and image) and temporal media (such as audio, video, and music); thereby, the synchronization among media in the same document has to be resolved along with its operability among dynamic and/or multimedia data contained in the federated collections.
Considering the question of collection containers, in the functioning of learning environments, we note that WBT systems use rough object stores or a set of data bases with specific task; but their organization isn't oriented to further integration.
The choice of well suited containers becomes pre-eminent, instead, when we look to the perspective of interoperating TMDs collections. A number of technical problems arise when concerning the nature of multimedia document: how they be represented in their atomic components and at the whole to handle content-based multimedia data retrieval; or how to define a global access to multimedia databases geographically distributed. The area of databases results newly stressed, and hypothesis for the short-medium period concerning global schemas of distributed objects stores go together with others focusing "on the integration of multimedia databases for use in a distributed web-environment" employing metadatabase and search agent.

The reuse problem poses still an other question: to look at repositories both as containers delivering information on-line and as places supporting other user activities such as information management and sharing. Reuse, in fact is based both on the need of search and access capability and on mechanisms to manipulate different objects in order to create new TMDs. This question, apart the case where materials are reused at the whole (the need is that of an easy upload capability), involves the integration of different technologies. Video education on demand services are an example. The perspective nowaday, is that of extending the dimension of documents from pure container of information into digital information object, 'active compound documents', combining information content together with executable code to introduce active behaviour [10]. The need of integrated work support environments may extend the scope of educational digital libraries and increases the requirement of some architectural framework handling all the aspects treated and more, giving consistency to any web learning environment design.

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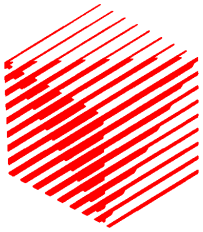

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DANIT

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FORTH

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GMD

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INRIA

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SICS

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SARIT

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http://www.ifi.unizh.ch/groups/staff.html

SINTEF

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SRCIM

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