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Collaborative Technologies for Web−Based Instruction

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Virtual course students are not constrained by time or space. They do not have to go to a classroom or attend learning sessions. The 'virtual classroom' − unlike a physical space with benches, blackboard and chalk − is an environment that can be accessed through the Internet, offering the necessary communication channels to simulate the presence and participation of a teacher, fellow students, materials, activities and even support areas, such as the library or the teacher's office.

Distance Education makes use of information and communication technologies, the majority of which are delivered through the Internet, in order to create virtual courses. Technology thus plays a vital role in this form of education. But technology on its own does not solve learning problems; the support of instructional design is essential. Indeed, the 'instructional design' defines the pedagogical structure of the course. So the two elements, instructional and technological design, must at all times maintain a healthy interdependence throughout the planning and developmental phases of the course.

This paper has two main aims: first, to describe the use of the Internet environment in teaching; second, to review the technologies used for the creation of Distance Education on−line courses. We should stress that in this second aim we do not intend to promote a specific technology or product, but to outline and compare the different technologies available on the market.

With these aims in mind, the integrated technologies we will review are: *Lotus' LearningSpace, WBT's Top Class, Simon Fraser's Virtual−U, and British Columbia's WebCT*. These technologies are among the most widely used throughout the world for the creation of on−line courses.

Virtual Educational Environments

Virtual educational environments are based on student−teacher interaction, through synchronous and asynchronous communication services.

Firstly, for this kind of environment to exist, a base structure is absolutely necessary. The infrastructure will depend on the institution's educational aims. The width of the transmission band should at least equal that of United States universities, in order to ensure that certain standard educational tools can be used.

- Standardisation of communication protocols
  Standardisation of communication protocols is of the utmost importance for the creation of the institution's internal networks, especially those involving teamwork. The proliferation of systems sometimes complicates communication between one computer and another, even when the two are close. Local Area Networks (LAN) offer the best conditions for collaborative and learning projects.
- Support structures
  Once network communication has been standardised, both academic staff and students need support and collaboration structures. The development centres of educational institutions (the faculty, the institute, the school, etc.) must promote the use of any available technical resources. The new educational environments comprise far more than just the Web. The Internet offers other tools, such as e−mail, discussion groups, MOOs, e−library search resources, chat (ICQ), and audio− and video−conferencing.

Collaborative Instruction Techniques

Collaborative instruction techniques are the latest computer tools that allow synchronous or asynchronous interaction, and, above all, a collaborative work method. These techniques aim to encourage the development of projects without the restraints of physical or temporal separation. Some time ago the company *Lotus Corporation* launched *LotusNotes*, one of the first programmes to allow a relation of this kind.

The exchange of information through these new programmes is the key to the success of collaborative technologies. We no longer use the terms 'document' or 'file'; we speak of 'collaboration'; i.e. the result of group work.

Many companies are currently battling over the recently available market space for these technologies. Among the leaders are *Lotus*, *WebCT* and *Symposium*.

Norton Connect Net is an accessible technology which caters for collaboration among all the members of the class, just by using *Microsoft Word* as communication interface. Apart from an Internet connection, very little is needed for the group to communicate, either synchronously or asynchronously.

Another technology that easily adapts to a pedagogical context is *WEBBoard*, which permits the creation of exchange groups and discussion groups through the WWW, with only a navigation programme/using only a browser.

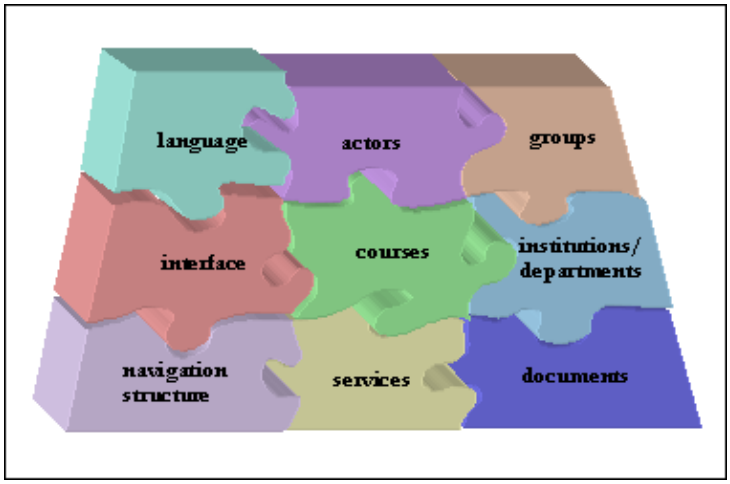
Collaborative technologies allow much more active interaction between participants. Evaluation can be carried out almost automatically, and data protection is guaranteed by personalised access codes.

A Comparison of Some Collaborative Instruction Technologies

According to the *Instructional Management System* (IMS), all technologies can be used in the development of Web courses in the following areas:

- *Courses*: Technologies allow the creation and running of courses. The contents of each course can be updated through services and documents.
- *Actors*: The subjects involved in the educational process: students, teachers, tutors, administrators, etc.
- *Services*: Different services have their own specific functions:
    - ♦ Administrative services: course diary, notice board, etc.
    - ♦ Communication services: chat, e−mail, forums.
    - ♦ Teaching services: transparencies, references to web addresses, etc
    - ♦ Evaluation services: tests, self−evaluations, etc.
- *Documents*: The materials handled by the services: for instance, in the teaching service, a document is part of the teaching material.
- *Groups*: Technologies allow collaborative work, because communication is possible either between 'one' and 'several' or between 'several' and 'several'.
- *Institutions or departments*: The educational environment can be personalised by each of the institutions or departments.
- *Language*: Technologies support the creation of courses in different languages.
- *Interface*: Technologies allow personalisation of the interface according to the educational environment.
- *Navigation structure*: Technologies allow personalisation of the navigation structure of the educational environment.

With these nine elements, the model of components for the creation of courses will be defined as shown in the picture below:



Model of components according to the IMS

The IMS model outlines the basic characteristics of the tools used in the creation of Web courses. We now describe several tools and compare their components to those proposed by the IMS.

A Description of Tools

Several tools for the creation of Web−Based instruction are currently on the market. Some have been designed by university institutions, others by companies. Only the most frequently used will be specified here; they have been selected after a search of real applications.

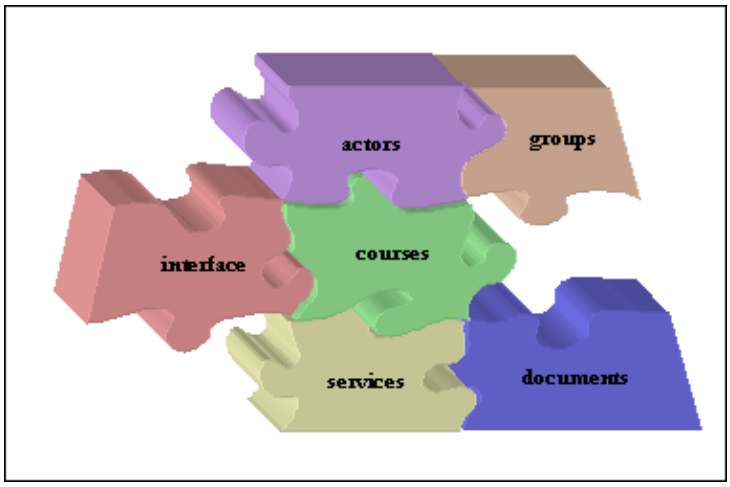
> *WebCT*

WebCT, produced by the Computer Science Department of the University of British Columbia, Canada, is a tool that facilitates the creation of Web−based educational environments. It can be used to create complete on−line courses, or merely to launch complementary material for already existing courses. This software uses standard navigation technology both for student access and for course design by the instructor. *WebCT* also uses a series of tools to add characteristics to existing courses, including e−mail, conference system, chat, course management, and evaluation / exams.
WebCT includes an interface that allows personalisation of aspects of the course (page design, colours, back, fonts, icons, etc); a number of educational tools to facilitate learning, communication and collaboration; and a number of administrative tools to help the instructor in the course configuration. *WebCT* has the following characteristics:

- Multimedia possibilities
- Self−evaluation and on−line evaluation for students
- Maintenance and grade distribution
- A system of lectures including the presence of a chairperson
- E−mail system
- Course monitoring by the instructor
- Internet links
- Possibility of real−time chat
- Image archive
- Student and teacher presentation areas; creation of presentation pages
- A series of design tools and course−management tools
- Security and access control
- Possibility of saving and executing the course

WebCT is currently being used to carry out over one hundred courses at the British Columbia University, and in other world−wide universities as well. It requires a UNIX server platform and Web navigators for PC or Mac.

By comparing the IMS model with the *WebCT*, we obtain the following model.



Model of components of *WebCT*

List of *WebCT* services

Kinds of services	Services
Communication	E−mail News Chat
Administrative	Notice board Grade posting Student progress control Course monitoring
Evaluation	Periodical evaluation
Teaching	Indexed glossary Notepad for students Course reference material Shared and interactive area
General	Student presentation area Indexed image archive Indexing and automatic search

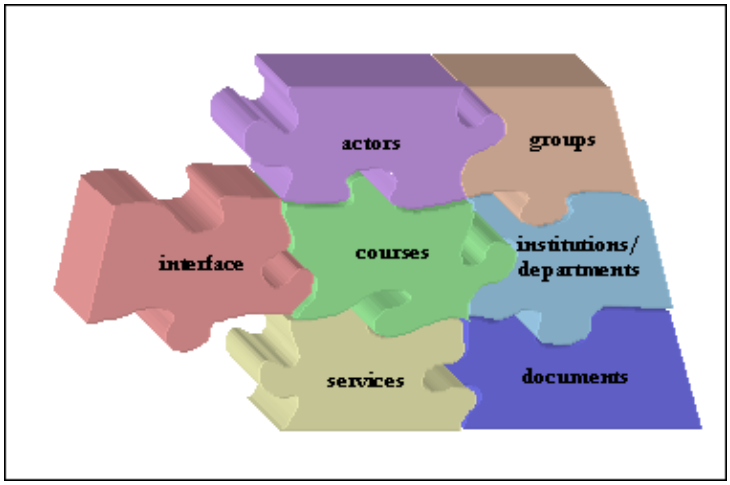
> *Virtual−U*

Virtual−U is a Web−based environment, developed by the Simon Fraser University in Canada. It allows the integration of tools and patterns for the creation, maintenance and development of on−line courses.

Virtual−U includes the following components:

- The group conference system, known as *V−Groups*, enables instructors to establish collaborative groups, and to make structures, tasks and objectives precise.
- The Course Structuring Tool allows the instructors to create complete courses even with no knowledge of computers.
- The course diary informs the instructor about weekly revisions, the list of required reading, the level of the material and compulsory essays written after collaborative conferences.
- The 'Gradebooks' organise students' qualifications for each course, saving them in a database, whilst showing graphic representation of the students' progress.
- The System Administration Tools guide the administrators in the instalment and maintenance of *Virtual−U*. Currently, there are two versions of *Virtual−U*: Lite and Gold. The programme is available in English and French.

Virtual−U requires a Sun Solaris (UNIX) server. The main users − students and teachers − can access *Virtual−U* through standard Web navigators, from any computer platform.



Model of components of *Virtual−U*

List of services offered by *Virtual−U*

Kinds of services	Services
Communication	E−mail News Debates
Administrative	Course diary
Evaluation	Exercises Tasks
Teaching	Seminars chaired by students Project time Goal establishments Real−time conference 3D−Chat in real time
General	Statistics

> *LearningSpace*

LearningSpace is an application of Lotus Notes, designed to support distributed and collaborative learning in educational environments.

It allows collaborative learning through an instructor who is available at any moment or place. *LearningSpace* rates high within software for *Lotus Notes* and *Domino* servers, taking advantage of the unique database structure of Lotus and of the possibilities of Internet distribution. Lotus' *LearningSpace* offers a series approach to multiple database application.

The five databases included in the application of *LearningSpace* comprise:

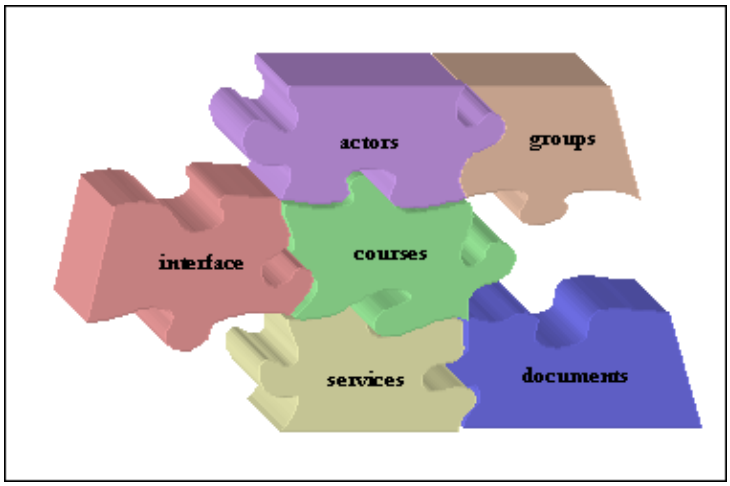
- The *Schedule* database, created by the teacher so that the student has a point of reference − a guide − for all the activities assigned to him/her throughout the course.
- The *MediaCenter* database contains a large number of files of different types, which, in turn, have hypertext links to other sources or documents in other databases, either on the hard disk, in other net servers, or in another *LearningSpace* area.
- The *CourseRoom* database is the most dynamic component of *LearningSpace*. In it, students, work teams, and course teachers submit comments on topics of interest. This database facilitates collaborative work by serving as a forum for debating issues and presenting the progress of assignments.
- The *Profiles* database contains a directory with the course members: students, help desk (assistants) and teachers. Its aim is to update the information about all those involved in the course, in order to maximize integration and collaboration. This option allows the student to design his/her

'electronic page' for easier identification.

- The *Assessment Manager* database is used as an evaluation tool so that the instructor can examine and receive feedback in private about the progress made by each student.

Some of Lotus' *LearningSpace* key features include tools that allow the creation and distribution of contents via e−mail, together with a virtual class environment and asynchronous interaction. *LearningSpace* has not designed a synchronous interaction, even though this would in fact be possible through several products appended to Lotus Notes.

The students can access the course environment either through a *Notes* standard client or through a WWW navigator, or even through the new *Lotus Domino* server technology, which dynamically converts Notes documents into HTML for WWW distribution. Future versions of *LearningSpace* will include additional multimedia and real−time collaboration contents. LearningSpace can be stocked in the WWW using *Lotus Notes* with *Domino*.



Model of components of *LearningSpace*

List of services offered by *LearningSpace*

Kinds of services	Services
Communication	E−mail News
Administrative	Course diary
Evaluation	Exercises Tasks
Teaching	Multimedia documents Images / sound / video
General	Student profile Instructor profile Evaluation assistant

> *Symposium*

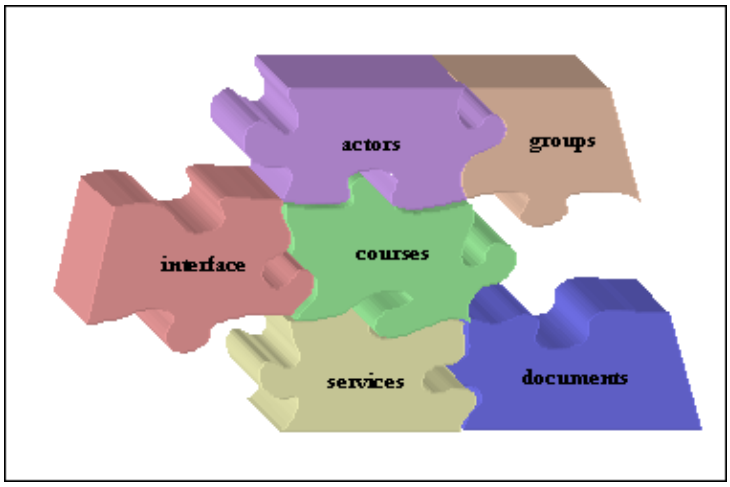
Centra's Symposium is a Web−based teaching software, specially designed to support direct group collaboration, and asynchronous self−regulated learning in an integrated on−line environment.

Students can access *Symposium* from a number of platforms using standard Web navigation technology. It includes functions that allow synchronous visualisation of multimedia contents, sending messages and asynchronous lectures. The 'Body Language' of *Symposium* supports an environment of virtual classroom with 'hand raising' participation, feedback and group regulation tools.

Symposium also has on−line learning environments, allowing breaks, role playing, labs, group computer learning, and Web 'Safaris' (WWW searches with specific goals), which allow instructors to provide participants with links related to group discussion. *Symposium* has developed a collaborative program with *Allen Communications* to use *Quest Net+* in their learning programmes, thus adding multimedia possibilities.

Among *Symposium*'s key features are: student synchronous answer, electronic 'hand raising', graphic class list to identify students, self−regulated computer learning, chaired and guided discussion groups, real−time chat, notepad with previous sessions and saved sessions, separate module to design the course − which allows import of new or existing multimedia contents, by structuring the sequences through a choreography tool − enrolment and distance administration of the course, instructor's control of student access privilege, and evaluation of the acquired skills with the possibility of monitoring through *Quiz Designer*.

Symposium requires a Windows 95, NT or Solaris UNIX server, together with a common Web navigator.



Model of components of *Symposium*

List of services of *Symposium*

Kinds of services	Services
Communication	E−mail Asynchronous lectures Synchronous class participation through hand−raising
Administrative	Enrolment and distance course administration
Evaluation	Evaluation of skills
Teaching	Multimedia documents Images / sound / video
General	Access privileges Course monitoring

> *First Class/LearnLink*

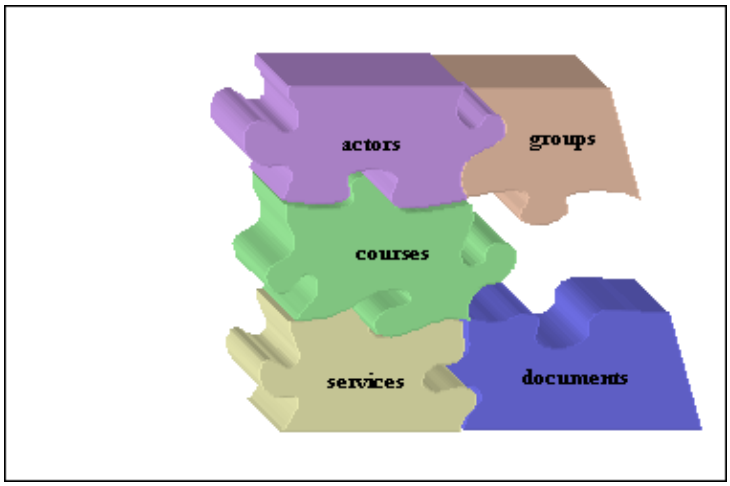
SoftArc's First Class is a software group product with distance multi−platform e−mail integrating e−mail, possibilities of chaired discussion and distance access.

First Class recently launched a version which allowed access to the software through the use of standard Web navigators, instead of owner clients. This new version also provides users with a graphic interface which supports multiple platforms.

First Class does not allow an instructional development environment. Recent applications in educational institutions propitiated more possibilities of development / distribution and management. *SoftArc* is expected to issue generic patterns in this area.

First Class is widely used in distance education. The Open University in the UK, for instance, uses it for its Internet−based distance education programs. Some of *First Class's* central features include graphic interface based on icons, multimedia attachments through files, active links with discussion groups, list servers, Web resources and the possibility to chat in real time.

The server software for *First Class* requires a Windows NT or Mac server, but at the moment, the client also has to be the owner. *SoftArc* has launched a version called *LearnLic*, which supports Web navigators.



Model of components of *First Class*

List of services offered by *First Class*

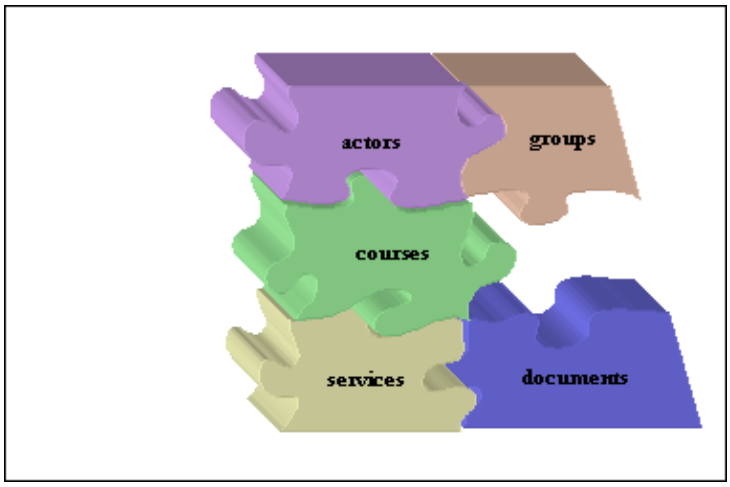
Kinds of services	Services
Communication	E−mail Chat News
Administrative	Distance access
Evaluation	On−line evaluation
Teaching	Multimedia documents Images / sound / video
General	Monitoring FTP Telnet Supports a large number of users

> *TopClass*

TopClass (formerly called *WEST*) by *WBT Systems* is a software for servers, designed for Web−based teaching either through Internet or LANs. It can be accessed through multiple platforms using standard navigators. *TopClass* provides students with a virtual class atmosphere, message−composition support and discussion forums.

It can also create course contents and help course management. Among the key features of *TopClass* are: message composition through files and lists of multiple and chaired discussion, the possibility to transfer files and attachments, the possibility for the instructor to become a chairperson, icon−based interface and navigation, security and license tools, wide scope of formats of import / export for course contents, access to multiple courses, the possibility that the instructors follow the development of the course and the students, and the possibility of self−evaluation on the basis of students' performance and the course material.

WBT Systems contains a range of strategies to assess both teaching and the *TopClass* software itself. The license is provided to every individual server, or to multiple servers with a specific level of users simultaneously connected. The license options also include subscription or purchase. Subscription rates include technical help and product update.



Model of components of *TopClass*

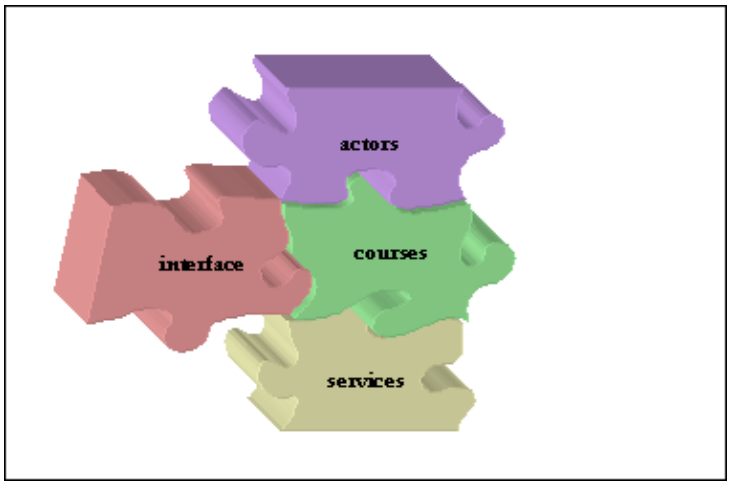
List of services offered by *TopClass*

Kinds of services	Services
Communication	E−mail Discussion groups News
Administrative	Notice page about the class
Evaluation	Multiple option evaluation Short answers Essays True/false answers
Teaching	Transparencies Web references
General	Monitoring of student progress within the class

> *WCB*

Web Course in a Box is a tool developed by the Virginia Commonwealth University for the creation and maintaining of Web courses. The *WCB* environment allows for the creation of WWW pages for services such as updating a course, diary service, creation of personal pages, together with interactive functions such as discussion forums and self−corrective exercises.

Both the creation and the access to courses are carried out through a Web navigator, and no technical knowledge is needed to develop the courses.



Model of components of *WBC*

List of services offered by *WCB*

Kinds of services	Services
Communication	Contact with teachers Chat
Administrative	Course news Diary
Teaching	Transparencies Web references
General	Students' personal pages Teachers' personal pages WCB forum

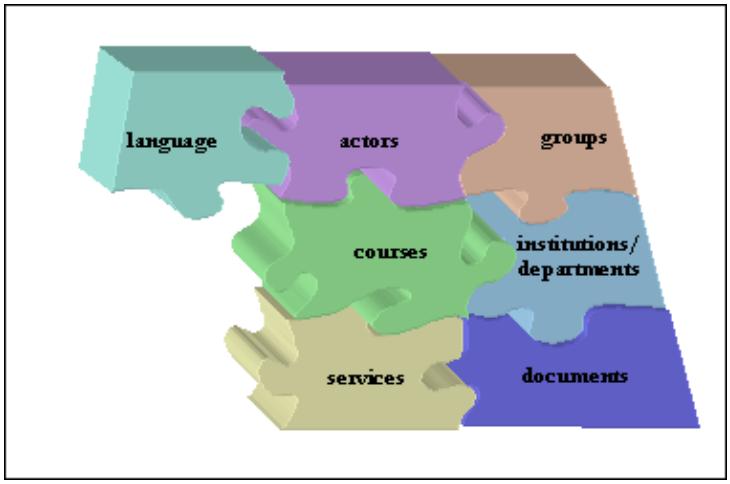
> *Aula Net*

Aula Net is a Web−based software environment, developed by the Engineering Lab of the Computer Department of the PUC−Rio, for the creation and assistance of distance courses. Three courses were taught using this software over the second semester in 1997. *Aula Net* rests on the following basic premises:

1. The courses should be interactive, in order to encourage wider student participation in the learning process.
2. The author of the course does not need to be a specialist in the use of the Internet.
3. Servers for the creation of courses must correspond to those in a conventional classroom, integrated with others in a Web environment
4. The use of already−existing contents in digital media, such as file import, has to be possible.

The use of *Aula Net* makes the creation of distance Web−based courses possible and easy. Services have a high level of interactivity and allow for student participation, without requiring the author to be an expert in the Web environment. Furthermore, a course can use contents already existing, saved in digital media.

At the moment, one hundred courses are currently underway in different areas of the University PUC−Rio, and in other Brazilian universities, through the use of *Aula Net*.



Model of components of *Aula Net*

List of services offered by *Aula Net*

Kinds of services	Services
Communication	Interest groups Discussion groups Teacher contact Debates
Administrative	Course diary Course news Teacher register
Evaluation	Tests Tests results Projects Projects results Exercises Exercises results
Teaching	Classroom map Transparencies Tape presentations Texts Textbooks Demos Bibliography
General	Internet tutorial Student pages Search engine

Conclusion

Today the use of Internet allows the application of different resources, such as e−mail, chat, MOOs, discussion groups and forums to carry out the teaching−learning process whether in a synchronous or asynchronous manner.

For this reason, universities have started to acquire a number of tools to create Web−based courses. These tools have proliferated in a very short time. Some are designed by universities, others by companies, and it is difficult to keep track of them all.

Each university chooses the tool which best suits its needs. The Open University, for instance, uses *SoftArc's First Class* for its Web courses. When Open University started using this tool in 1994, it had 1,200 users; by 1998, this figure had risen to 35,000. Today, *First Class* is being used in the Web for over 80 courses, and over 5,000 conferences with 1,000 chairpersons. Through this tool, 15,000 daily connections are being made by 4,000 users. As we can see, *FirstClass* meets the needs of the Open University in the UK.

Other widely used tools are *LearningSpace* and *WebCT*. The former is used in Mexico, at the Superior Technological Studies Institute of Monterrey (ITESM), where it is used as support for almost 150 courses, and *WebCT* is used to offer courses in a program with the University of British Columbia. This tool is also used in the following Spanish universities: Universidad de Sevilla, Universidad de Las Palmas de Gran Canaria, Universitat Autònoma de Barcelona, Universitat de Barcelona, Universidad de las Islas Baleares and Universidad de Salamanca , either as the basis for virtual courses or as support for them.

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