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# Delivering Synchronous and Asynchronous Educational Material in Conservation Science Using Various Communication Channels

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## 1. Introduction

Through existing information and communication technologies, learners and teachers can not only interact synchronously, but also have an efficient cooperation or collaboration over distance. Computer-supported collaboration learning is one of the most promising innovations to improve teaching and learning, since it achieves combination of communication technology with psychological and pedagogical aspects, along the lines of a constructivist approach (Silverman, 1995). Computer-supported collaboration learning can be a powerful tool in creating learning communities, where students have a chance to be present by developing explanations on the subject studied, and analysing knowledge in a collaborative way (Scardamalia & Bereiter, 1994). The importance of interacting and the influence it exercises on the learning process in distance education was described by Moore (1993) in a model called “transactional distance”, *i.e.* the distance created between lecturer and learners, which potentially increases in distance education. The term “transaction” refers to a mutual action between environment, individuals and behaviour patterns in a particular situation. The distance education transaction is “the mutual action between teachers and students, in environments whose uniqueness is their separation from each other, and as a result exhibit unique behaviour patterns of distance education” (Moore & Kearsley, 1996). The transactional distance is affected by two variables, the dialogue or verbal interaction and its adaptation to distance learning. The transaction distance will decrease as the level of dialogue increases, and this will lead to an increase in the effectiveness of learning (Offir et al., 2008). There are essentially two kinds of interaction with regard to learning. One deals with a student individually interacting with content, and the other implies social activity: a student interacting with others about the content.

Two different types of computer-supported collaboration learning environments, that is two methods for implementing distance learning are used, according to the moment when student-teacher interaction takes place: asynchronous and synchronous systems (Bafestou & Mentzas, 2002). Ellis et al. (1991) categorised group interactions according to time and space. Collaboration could be enhanced within a real-time or a non-real time interaction. A

distinction is made between same time (synchronous) and different times (asynchronous), and between same place (face-to-face) and different places (distributed).

Asynchronous communication allows students to exchange data and views in their own time and space, hence it is insensitive to time and geography. Asynchronous communication tools remove both geographical and temporal barriers. This type of collaboration offers some advantages. Firstly, students are not pressed to react in a short unit of time and secondly, they may organise their messages by "branching" them around themes (Veerman et al., 2000). Problems arise for asynchronous communication, when it is expected from two or more group members to work on a common task electronically, although they are coming from different countries, they have different background knowledge, and/or did not work together previously (Jaervelae et al., 2004). Additionally, isolation feelings are usually common among students participating in asynchronous communication, a fact causing diminished motivation for learning. On the other hand, in computer-supported collaboration learning synchronous environments students share data and views through the Internet in real-time like a face-to-face interaction without feeling isolated (Marjanovic, 1999). Example for synchronous communication tool is the live chat room, web-conferencing and other systems, which allow users to immediately exchange information. One of the challenges to communication technology is how to make distributed interactions as effective as face-to-face interactions, as human interaction, since mutual understanding or shared values and goals are hard to be created in a distant-environment. A remote interaction supported by appropriate technology, which will allow students to access further relevant information without interrupting the flow interaction, should be the solution. In most third-cycle education classes asynchronous and synchronous communication work hand-in-hand. They are symbiotic. In fact, a number of research studies, beginning in the late 1970s, concluded that "instructor use of nonverbal and verbal immediacy" fostered all kinds of benefits in the conventional classroom: more learning, more student motivation, more empowerment (Freitas, 1998, pp. 366-67).

Learning management systems such as Moodle or Blackboard, and real-time applications, such as videoconferencing, are used in order to create Virtual Learning Environments able to support Collaborative Learning. Their mediator role is essential to improve the educational experience in the scientific concepts. Especially, these mediators are largely useful in the field of science education, where lecturing material derives from predetermined texts, giving students little incentive to attend and participate in class. Learning management systems are server-based platforms that control access and delivery of on-line learning resources through a standard web browser. They are designed to support teachers in the management of computer supported educational courses. These systems consist of:

- "Communication tools", such as e-mail and a discussion board,
- Tools for organising the administration of a course, and
- Tools for student testing, through quizzes, and for disseminating the information.

A major opportunity provided through the use of new information and communication technologies in education is the use of multimedia material at the presentation of cognitive contents to the students. Multimedia computer-based training and learning including hypermedia technology has been an area of research for the educational experts. Experience in evaluating the quality of learning from hypermedia documents has been highly positive, and it has been established that a part of the positive attitude is due to the novelty of the

medium (Brown, 1995). Relan and Gillani (1997) generally accepted from a pedagogical perspective that multimedia technologies have the potential to reshape and add a new dimension to learning. By incorporating multimedia technology in a dynamic system with good-quality educational material, it is now possible to develop effective new teaching and learning strategies. Multimedia technology plays an important role in education and training because of its ability to provide a virtual environment permitting learners to effectively acquire knowledge. With sound and visual effects, multimedia enhances computer simulation of the real life events. It has the potential to transform the classroom from a physical world to an unlimited imaginary virtual environment. Multimedia simulations can instantly put the learners in an environment, where they can discover, explore further knowledge actively. It has also facilitated several types of training, such as fire fighting, driving and flight simulations. Visual and audio can powerfully affect the learners' processing of information. In addition, Selwyn and Gordard (2003) emphasize that the use of multimedia technologies in educational institutions is seen as a necessity for maintaining an education relevant to the 21<sup>st</sup> century. The optimal use of multimedia technology in education and its full potential will only be realised if it is to be adopted not only as a vehicle for knowledge "delivery", but most importantly as an instructional tool.

Forming the world's largest network of networks, Internet now serves as a significant channel for delivering education, There are four ways of connecting a client computer to the Internet:

- Dial-up connection using a telephone line or an Integrated Services Digital Network (ISDN),
- Digital Subscriber Line (DSL),
- Cable TV connection,
- Satellite connection and
- T-Carrier systems.

The general rule about Internet connection is the faster, the better. The bandwidth and transfer rate determine how rapidly pictures, sounds, animation and video clips will be downloaded. Since multimedia and interactivity make the Internet such an exciting tool for information sharing, speed is the key. Dial-up access provides an easy and inexpensive way for users to connect to the Internet, however, it is a slow-speed technology and most users are no longer satisfied with dial-up or ISDN connections. The broadband access is now possible with TV cable, DSL and satellite links, and T-carrier systems. Broadband forms of connection are largely gaining popularity with the general public and with business, governmental, and educational organizations. Broadband systems divide the cable capacity into multiple independent bandwidth channels allowing several data transmissions to occur simultaneously over a single cable. Each transmission system is allocated a part of the total bandwidth

The Digital Subscriber Line (DSL) is a high-speed data service that works over Plain Old Telephone Service (POTS). It is a family of technologies that provide a digital connection over the copper wires of the local telephone network. Older ADSL standards could deliver 8 Mbps over about 2 km of copper wire. The latest standard ADSL2+ can deliver over 24 Mbps per user over similar distances. Many copper lines, however, are longer than 2 km, reducing thus the amount of bandwidth that can be transmitted.

Cable Internet access refers to the delivery of Internet service over the unused bandwidth on a cable television network. Users in a neighbourhood share the available bandwidth

provided by a single coaxial cable line. Therefore, connection speed can vary depending on how many people are using the service at the same time. Speeds offered range from 3 Mbps to 30+Mbps. Often the idea of a shared line is seen as a weak point of cable Internet access. From a technical point of view, all networks, including DSL services, are sharing a fixed amount of bandwidth among a multitude of users – however, since because cable networks tend to be spread over larger areas than DSL services, more care must be taken to ensure good network performance.

Satellite Internet services are used in places, where other possibilities for Internet access are not available and infrequently moving locations. Internet access *via* satellite is available globally, including vessels at sea.

One-way multicast is used for IP multicast-based data, audio and video distribution. Most Internet protocols will not work correctly over one-way access, since they require a return channel.

Two-way satellite service sends data from remote sites *via* satellite to a hub, which then sends the data to the Internet. The satellite dish at each location must be precisely positioned to avoid interference with other satellites. Uplink speeds rarely exceed 1 Mbps and latency can be up to one second.

The T1 line is a common dedicated leased line used by many organizations. The T-carrier system was designed to combine multiple telephone conversations over one wire. Most T1 lines are dedicated fibre lines, but some may be copper connections.

A T1 line has 24 channels with speeds of 64 Kbps and can carry 24 concurrent conversations by converting each one into digital format and placing it on a channel. Fractional T-services are available, which enable an organization to lease only part of the T-service. T1 supports 24 channels at 1.544 Mbps total bandwidth. There are also greater capacity T-carrier lines such as T2, T3, etc. lines available for larger organizations.

Highly pronounced interdisciplinarity in both staff and course contents is a core feature and main characteristic in conservation science studies. History and archaeology; chemistry, physics and biology; geology and survey engineering; statistics and documentation; conservation and restoration – are fundamental topics, closely interconnected through the main goal of safeguarding the cultural legacy of the past. Being thus at the boundary of natural sciences and humanities, material heritage preservation is difficult to be covered in all its aspects in one institution, even a large university. Furthermore, it is crucial to offer non-systematic distant adult learners in-depth instruction on specific themes in an interactive manner, and this can only be achieved with the assistance of specialized scientists and tutors recruited in more than one area. An efficient reply to the problem is the formation of flexible hybrid schemes, characterized by extended use of a multidimensional e-learning system using both synchronous and asynchronous techniques.

e-Learning is at present widely recognized as a valuable and legitimate vehicle for the delivery of flexible learning, a scheme focusing on how students will engage in educational activities both meeting their needs and considering the options available to them(Pond et al., 1995), and on the ways analogous initiatives may be supported(Taylor and Joughin, 1997).



## 2. Connecting Geographically Isolated Areas Using Very Small Aperture Terminals Technology

The project is based on the concept of the interactive unified virtual classroom in both lecturing and practicing laboratory work; and is relying upon former experience in designing and setting up a multi-dimensional e-learning system using both synchronous and asynchronous techniques.

The current generation of equipment, easily providing portable and wireless apparatus, and the low-cost connection enable at present most universities teachers to utilise the richness of videoconferencing for achieving a more learner-centred teaching. Broadband technology allows ameliorating three to eight times the quality in picture and sound, so that these may approximate the images seen on television screens. Dual transmission of live action, enhanced with simultaneous transmission of video, PowerPoint slides, and audio tracks, is easily achieved.

Very small aperture terminals (VSAT) are proposed as a reliable architecture for putting into operation interactive unified virtual classrooms in isolated areas, and establishing learning activities in both lecturing and practicing laboratory work using synchronous techniques. The implementation of a network using very small aperture terminals is a secure and reliable medium to connect geographically dispersed locations in a situation where other connectivity options are not feasible. Transmission of live video to and from the hardware videoconference systems or PC is performed bi-directional over the satellite network.

The implementation of a network using very small aperture terminals (VSATs) is a secure and reliable medium to connect geographically dispersed locations. In a situation where other connectivity options are not feasible, VSATs offer two distant advantages, namely reduced deployment time and straightforward manageability (Cheah, 2001). VSAT networks provide low-cost access to communication services *via* satellite. A VSAT station is a micro-earth station using the latest innovations in the field, and proposing services comparable to those of large gateways and terrestrial networks. A typical terminal consists of the indoor (IDU) and the outdoor unit (ODU).



(a)



(b)

Fig. 1. Indoor unit (a) and outdoor unit (b)

The latter is the VSAT interface to the satellite, since it contains the antenna and the electronics package, *e.g.* transmitting amplifier, low noise receiver, up-down converters, and frequency synthesizer. The indoor unit is the interface to the terminals or to a local area connection (LAN). The equipment requires minimal installation – up to a couple of hours – and simple trouble repair, and is easy to operate, while power necessities are low, and

eventually supplied by means of solar cells, given that fly-away VSATs are constantly transported, assembled and disassembled.

As seen in Figure 2, VSAT terminals are generally part of a network, with a larger earth station serving as master/hub. Hubs contain the intelligence to control the network operation, configuration and traffic; and are usually located in places, where the bulk of the network traffic originates and/or terminates. VSATs use a star network bearing satellite earth stations that rely on a large central hub. The two way connectivity between terminals is achieved by double hop link, with a first hop from VSAT to hub (inbound link) followed by a second using the hub as a relay to the destination VSAT (outbound link). Both inbound and outbound consists of two links, uplink and downlink. Alternatively the network may be hubless, the relevant mesh topology permitting all terminals to intercommunicate directly, and ensure by themselves network management and traffic control. Mesh topology is recommended for voice applications, where extended delay cannot be tolerated.

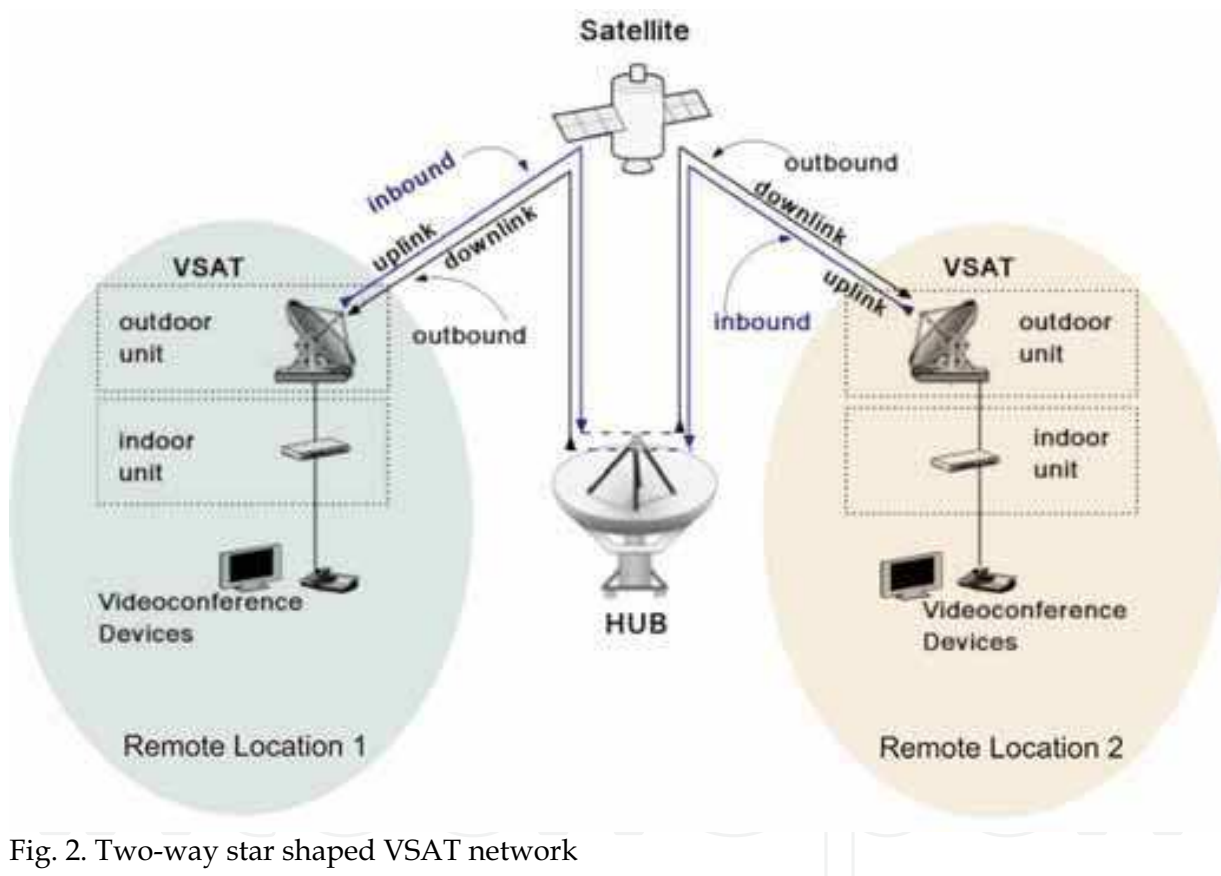


Fig. 2. Two-way star shaped VSAT network

Since they offer a wide span of solutions for most telecommunication needs, VSAT networks are suited for domestic and/or international applications, broadly falling into two categories, *e.g.* one-way applications or broadcasting, and two-way or interactive applications, which cover data, voice, video and high-speed point-to-point services. Current compression techniques enable video conferencing at data rates as low as 64 kbit/s. However, a 384 kbit/s rate is the best trade off between quality and cost. The chosen satellite service offers a bandwidth of 256 Kpbs outbound and 1024 Kbps inbound.

In each partner institution a videoconference classroom is set up as a remote node. Each virtual classroom has the minimum facilities required for videoconferencing:

- Coder-Decoder (CODEC) system (H.323 compliant),
- Video: camera and monitor,
- Audio: microphone and speaker,
- Connections to the IP (H.323).

These basic components must be present in every system, from desktop to room-based. Desktop systems are likely to utilise the monitor, microphone and speakers, supplied as part of the PC. All that is required to complete such a system is a CODEC and a camera, which may be integrated into a single compact unit. For roll-about and small room-based systems the speakers may be integrated with the monitor, and the camera and microphone may be integrated with the CODEC.

As a result of the limited power of VSATs on uplink, video transmission is feasible at low rate, using video coding and compression. Videoconferencing takes place via the IP (Internet Protocol) network, using the H.323 Standard. The H.323 standard (ITU, 2000) encompasses audio, video and data communications across packet-based networks – LAN, Intranet, Extranet and Internet. It is a set of standards developed to allow interoperability of multimedia products and applications coming from multiple vendors. It is addressing issues such as call and session control, multimedia and bandwidth management for point-to-point and multipoint conferences. A H.323 based videoconferencing system (VCON HD 3000) is used for the remote communication. The advantage of hardware-based codices is their capability to support high bit and frame rates in acceptable size large picture formats CIF (352x288). The videoconference system will give learners the feeling of a common study, benefiting of guest lecturers or collaborative teaching.



Fig. 3. Set-top videoconference unit (VCON HD 3000)

From an educational standpoint, most important issue in a virtual classroom is the establishment of communication and interaction among the participants (Greenberg, 2004). This target can be enhanced by using oral communication between the remote classrooms, and text chat for the individual participants, in order to pool questions and facilitate discussing them. Text discussion groups will permit continuous interaction during and after any seminar. At a later phase, interest may focus on the development of a distributed infrastructure media on demand server, which will further contain information on future educational activities, *e.g.* time plan delivered courses and pre-instructional material, creating thus an e-learning grid on the topic.

The case studies considered are representative for several virtual mobility types, *e.g.* unified theoretical or practical classes, and vocational seminars; as well as “first aid line” meetings,



usually founded on the shared concern about problems or the simple need for argumentation, and adopted to the requests presented by the persons involved. Laboratory training is simultaneously followed at all nodes, and is primarily focused on reviewing ambivalent results and adopting best practice examples. Live participation ensures interacting more or less the same way as when physically sharing the same site.

Evaluation is mainly consisting in the valorisation of a constant feedback in questionnaires, observation sheets and semi structured interviews for teachers and students. The overall axes used in organizing these procedures are based on generally acknowledged guidelines (Quality Assurance Agency for Higher Education, 2003 ), and are taking constantly into account the need for assessing both the learning material and outcomes *per se*, as well as the strategies employed for efficiently working in a virtual environment, while enhancing autonomy and involvement. Crucial parameters include didactic concepts, degrees of flexibility, quality of information, audiovisual receptiveness and friendliness of the equipment, interaction possibilities, and added value of participating in a model unified multi-component classroom.

A series of six vocational seminars comprising theoretical classes, problem-solving sessions and a pilot laboratory course, and dealing with conservation science issues, were delivered at the Aristotle University of Thessaloniki. The remote learners were encountered at their working places, namely two museums and four excavation sites located in Northern Greece and the adjacent Western Balkan countries.

Evaluation data permit an initial qualification of the system as used during the abovementioned exemplary situations. Questionnaires were distributed among thirteen professional conservators/restorers and twenty-two vocational trainees. As a crosscheck, lecturers and laboratory tutors were asked to complete observation sheets, while semi-structured interviews provided insight to specific issues, as well as to general impressions on the methodology used.

Course contents were in all cases judged very positively, since *viva voce* lecturing could constantly be combined with all types of multimedia support. Questioned on audiovisual receptiveness, lecturers were not always at ease with localising participants in the audience; in the same framework laboratory audiences markedly confirmed the preference for clearly focused-on persons or objects. There were no problems concerning sound and image quality, even where spectroscopic data, artwork visual aspects or text fragments were displayed. Interaction possibilities and friendliness of the equipment were positively evaluated, although vocational trainees were rather reluctant to use opportunities for interactive communication preferring to address the tutor present. Finally, the added value of participating in a satellite-delivered virtual learning environment was universally recognised.

The abovementioned virtual track of communication has been developed as an equivalent to further analogous applied distance learning initiatives (Suzuki et al., 2003). Characterized by flexibility, friendliness to the user and low cost, it is entirely meeting the difficulty of instructing isolated partners on issues not satisfactorily covered by individual study. The initiative is offering a clear enhancement in the quality of both organized seminars and *ad hoc* interventions, and may be considered as an excellent tool for integrating cut-off vocational professionals to the latest methodologies of their discipline.

### 3. Using Learning Management Systems for e-Learning in Conservation Science

The case study considered is the result of an ongoing project funded by the European Commission, Lifelong Learning Programme, Erasmus, Multilateral Projects, Virtual Campuses; titled: Systematization, Valorisation and Dissemination of e-Learning Courses in Conservation Science; and dealing with the implementation of teaching modules in cultural heritage preservation with the support of ICT technologies. Four European – Greece, Italy, France, and Spain – and one Arab Mediterranean – Morocco – countries are participating, represented by Aristotle University of Thessaloniki, Cà Foscari University of Venice, University of Avignon and the Vaucluse, Rey Juan Carlos University at Madrid, and Sidi Mohammed ben Abdellah University at Fez. aStyle Linguistic Competence, Vienna (Austria), is responsible for linguistic issues.

The virtual campus under discussion is encompassing specialized theoretical and practical modules on conservation science, as well as an open line dealing with concrete issues of immediate interest. The integration of the distance education network is using services of asynchronous techniques, in order to enhance the capability of material deriving from synchronous training to be archived and used. As a result, all curricula offered attain superior quality; while non-systematic remote adult learners are also presented with interactive in-depth instruction on specific themes treated by experts recruited in more than one institution. Real-time oral communication possibilities and simultaneous laboratory training of all attendees are ensuring a global feeling of unity among participants (Baecker, 2003). The virtual community thus constructed is responding to a factual need for creating a trans-national and intercultural shared language in relevant problem solving; and is meeting the urgent necessity for expanding pertinent encyclopaedic schemes, for creating scientific co-operations, and for permitting all contributors develop close multilevel contacts (Sedgers et al., 2005).



Fig. 4. Videoconferencing among remote sides

The educational environment is designed on the basis of a three-fold pattern – before, during and after each course unit or module. In the first phase learners are prepared for the course by having available all didactic material needed. During the frontal hours they are using videoconferencing, and webcasting/archiving; and afterwards they may benefit from study material, self-assessment opportunities and a meeting point with the instructor. Linguistic issues are attended to at all instances.

The first phase of the three-fold pattern, namely the period before entering the course, has been met in a multifaceted approach, encompassing archived preparatory material of various types, from text files and power point presentations to video presentations and multimedia modules; as well as selected bibliographical references and websites, and self-assessment tests at various levels. Thus, prerequisites are fully covered and the relevant private evaluation is perfectly controlled.

The courses are delivered in a synchronous manner *via* a videoconferencing and webcasting scheme. It is obeying the logic of a hybrid environment, *i.e.* a structured distance-learning setting with definite timetables, fixed audiences and locally organized examination schedules, in which videoconferencing is addressing the need for a multidisciplinary trans-national covering, and archived material is serving private study (Dede, 1996). The post-course phase is mainly based on the parallel activities of study – since the user can connect to the server at a later date and view the archived version of the videoconferences –, self-assessment, and direct questioning of the lecturer. Adult learners may use both the direct open line to the teaching staff, and the distributed infrastructure media on demand server.

Linguistic issues are answered by offering to all types of users the possibility of following on-line courses on language and terminology connected to conservation science issues, and of being consequently assessed, in order to permit them acquire the necessary minimum of linguistic and translation competences in terminology for entering the trans-national scientific community. A specialized on-line course, titled English for Specific Purposes: Conservation Science, is being created by the partners on the basis of the successfully completed Leonardo project English for Specific Purposes: Chemistry [<http://moodle.espc.org>], and is offered to students as a self-assessment and assessment tool. A further analogous instrument in several significant topics is the EChemTest, a computer-based multilingual test of European standard, developed by the European Chemistry Thematic Network and managed by the relevant Association [<http://www.cpe.fr/ectn-assoc/echemtest/index.htm>]. It is permitting evaluation of knowledge and skills in chemistry at four different levels, corresponding to the end of compulsory education; the beginning of university studies; the completion of the core chemistry syllabus in analytical, biological, inorganic, organic and physical chemistry; and the closing stages of master's curricula in synthetic and computational chemistry, and chemistry applied in conservation science. The English version is serving as an overall linguistic training and self-assessment possibility. Any other European language considered necessary for mastering specialized information on concrete issues may as well be approached by the abovementioned on-line courses.



Fig. 5. e-learning portal layout using Moodle

The learning platform utilized consists of an open-source Course Management System (CMS), Moodle (<http://moodle.org>), and serving the learner-content interaction. The contents are divided in five major course categories, corresponding to the general topics: metals; mortars, ceramics and stone; colouring agents and binding media; fibrous materials; and image treatment applied in conservation science. Moodle permits having each course category managed by a team of experts belonging to all partner institutions.

The courses in Moodle are implemented in duplicated topic format. The first copy contains the didactic preparatory material, and the second is hidden. After the lecture, and while the first copy disappears, the second is revealed: it contains extra material in form of video archived lectures, and a virtual meeting place with learners. For later learner-teacher interactions in the created meeting place, Moodle is combined to a direct dialogue tool, actually a Web2 audio and video web conference system (DIMDIM browser-based web 2.0 service) (<http://www.dimdim.com>), giving the instructor the possibility to show over the Internet presentations, applications and the desktop, as well as to converse, and use the webcam. Since the tool is a presenter, only a browser plug-in is needed, attendees not having to install anything.

A video learning system, implemented through the ePresence platform (<http://epresence.tv/products>) for capturing, archiving and webcasting lectures, is sustaining both adult learners and any type of extended self-study. The ePresence system is developed at



the Knowledge Media Design Institute, University of Toronto, is scalable, interactive, and able to support live and on-demand broadcasting.



Fig. 6. Dimdim plugin for Moodle

In each partner institution a videoconference classroom is set up as a remote node. Each virtual classroom has one or more cameras, microphones, loudspeakers, and monitors. A H.323 based hardware videoconferencing system is used for remote communication (VCON, 1998).

The pedagogical background to the overall structure is based on the theory of reasoned action, proposing that beliefs influence attitudes, which in turn may lead to intention and then generate behaviours (Turgeon, 1997).

The IT friendliness is checked according to the Research Model, an adapted version of the Technology Acceptance Model (TAM). Goal of TAM is to explain the determinants capturing the attitude and behaviour of a broad range of users towards IT, in the framework of two posited beliefs, namely perceived usefulness and perceived ease of use (Davis, 1993). Within the present context, perceived usefulness is defined as the students' prospective subjective probability that the course is at the required standard for ameliorating his knowledge and skills within the educational community and the job market; while perceived ease of use refers to the degree to which prospective users expect the three phases of the courses to be free from cognitive effort in what regards the IT environment (Johanssen et al., 1995).





Fig. 7. ePresence video streaming and archiving

Offering a flexible e-learning environment, the case study under consideration permits activities to focus on the deployment of a suitable infrastructure and on the implementation of contents, while the user may easily adapt the learning path to his timely and geographical constraints. It is encompassing third cycle theoretical or practical classes, as well as *ad hoc* meetings, founded on the shared concern about problems or the simple need for argumentation, and adapted to the requests presented by the students involved. Laboratory training is simultaneously followed at all nodes, and is primarily reviewing ambivalent results and adopting best practice examples in both physicochemical and safeguarding issues. Evaluation is mainly consisting in the valorisation of a constant feedback in questionnaires, observation sheets and semi structured interviews for teachers and students. The overall parameters used in organizing these procedures are based on generally acknowledged guidelines, and are taking constantly into account the need for assessing both the learning material and outcomes *per se*, as well as the strategies employed for efficiently working in a virtual environment, while enhancing autonomy and involvement (American Distance Education Consortium.,2003). Decisive parameters include didactic concepts, degrees of flexibility, quality of information, audiovisual receptiveness and friendliness of the equipment, interaction possibilities, linguistic issues, and added value of participating in a model unified multi-component classroom (Pituch and Lee, 2004).

Evaluation data permit an initial qualitative characterization of the scheme, in the way it is used during the abovementioned first phase of the project. Sets of questionnaires were distributed among thirty-eight postgraduate students originating from all participating countries, for both lecture and laboratory attendance. As a crosscheck, teachers and tutors were asked to complete observation sheets, while semi-structured interviews provided insight to specific issues, as well as to general impressions on the methodology used. As

already mentioned, the approach is based on the Research Model, an adapted version of the Technology Acceptance Model (TAM).

Course contents were in all cases judged very positively, since *viva voce* lecturing could constantly be combined with all types of multimedia support. Questioned on audiovisual receptiveness, lecturers were not always at ease with localising participants in the remote classroom; in the same framework laboratory audiences markedly confirmed the preference for clearly focused-on persons or objects. There were no critical problems concerning image quality, even where spectroscopic data, artwork visual aspects or text fragments were displayed. Main relevant difficulty appeared to be the multilingual background of teachers and students, since a dramatically higher sound quality was requested whenever the user had to understand notions uttered in a foreign language. Interaction possibilities and friendliness of the equipment were positively evaluated, although often learners were again rather reluctant to benefit from opportunities for interactive communication in any other than their mother tongue. Finally, the added value of participating in a virtual learning environment was universally recognised, with the argument that a great variety of specific theoretical and practical topics could both be discussed in depth and presented from different standpoints.

Structuring a valid equilibrium between respect for the multilingual environment and the necessity of being at all instances clearly comprehended, proved to be the greatest cultural challenge within the trans-national virtual campus. Although all contributors had an acceptable passive knowledge of English, nevertheless they insisted in having courses as well offered in other major European languages involved. Fluently French-speaking Moroccan participants and non-European Spanish native speakers were pronouncedly negative in the introduction of English as a generally operative language, while Middle East Arabs studying in Italy and Greece insisted on its overall application. To address the problem, and in addition to the specialized online training and assessment tools offered, partners introduced a consistent language policy by implementing a combined system in the frame of *viva voce* lecturing and multimedia support. Thus, talking in another language is mingled to an extensive English multimedia presentation and *vice versa*, while interactive communication is largely managed by the tutor present in each classroom. Being at least bilingual, the tutor is encouraging participation, and is *ad hoc* translating difficult notions, obeying at the sole criterion of permitting everyone to be largely understood.

Future work on the subject will address evaluation by external experts. Firstly the collaborating institutions, mentioned in the next paragraph, and then international panels – such as the Working Group on Chemistry and Cultural Heritage, European Chemistry Thematic Network Association – will be asked to be involved in validating the project's outcomes. Crucial axes for building up this stage include didactic concepts; degrees of flexibility; quality of information; audiovisual receptiveness and friendliness of the equipment; interaction possibilities; linguistic issues; and added value of the model unified multi-component classroom.

The project is structured at two interconnected levels, the partner universities and a number of collaborating institutions prepared to participate in the courses and evaluate the results. Further dissemination of the course will primarily focus on a most global covering of Europe and the Arab world, before taking into account other regions. Target groups will largely belong to postgraduate students in conservation science at the institutions involved. A second important target group are non-systematic distant adult learners confronted with

specific problems or willing to keep their knowledge updated with the aid of the archiving system.

Characterized by flexibility, friendliness to the user and low cost, the virtual track of learning and communication presented is entirely meeting both the difficulty of covering all topics dealing with cultural heritage preservation in one place, and the urge to instruct isolated partners on urgent issues. The project is offering a clear enhancement in the quality of both organized courses and *ad hoc* interventions, and may be considered as an excellent initiative for creating a trans-national and intercultural virtual community using common approaches and sharing knowledge and skills in a highly interdisciplinary subject.

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