

DISTANCE LEARNING IN CONTROL AND COMPUTER NETWORKS TEACHING BASED ON INTERNATIONAL COLLABORATION

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Abstract *¾ The paper presents the results of the international collaboration in the field of open and distance learning established within the Socrates/Erasmus program framework. The main idea of the project was to link the lecturers from various universities while working on the content and form of their courses to be suitable for open and distance learning paradigm. Silesian University of Technology lecturers were involved among other in the preparation of the distance learning versions of lectures concerning adaptive control and computer networks. The pilot versions of the transformed lectures were made available to the students by means of Internet connection and appropriate open and distance learning systems like Blackboard. The system supports online education by means of excellent tools for posting lectures, enrolling students, preparing questionnaires and tests, organizing communication system between students and instructors as well as possibilities for accessing external education materials. The lectures were tested by pilot group of students from Silesian University of Technology.*

Index Terms *¾ Open and distance learning, Internet based learning, Multimedia courses, Authoring software.*

LINK PROJECT OBJECTIVES

The global aim of the described international collaboration in the field of open and distance learning – called the LINK project – was to lower the burden for university and other teachers to develop multimedia course modules themselves. Creating a multimedia course should become as familiar to them as the use of a word processor. The course development involves the use of multimedia tools and authoring software and the teachers that are going to participate in this collaboration have to be taught to work with these tools. At the same time, teachers will be prompted and taught to use the internet to retrieve specialized information and to co-operate with other teachers in developing their course. For this purpose, "collaborative work software" should be installed on a web server at one of the partners' site.

More specifically, the aim of the project was the development of an easy to use methodology for the creation of multimedia course modules: the partners had to set up a semi-automatic system to compose a new course or re-elaborate an already existing course, guided by software

tools. These tools role was to assist the course developers to plan and realize all elements of the course. Preferably such system should be based on an internet. It should allow the guided access to information belonging to other courses and databases. The system must also encourage and support collaborative work as well as tele-working between course developers.

The pilot courses are prepared for individual learning meaning that students study the course on his computer connected to a server –which delivers the course. While going through the course, the students are not assisted by any tutor. However, tutorial sessions should be organized at different time intervals at the partner universities. In these sessions, students have to cooperate with each other to solve problems, supervised by the teacher. The multimedia course should also contain self-assessment tools allowing students to evaluate their progress in learning. The final examination should be done in a traditional way.

The target users of the courses under development were students and trainers of the partner universities. All students were undergraduate students, e.g. last year students in engineering. The majority of these students will find a job in a company, in which self-study at one's own speed, collaborative teamwork and the use of information technology is the most important.

The new methodology was tested and evaluated by the target users. Together, the partners worked on reviewing the methodology and made adapted versions of the courses, based upon the evaluation reports and the students' examination results. New partner universities will be encouraged to copy the new method, and to introduce the pilot or new courses in their education system.

The multimedia aspect includes: the use of hypertext (text containing hyperlinks to other parts) and the use of charts, graphs, pictures and computer animation, which would support the written text. Audio fragments can be used for language courses.

The course modules appear in a digital form, as software files. They are installed on a server, and are accessible to the target group via a LAN or internet with a computer. Printed materials can be used as an additional help. For further dissemination, the software can be finalized in a CD ROM format.

The course design was done by means of specialized software tools, which could form the structure of the course,

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which would be filled with the specific contents by the author of the course. Such tools must be universal to tackle most different kinds of tasks. The tools must be flexible enough to allow for fast maintenance – adapting to new concepts and methods.

After developing the methodology teachers were supposed to use the software tools themselves. In each partner university several teachers were involved in getting accustomed with such software tools. The teachers tested the tools by transforming a small module of their classical course into a multimedia network format. Next step was to choose one or two pilot courses to be developed in each partner institution. This development was assisted by specialists in the same field from other institutions. This was proposed to be possible by tele-working, using 'collaborative work software' on the internet.

The learning process must be as fast as possible, and the total learning time must be limited. The teachers should believe that the quality of their course is improving both in attractiveness and in transfer of knowledge. The workload needed to transform a classical course was aimed to be minimal.

The tools used must be really platform independent. A number of authoring tools which are platform-independent are available on the market. This means that multimedia material accessible from PC's, Macintoshes and Unix workstations alike can be created.

The modules and data must be easily retrievable from, and deliverable to the World Wide Web, without having to be an expert in programming or in a specific computer technology. Collaborative work software will be used, in order to allow for joint development of modules at a distance. At the time of LINK project planning a good example of tele-working software was BSCW (Basic Support for Cooperative Work). This package enables collaboration over the Web. BSCW is a 'shared workspace' system which supports document upload, event notification, group management and much more. To access a workspace only a standard Web browser is needed.

THE AIMS OF THE LINK PROJECT IN DETAIL

This section contains the details concerning the basis, aims, beneficiaries and dissemination plans concerning the LINK project.

Promoting Open and Distance Learning

In the LINK project, several objectives of the SOCRATES ODL strand were fulfilled:

- Involving as many teachers as possible in multimedia course development. Exchanging know-how across the borders in the development and in the assessment of multimedia courses.
- The introduction of collaborative tele-working by teachers: distant development of multimedia course material using the internet.

- Improving the skills of educators and students in working with multimedia material:
- Lowering the threshold for teachers to transform their traditional courses into multimedia courses for individual learning
- Lowering the threshold for students to study multimedia courses on their own.
- The introduction of Computer Assisted Learning for students.
- The introduction of collaborative learning for students during the tutorial sessions.
- Creating a network of institutions, which will make use of this development and learning method.
- Undertaking dissemination actions to promote this methodology towards other institutions in the EU.

Specific Objectives of the Project

The detailed objectives of the LINK project could be formulated as follows:

- Creating a survey of existing manuals and courses for multimedia production; creating a survey of modern authoring software.
- Creating a glossary of multimedia courses developed in the partner institutions; exchanging existing experience in the development and assessment of multimedia courses.
- Development of methodology to make use of pre-set software tools, which must facilitate the course development. Writing out guidelines to structure and to design a course for this purpose.
- Setting up an internet platform for collaborative course development (tele-working for teachers in different countries).
- The joint creation of several pilot courses by teachers .
- Working out a methodology of organizing collaborative tutorial sessions with a lecturer for a small group of students; working out self evaluating tests included in the courses.
- Testing out this ODL education methodology; evaluating the quality and 'friendliness' of all the ODL tools.

Beneficiaries of the Project

The public to study the pilot courses developed consists of university students in an engineering program: undergraduate students in a specialized year, e.g. last year students in engineering (architecture, mechanical, chemical, electronic, civil, manufacturing engineering...).

Nevertheless, the methods developed can be transposed to other *levels* e.g. postgraduate students or doctoral students, specialized company training, technical adult education program etc. The user group can be also easily broadened to other university *disciplines*, e.g. medicine, science, mathematics, language studies, teacher training,

The pilot educational sector consists of engineering departments of the partner institutions in the project group. But most partner institutions offer a large variety of study disciplines. Because the development basically surpass any discipline, they can have a strong multiplication effect to all course developers and trainers in the partner institutions.

The scope of the project could include the following items:

- Improve the skills of teachers to create their own interactive multimedia teaching materials. The creation of this type of courseware should be just as familiar as the use of a spreadsheet or word-processor.
- Stimulate the teachers to collaborate with colleagues across the borders, using collaborative work software on the www (tele-working). This kind of cooperation should be as familiar as going to a library for lending out specialized books.
- Through the multiplication of interactive courseware, students will become familiar with these tools and accept them as just as conventional as textbooks and other traditional material.

The expected results of the LINK project were supposed to be the following:

- The availability of user-friendly and platform-independent tools to create courseware.
- The availability of re-usable courses (software-modules) that are easily adaptable to answer specific needs.
- The establishment of an internet platform for tele-working: using "collaborative work software" installed on a web server at one of the partners' site.
- The dissemination of these ICT (Information and Communication Technology) tools among EU partners, in and outside the partnership.
- A further outcome is the establishment of a new collaboration between various European universities and schools for higher education, to develop course and curricula for and with each other.

IMPLEMENTATION OF PROJECT ACTIVITIES

There are several excellent tele-learning platforms on the market, combining several features in one package: giving access to course modules on the www, creation of a discussion forum, creation of asynchronous collaborative work groups with online file exchange, the realization of online testing (assessment tools and grade book), administration of student's activities (database reporting and course statistics), and offering the possibility of synchronous class discussions.

The possibilities of internet-based videoconference (IP based videoconference) have grown, because more bandwidth became available. ISDN based videoconference is still quiet expensive platform.

At the first meeting, the partners decided to put a lot of effort in the choice of a tele-learning platform, which includes the possibility of group communication

(synchronous chat room between different users, also called "virtual classroom"). This choice would omit the purchase of an ISDN based videoconference system, operating independently from the distance-learning tool. For this discussion and decision-making, an extra technical meeting was required. Each partner has made a survey of existing manuals and courses for multimedia production.

Each institution has made a glossary of existing CAL (Computer Assisted Learning) courses, developed by their own staff. Some of the authors attended the starting meeting.

Methodology and tasks – details of LINK project realization

- At the *starting general meeting*, the results of the preparation phase were communicated and the methodology discussion started. The advantages and disadvantages of previously used authoring software were discussed. Experiences in distance learning in Portugal, Italy, UK and Belgium have been exchanged.
- Advantages and disadvantages of several tele-learning platforms on the market have been investigated. The development of the Confad platform was prepared by the Italian partner. A demonstration of a preliminary course was given by the Antwerp coordinator, making use of the American Blackboard system.
- The starting meeting has lead to a work plan of the project.
- At the *technical meeting*, the organization of the collaborative course production was discussed. A demonstration of a draft version of a Confad platform-based course was given by the Italian partner. Pilot courses to be developed by the partners were chosen, and partners were paired.

Technical preparation

- A discussion forum was created at the Studio Teos (Italian partner in the LINK project) server, as well as the software for collaborative work. Installation of the server at studio TEOS has been done previously.
- Two tele-learning platforms have been selected: Blackboard and Confad.
- Licences for creating courses on the American Blackboard system have been paid.

At the *second general meeting* the following aspects still were discussed:

- The aspect, layout and content of the self-assessment materials that will allow the student to evaluate his progress in learning.
- The organization of tutorial sessions.
- The assessment of students at the end of the semester.

Pilot course development

Each partner institution was developing one or two new multimedia courses according to the models and tools defined during the project management meetings. The development of each course is done jointly by at least two institutions. In this way, the newly developed courses are discussed and evaluated by the different partners (peer review). Such joint work could be realized by means of the 'collaborative work' tool on the tele-learning platform. Tutorial questions to be solved by students had to be added to each module. This enabled to make the modules more understandable, and will broaden their insight in the matter.

Teacher instructions

At the *second general meeting*, pilot courses, quizzes and assignments under development were demonstrated (hands-on seminar on computers). During the second year, several teachers were accustomed with and trained to use the newly developed tools. These teachers are going to test the tools and methodology by transforming a small module of their classical course into a multimedia format. The teachers should be trained to use the internet to retrieve specialized information (data, images, graphs, charts etc.) for their courses. They should also be trained to communicate at a distance (e.g. via the www) with other teachers for collaborative course development. This training should be organized in each institution.

Evaluation

In the second year of the project, each course will be tested out by the home students: in each of the course developing universities, a group of students and one tutor are selected. The students study the course during the first (autumn) semester of the academic year. They evaluate the learning method by filling in a questionnaire. At the end of this semester, they are assessed by the course-developing teacher in a traditional way. The results of this examination will provide plenty of information on the quality of the courses. At a *third general meeting*, the methodology will be reconsidered and refined. The courses already developed will undergo modifications based upon the student reports and their exam results. They will be adapted to the new insights.

Evaluation

At the start of the next semester, the developed courses will be studied by a new group of students. Again, they'll evaluate the learning method by filling in an enquiry. At the end of this semester, they are assessed by the course-developing teacher in a traditional way.

A *mailing* will be done to related institutions (e.g. partners in the Socrates Institutional contracts). They will be asked to join the project in its dissemination phase.

Dissemination

Dissemination actions to promote the methodology among other institutions were undertaken. Interested institutions will be invited to share the results and conclusions as formulated during the *final LINK project meeting*. At this meeting the developed methodology and final evaluation report will be drawn up. Finally, for each course developed, a partner institution (or any other interested new partner) will adapt it to its own needs. In this way, each new course will be used by at least two institutions. Institutions who want to distribute the final course to a broader audience can transform it into a CD ROM.

LOCAL LINK PROJECT IMPLEMENTATION

This section includes the details concerning the work and results as obtained at the Silesian University of Technology, Gliwice, Poland, while participating in the Socrates/Erasmus LINK project.

In the pilot phase the work concentrated on two courses. The first one is called Signal Theory and is normally proposed to the students of the sixth semester, Electronics and Telecommunications direction, all specializations. Some parts of the course were presented to the students during summer semester in the PowerPoint version. The first modules were transformed to HTML version and presented to the students of the ninth semester, Automation and Robotics direction, Computer Controlled Systems specialization, as part of the course on Digital Signal Processing – laboratory exercises, as well as part of the courses on Adaptive Control and Computer Controlled Systems Programming. The modules were also translated into English language – in PowerPoint as well as HTML version. The second course was called Computer Systems and Networks and was typically offered to the students of the ninth semester, Electronics and Telecommunications direction, all specializations, nonobligatory course. The modules were presented in simple PowerPoint version and transformed into HTML. The course was offered in on-line version to few students in English language version, for the summer semester a Polish language version is being prepared for the students from Automation and Robotics direction.

The users of both courses are students of the Automation and Robotics, Electronics and Telecommunication and Computer Science faculty. Students are from both Automation and Robotics direction of studying as well Electronics and Telecommunication direction. Specializations include Computer Controlled Systems, Electronics Apparata, Biomedical Electronics, Telecommunication. Both courses could be offered to various groups of students from above mentioned directions and specializations. In principle the Polish language version has to be delivered to students, it may be of course accompanied by the parallel English version.

There were 16 students fully attending computer systems oriented course. These students were offered an examination tests based on the course contents and they attended the examination. This course is going to be continued for the approximately 30 students from the Computer Controlled Systems specialization as well as from Robotics specialization, during summer semester. The course on signal theory in off-line PowerPoint version (in Polish) was offered to about 100 students. The chosen parts of this course were presented to the 28 Computer Controlled Systems students as part of the Digital Signal Processing course laboratory.

Typical courses are composed of 30 hours, which comes from 15 weeks per semester and 2 hours per week (lecture). The course on computer systems and networks is such typical course with up to 30 hours of course. Signal theory course is a more intensive one and it takes 3 hours per week during the whole semester, which gives 45 hours.

The courses are constantly under development, some version were available after approximately 9 months, meaning that more intensive work started at the beginning of the year 2000 and some finished modules were presented at the beginning of the winter semester. On the other hand several lectures from the course were presented earlier, during the summer semester. On the even more other hand these lectures and computer systems and networks lectures were refined during the whole winter semester and they are still under development. Both courses were developed in two language versions as it turned out that in most cases Polish language version had to be used with respect to Polish students, whereas the English version was necessary because of the international collaboration.

The objective of the course is to teach basics of signal theory and basic principles of sharing media in computer networks, protocols, multi-users systems, network operating systems, local area networks, wide area networks, wireless networks, domain name systems, network security and management, tp, telnet, www, Java applications and applets.

The courses are typically structured into small modules. The simplest and usually adopted solution was to choose one lecture as one module, however, in many cases such concept would result in modules becoming too small.

There are nine signal theory modules, there are approximately 13 to 15 computer systems modules. The modules contents includes e.g. computer networks basics and structures and topologies, definition of signals, signals spectrum, aperiodic signals and Fourier transform, signals modulation, filtering and filters, signals sampling and restoration, also protocols, multi-users systems, network operating systems, local area networks, wide area networks, wireless networks, domain name systems, network security and management, tp, telnet, www, Java applications and applets.

Typical didactic strategies were used, basically tutorial, also case studies and examples. In the initial pilot phase self-learning was used

There were examination as well as questionnaires in the courses. The first version on the signal theory course has not included the assessment tools. The Digital Signal Processing laboratory course included some introductory tests. The computer systems and networks course for the chosen 16 students included full 5-questions examination.

The aim of the assessment and evaluation was obviously to form the basis for examination pass as well as for self-assessment. Self-assessment was planned after each module, examination and tests at the end of course

The tutors and teachers in the courses are consulting students, questioning students, assessing tests and examinations, now also preparing lectures and tests/examination.

Lectures were mainly produced with Microsoft PowerPoint, transformed to html, posted as external links with Blackboard. Some tests/examinations were tried with Confad. The activities included external materials editing, users organization, evaluation tools generation. E-mail was used as communication tool

Typical – not very serious problems – included the division of the courses in to modules and the choice of exemplary material, obviously also the test/examination questions were faced while working on the course contents. The more important were technical problems. The Blackboard online system is very good but it is very, very difficult to use it efficiently because of slow data transfer. The Confad system is accessed faster but often it is also slow in response and may easily hang-up. There were difficulties in assigning assessment materials to new courses under Confad. Obviously the best solution would have been to have local server at our university, also because of Polish language being the preferred language of presentation.

Technical problems are definitely not solved – they concern mainly the speed of accessing the servers outside Poland, specifically the Blackboard server in USA.

Students were semi-interested in the new form of course, they accepted it as just everything else during studying. They accepted the didactic materials, as usually they had to be accompanied by referenced books. The students accepted the platform utilities, however, they are usually nothing special in the today computerized and internetized world. They also did not complain with respect to the tutorial support.

The preparation of both courses and running them is an interesting experience and it makes the teacher to think through his didactic strategy and tools

FUTURE ACTIVITIES WITHIN LINK PROJECT

The proposed third year of the LINK projects consists of several activities concerning mainly further improvement of the produced multimedia courses for tele-learning platforms and disseminating the results of the project. It is foreseen that the outputs achieved during the third year of LINK would include the following:

- revised versions of multimedia interactive courses for tele-learning platforms;
- tools for semi-automatic translation of HTML based lectures to all LINK partners countries languages;
- other partner language versions of several produced multimedia interactive lectures;
- dedicated www sites at all partner institutions promoting the LINK project and its multimedia courses for tele-learning platform, also translated to the partners languages;
- dedicated www sites at all partner institutions promoting the open and distance learning paradigm as well as existing excellent tele-learning platform, also translated to the partners languages;
- reports concerning the LINK project achievements, prepared for LINK dissemination face-to-face sessions and meetings;
- overall report of the LINK project activities carried out in the third year and in all three years;
- localized versions of the Confad tele-learning platform developed by the Studio Teos LINK partner;
- reports on the methodology used and experience gathered while delivering the multimedia course by means of tele-learning platforms – prepared for transnational meetings.

The courses mentioned as outputs in will be directly used by students from participating universities, possibly by students from other universities approached in the dissemination phase and other'

The reports on the methodology used and experience will be used by teachers from participating institutions, invited institutions and other.

The dedicated www sites will be used by students and teachers from participating institutions and other universities.

The localized tele-learning platform and lectures will be used by teachers (lecturers) from participating university and possibly from other universities.

The overall report will be used by teachers and authorities at participating institutions.

The lectures being the output of the LINK project will be used in participating institutions as alternatives to standard version of such lectures.

Dedicated sites for LINK project based collaboration and results and ODL itself will be implemented and used by teachers and authorities from all participating partners.

Reports on teachers and students experience while trying to run the tele-learning platform-based courses, as well as overall project report will be used by teachers and authorities from participating institutions.

The project activities and results concerning the posted multimedia interactive lectures will be monitored by appropriate teachers and local coordinators.

The development and maintenance of the dedicated www sites will be monitored by local coordinators and LINK project coordinator.

All partners will be regularly contacted by the coordinator using e-mail facilities with respect to the dedicated www sites development, report preparation and tele-learning based revised versions of multimedia lectures usage.

The evaluation will be done internally during the LINK project realization. The strategy itself will be hierarchical, i.e. the activities performed will be evaluated by local coordinator along with local authorities and rules, whereas on the joint project level the evaluation will be done by the project Steering Group including the LINK project coordinator.

The evaluation of the multimedia interactive lectures will be done on the basis of students' and teachers' questionnaires.

The evaluation of the dedicated www sites will be done periodically by the appropriate coordinator, www design specialist and local university authorities and also on the basis of online questionnaires.

The evaluation of face-to-face dissemination meetings will be done by local coordinators on the basis of questionnaires prepared by LINK staff and filled by dissemination meeting participants, as well as by means of post-meeting e-mail correspondence.

As described above the dissemination activities are one of the most important for the proposed third year of the LINK project. It is supposed that the mentioned face-to-face meetings as well as specially prepared dedicated www sites would popularize the results and success of the LINK project and make other teachers and teachers from other universities interested in ODL techniques.

As the successful results of the project are going to be disseminated by means of dedicated www sites it is supposed that such dissemination would be successful also beyond the borders of the participating countries.

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