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Distance learning in a multimedia networks project: main results

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Abstract

This paper discusses a goal-oriented project called Distance Learning in Multimedia Networks (ETÄKAMU) that was a part of the Finnish Multimedia Programme (FMP). The project started in February 1996 and lasted until January 1999. The project combined the efforts of Finnish telecommunication companies, content providers, publishing houses, hardware companies and educational institutions in the field of distance learning.

This paper describes the background, the goals and part of the results of the ETÄKAMU project as well as the project's organisation. The main goals of the ETÄKAMU project were to research, develop and evaluate open learning environments using computer networks and computers in learning.

The pedagogical background of the project is based on seven qualities of meaningful learning that are applicable to lifelong learning independent of time and place. The ETÄKAMU project arranged teaching experiments and user trials for various learners in different content areas and in different learning environments. Feedback and data were gathered via an investigation of how various pedagogical and technical solutions function in practice. This paper presents some pilot areas of the ETÄKAMU project and main results received in the project.

Introduction

The Distance Learning in Multimedia Networks Project <http://matwww.ee.tut.fi/kamu> combined Finnish technical and pedagogical research centres and institutions in the field of distance learning, hardware and software producers, publishing houses and telecommunication companies in an extensive joint project. In 1998 the budget of

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the project was approximately US$900,000. The project was funded jointly by the National Technology Agency and by 32 Finnish enterprises. It was co-ordinated by the Hypermedia Laboratory of the Digital Media Institute at Tampere University of Technology (Pohjolainen and Ruokamo-Saari, 1997; Pohjolainen and Ruokamo, 1998, 1999).

The main aim of the Distance Learning in Multimedia Networks Project was to research and develop pedagogically appropriate and technically functional open learning environments for distance learning. The design of the learning environment was based on the rapid development of information technology, especially on broadband computer networks and hypermedia-based learning materials. The learning environments were studied and developed from telecommunications (hardware), hypermedia material (courseware) (Nykänen and Ala-Rantala, 1998; Pohjolainen *et al*., 1999a) and pedagogical points of view (Ruokamo and Pohjolainen, 1998; Pohjolainen *et al.*, 1999b).

Distance learning using multimedia was exploited by schools, educational institutions, and enterprises for all ages ranging from children to adult learners. Various pilot projects and teaching experiments were set up in ten pilot areas to gain feedback from the methods and solutions developed. The purpose of the teaching experiments was to test both the technical and pedagogical functionality of the distance learning solutions developed.

Collaborating partners
The Distance Learning in Multimedia Networks Project was divided between research and enterprise partners. The universities were the research partners in the project.

Research partners
- Tampere University of Technology / Digital Media Institute / Hypermedia Laboratory
- Helsinki University of Technology / Centre for Educational Technologies
- University of Tampere / Hypermedia Laboratory
- University of Tampere / Institute for Extension Studies
- University of Jyväskylä / Information Technology Research Institute
- University of Helsinki / Lahti Research and Training Centre

Enterprise partners
The project's enterprise partners were divided into steering enterprises and follow-up enterprises as follows:

Steering enterprises

- City of Jyväskylä
- City of Tampere
- Data Network Institute
- Edita Ltd.
- Helsinki Institute of Physics
- Helsinki Media Company Ltd.

- Helsinki Telephone Corporation–FINNET Group
- Jyväskylä Science Park Ltd.
- Lifelong Learning Institute, Dipoli Helsinki University of Technology
- Nokia Mobile Phones
- Otava Ltd.
- Sonera Ltd.
- Sun Microsystems Ltd.
- Tampere Technology Centre Hermia
- WSOY Ltd.
- Xenex Ltd.

Follow-up enterprises

- AAC-Institute
- Centre for Technical Training AEL
- City of Nokia
- CSC–The Center for Scientific Computing
- Finnet/TPO Ltd.
- Finnish Association of Adult Education Centres KTOL
- KVS-Institute
- Mänttä Regional Education Center
- Promanet Ltd.
- Promentor Solutions Ltd.
- STAKES (National Research and Development Centre for Welfare and Health)
- Teleste Educational Ltd.
- The Folk High School for Finns in Sweden
- The Subregion of South-East-Central Finland
- Valmet Ltd.
- WM-data Kasanen

The project's organisation and research activities

The organisation of the Distance Learning in Multimedia Networks Project was divided into a steering committee, a supporting group, research groups and pilot areas. The steering committee decided on general plans and co-ordinated the activities between industry and academia. The supporting group was composed of all the researchers of the project and staff from research units that were responsible for the project. The research activities of the ETÄKAMU project were divided between research groups whose objective were to produce knowledge in support of project activities, to function as a support for pilots, to organise necessary training, and to analyse experiences gained from pilots.

The three research groups concentrated on:

1. Development of a prototype of the A&O open learning environment (Pohjolainen *et al.*, 1999a, 1999b).
2. Development of the criteria for technical functionality and structure for hypermedia-based materials.

3. Development of methods for distance learning and pedagogical evaluation criteria for open learning environments (Ruokamo and Pohjolainen, 1998).

In addition to the three research groups several pilots were set up in various areas through which distance learning solutions in multimedia networks were carried out and feedback on the performance of technical and pedagogical solutions were obtained. The participants in the pilots were project researchers and the staff of enterprises, and teachers and students at educational institutions. The pilots were divided into the following pilot areas: 1. Broadband networks and technical experiments, 2. Natural sciences, 3. Language learning, 4. Education, 5. Communication, 6. In-house education for enterprises, 7. History and civics, 8. New learning materials for schools (KUOMA) (Leinonen and Ruokamo, 1998; Hämäläinen, 1999; Piiksi, 1999), 9. Finnish Children Abroad, and 10. Web University (WU) (Rinta-Filppula, 1998).

Pedagogical research problems

The ETÄKAMU project applied seven important qualities of meaningful learning—based on a slightly modified list by Jonassen (1995)—as guidelines in the design, implementation, and evaluation of the open learning environments (Ruokamo and Pohjolainen 1998,1999a, 1999b; Pohjolainen and Ruokamo, 1998). On the basis of the qualities of meaningful learning, the following research problems for the pedagogical evaluation of learning environments were set:

1. Does the learning environment support learner-centred learning?
2. Does the learning environment support learners' active construction of new knowledge on the basis of prior knowledge in interaction with the surrounding reality (Constructivity)?
3. Is the learner's role active and are the learners responsible actors in the learning environment (Activity)?
4. Can learners work together and construct new knowledge with one another while utilising each other's skills (Collaborativity)?
5. Has the learning environment taken due heed of learners' goals and does it support the achievement of their knowledge objectives (Intentionality)?
6. Are the learning tasks located in meaningful, real-world tasks from the perspective of the learner or is there simulation of this through certain case-based and problem-based real-life examples (Contextuality)?
7. Can learners transfer what they have learnt from that situation and context and apply that knowledge in other situations? Can learners utilise formerly learned knowledge and skills in the learning of new things? (Transferability)?
8. Is it possible for learners to articulate what they have learned and reflect on the thought processes entailed in the learning process and the decisions taken (Reflectivity)?

The foregoing pedagogical research problems served as the basis for the pedagogical evaluation framework of the learning environments. This is intended for the scrutiny of learning environments and learning from the learner-centred perspective, with consideration for the perspectives of both the learner and the teacher.

Main results

Pilot projects constituted an important part of the ETÄKAMU activity. It was the aim of pilot work to try out the methods developed and elicit feedback on the technical and pedagogical functionality of the systems. In the field of piloting the focus was on the further development of the learning environments, on data collection and evaluation work. Pilot studies were implemented in ten fields in over twenty pilot projects. The following presents an overview of the main results from certain pilot projects.

Java in distance learning

The pilot project Java in distance learning was implemented in the DMI Hypermedia Laboratory. It comprised TUT and three Tampere schools on the ATM network: Kaukajärvi School, Tampere Teacher Training School and Pyynikki School and also the joint network computer experimental environment of Ylöjärvi Upper Secondary School. JavaStations were used to carry out teaching experiments in which it was noted that they are well-suited to use in educational institutions (see Häkkinen in Ruokamo and Pohjolainen, 1999a).

Pythagoras

The Pythagoras pilot project resulted in the Pythagoras learning environment for statistics <http://matwww.ee.tut.fi/pythagoras/>. It is targeted at pupils of the secondary and upper secondary school. Experiments were carried out in numerous schools in the Tampere and Ylöjärvi areas. The outcomes of the experiments show that Pythagoras is viable as a learning environment for the study of statistics. The questionnaire-tool in Pythagoras was felt to be particularly good in that it enables users to publish their own questions on subjects which interest them on the web and also to collect answers from other users of the environment. It was possible for users to utilise the data they had themselves collected for subsequent project work (see Mäenpää in Ruokamo and Pohjolainen, 1999a).

New learning materials for schools (The KUOMA Pilot)

The KUOMA learning environment and EnvironmentNet <http://matwww.ee.tut.fi/ymparistoverkko> were developed for the study of environmental subjects. EnvironmentNet was tried out in 1998 in Pyynikki School and in Ylöjärvi Upper Secondary School. The experiences gained from the experiment indicate that EnvironmentNet provides good opportunities for learner-centred learning. In order that optimal advantage be derived from these, more technical and pedagogical education would be necessary for teachers in using EnvironmentNet. Pupils, too, would require more orientation (Piiksi, 1999).

On the KUOMA pilot a learning environment called Russian on the Net <http://matwww.ee.tut.fi/venaja> for elementary Russian was also developed. It was tried out in the Tampere Teacher Training School and Ylöjärvi Upper Secondary School. Results indicate that Russian on the Net brought variety and interest to the study of Russian, for teachers and pupils alike. Pupils reported that the environment was useful for learning, but there was still room for improvement (Hämäläinen, 1999).

Web University (WU)
Web University pilot <http://cern.ch/webuniversity> operated as a virtual university through which it was possible to participate in real time and interactively in lectures of the Academic Training Programme by CERN and in CERN Colloquium seminars (Rinta-Filppula, 1998). International interest, and the further development and expansion of the pilot have shown that transmitting lectures by top experts is appropriate using broadband network-based, videoconferencing techniques, and multimedia services. Distance learners have participated for a total of over 100 hours in two years in contact teaching realised through WU-mediated CERN contact teaching. Transmissions were in real time and were interactive. However, they were also recorded digitally on FUNET multimedia server <http://mbase.funet.fi/> (Rinta-Filppula, 1998; Rinta-Filppula and Penttilä in Ruokamo and Pohjolainen, 1999a).

The ETÄKAMU project developed many different learning environments for different target groups and learning contents; it also conducted a considerable number of teaching experiments. Most of the learning environments were available on the Internet. They utilised WWW hypermedia properties, the opportunities provided for situations and simulations. Communication and co-operation tools were built into the environments, likewise cognitive and materials-production tools. It was seen that technology can be used to aid the construction of pedagogically relevant environments and tools which support learning.

The new technology has been accompanied by certain problems. With the rapid development in browsers, plug-ins, script and programming languages and applications, the computer network environment is not yet stable from the technical point of view. In consequence of this, the existing learning environments must be constantly updated so that their operationality may be guaranteed. This problem may cause less trouble in the future, when the development in some respects reaches a plateau and commercial software dominates the markets.

Although hypermedia enables the construction and adaptability of documents there are as yet no systematic models of the structure of didactically appropriate learning material to be used more extensively. Standardisation of the document structure would enable the use of content in different environments and facilitate both flexible combination of contents and information retrieval. Learning material, generated by content providers and learners, constitutes an important part of the learning environment. Content production would increase considerably if producers had at their disposal a user-friendly, structured tool for the production of multimedia material.

Achieving objectives in distance learning entails not only sophisticated technology but also appropriate pedagogy and contents—these must serve the same purpose of learner-centred learning. Efficient application of the existing technological options requires also pedagogical research. An optimally efficient and meaningful learning environment commits the learners to active construction of knowledge instead of reproducing this. It further commits learners to discussion, interaction, co-operation and reflection of the parties in the learning process as opposed to the one-sided

reception of knowledge or replication. The content of the learning environment should engage learners in meaningful contexts and situations in which it is possible to utilise knowledge and skills already acquired and to transfer these to further situations.

The pedagogical evaluation framework developed in the ETÄKAMU project proved functional in the evaluation of learning environments. It is also applicable in the planning and implementation of learning environments and in supporting learning. Of the seven qualities of learner-centred learning it was constructivity, intentionality and reflectivity which were found to be best realised in learning environments enabling project work. The learning environments were also found to enable contextuality and transferability. Activity and collaborativity were seen to pose challenges in many environments: what turned out to be problematic was how to get learners motivated and committed to the learning tasks and to make active use of each other's skills and knowledge.

The technologies available today enable totally new learning processes. In addition to the participation of traditional actors (teachers, educational institutions, etc.) there are new actors and producers of services such as teleoperators, producers of technical support services, content providers, coordinators of production etc. The dissemination of educational technology services developed in pilots and scaling them for more widespread use is a worldwide problem. The efficient dissemination of educational technology, contents and services requires that common rules of play be agreed on. This could be achieved by the dissemination of best practices and flexible standardising.

The efficient use of information technology (IT) in teaching is still at the experimental and pilot stages. Good experiments have been conducted but they need support in order to be realised. The risk exists that after experimentation, once the technical and pedagogical support personnel have departed, the environments used during the experiment will not continue to be part of the everyday practice of the educational institution or enterprises. The environments used in the experiments were neither technically nor pedagogically perfected products. There is a need for more user-friendly technologies to support learning, likewise appropriate content and more widely applicable models. Introducing and using learning environments should be easy, and not require great effort. Individual experiments should progress to more extensive nation wide trials and action models.

Resources should be invested in basic and further education for teachers so that they acquire the necessary competence to use the pedagogical and technical advantages of the learning environments and derive benefit from them. Those responsible for education in enterprises should also receive training through courses tailor-made to suit their needs. At the present time the exploitation of IT in educational institutions is the responsibility of too small a number of active teachers. Maintenance of the schools' computer classes has proved problematic as there is a discrepancy between the time needed for this kind of work and the remuneration. Society should contribute adequately to improving the circumstances under which the new technology operates so that it can be introduced more rapidly.

The major developmental trends in education (see Carley and Dailey, 1998) are:

- sophisticated technology will play a greater role in education
- the role of commercialisation will increase
- the demands of lifelong learning and for educational services will be greater
- there will be redevelopment and reorganisation of education systems.

The work on the research, development and evaluation of distance learning on the multimedia networks has served to promote these general trends, with a particular advance in the combination of technology and education. The increased demand for varied educational services has come strongly to the fore. With the help of learning environments it is possible to break out of limitations imposed by the classroom and individual educational institutions and offer new opportunities for training for companies and adults. Making these new opportunities a reality requires that in the long term the educational systems will be reformed.

Due to the nature of the research and development project the role of commercial considerations was not accorded so much attention in the present research. Nevertheless the research findings of the ETÄKAMU project give good cause to make the transition from the phase of research and experimentation to product development.

The activity of the project on distance learning on multimedia networks served as proof of the need for co-operation between the various actors in the development of educational technology and its exploitation. Co-operation between research units, educational institutions and enterprises, software and hardware manufacturers, content providers and teleoperators has been fruitful and has served to open new vistas. This valuable experience serves as a good point of departure for possible initiation of national and international projects in the future.

Conclusions

This paper presented part of the main results of the Distance Learning in Multimedia Networks Project. One of the goals of the project was to develop open learning environments that are functional and appropriate from both the technical and pedagogical points of view. The development of environments has been continued in the Open Learning Environment Project <http://matwww.ee.tut.fi/ao> that started after the ETÄKAMU project.

The design and implementation of the open learning environments was quite challenging taking into account the rapid development of information technology in relation to learning theories. We still do not know how much the open learning environment, the structure of the learning material, and the tools designed, will support constructivism and learner's activity, collaboration, learner's intentions and contextual learning, transfer of knowledge, and reflection in real learning situations. It will be possible to answer these questions in greater detail in the Open Learning Environment Project once learning experiments using the open learning environment have been set up and the results analysed.

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