

Practical Experiences with using E-learning Methodologies at CICT

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Introduction

Center for Information and Communication Technologies (CICT), located at Technical University of Denmark (DTU) has for many years use ICT as an integral part of its teaching. This paper outlines how ICT and e-learning are used for providing teaching to students outside the campus of the Technical University of Denmark, where CICT is located. The paper will focus on e-learning used for postgraduate training, as e-learning is deemed to have the largest potential in this area. Postgraduate students will most often be full time employed elsewhere, and find it inconvenient to make frequent travels to CICT.

In order to put these experiences into perspective, different concepts for e-learning and their suitability as learning methodologies in different contexts are first discussed.

What is e-learning?

The idea of using computers as a learning tool is almost as old as the computer, and e-learning is one out of several concepts, which are used for describing a host of new learning methodologies using e-learning in parts of or in the entire learning process. Concepts like flexible learning, distance learning, tele learning and computer supported learning cover to a wide extent use of similar learning methodologies.

The EU e-learning Action defines e-learning as “the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration.”¹ This definition is rather broad as it neither specifies the kind of learning methodologies nor the kind of technologies supporting it

¹ The eLearning Action Plan – Designing tomorrow’s education. COM(2001)172 final
Communication from the Commission to the Council and the European Parliament, Brussels, 28.3.2001

(multimedia technologies may cover almost any kind of computer based applications). It does however distinguish itself from distance learning, which can be done without use of ICT technology. Moreover distance is not a necessary condition for application of e-learning, although one of the most important advantages by e-learning is the flexibility it offers with regard to distance.

E-learning can be facilitated by use of the Internet or any other type of communication technologies but not necessarily. E-learning per se does not demand any type of on-line access.

E-learning is not confined to any particular part of the educational system – rather the contrary: one of the advantages by e-learning is that it makes it possible to extend the reach of educational and training systems into new areas. Thus e-learning can be applied both in the formal educational system (public schools, colleges, universities etc.), as well as for vocational training. It can be used both for private use as well as in the public and the private sector.

A report from the Danish Ministry of Science, Technology and Innovation operates with four different types of e-learning methodologies, which illustrate the wide spectrum learning methodologies covered by the concept of e-learning (Box 1):

- Model A: E-learning where the teacher and the students never meet physically, and where no dialogue between students or students and the teacher takes place.
- Model B: E-learning where the teacher and the students never meet physically, but where the dialogue between the participants is supported by use of IT based communication services.
- Model C: E-learning where parts of the learning takes place in a class room and parts of the learning is done elsewhere, where the students work on a computer on their own – e.g. at home or at their place of work.
- Model D: E-learning where all teaching is done in a classroom, and where computers are used as a learning tool.²

² Danish Ministry of Science and Innovation: Perspectives for competence development: Report on E-learning, Copenhagen 2003.

Box 1: Types of E-learning methodologies

Model A: E-learning without presence and without communication

This type of e-learning can be done entirely off-line as all information can be stored on a CD-ROM or on a hard disk. Continuous or occasional on-line connection will however enable up-date of the teaching material.

The user is provided with information on a certain topic, and may thereafter be given training through a number of exercises. The user may also be tested through a number of multiple choice tests. The user may seek guidance through a help function or similar.

The main advantage by this type of e-learning is its flexibility. The learning can take place everywhere and at all times. This enables use of this type of e-learning exactly where and when there is a need to acquire a certain type of competence. On the other hand it is difficult to design the learning process according to the needs of the individual user, and the user cannot seek guidance beyond what is included in the e-learning system beforehand. The users must be able to work independent and solve unexpected problems by themselves.

This type of e-learning is mainly used for teaching in very specific competences such as use of a particular IT-system, training in a new sales concept etc. But the method is less suitable for teaching in general competences and is therefore difficult to apply in teaching at universities.

Model B: E-learning without presence and with communication

This type of model demands some type of connectivity. Communication can either be asynchronous (e.g. e-mail communication) or synchronous (e.g. chat rooms).

Communication can either be with a tutor or with fellow students. The model is almost as flexible as model A. As a tutor is involved in the learning process, use of an e-learning system will often demand the user to register as a participant if he wants to receive advice from the tutor.

The use of a tutor enables use of less automated training exercises and tests. The model can therefore be used for teaching where reflection and dialogue is important for the learning

process. The model is often used in situations where flexibility in time and space is important. For instance the model is used for cross-border teaching by American universities.

Model C: E-learning combined with occasionally presence

In this model e-learning is combined with traditional class room teaching. A wide spectrum of models is here possible. The ‘electronic’ part can be with or without communication and it can either be a minor supplement to the traditional teaching or the traditional teaching can be a minor supplement to the ‘electronic’ part of the course.

Use of classroom teaching adds to the economic costs, but it also helps to make e-learning more efficient as it facilitates a dialogue between students and between students and the tutor also outside the classroom.

As explained in further detail below, CICT use this model in most of its courses. In most courses, e-learning is used to supplement traditional classroom teaching, but in our teaching related to supplementary training e-learning is used more intensively.

The International shipping company Maersk uses e-learning as part of their Maersk International Shipping Education. This is a two 2-year education with 600 students from 80 different countries³.

Model D: E-learning used as a tool in class-room teaching

E-learning can also be used as a tool in the traditional classroom teaching. The major advantage is here that this enables use of modern pedagogic teaching methods. For instance use of games and scenarios in realistic settings.

The usefulness of the different models depends on the environment, the kinds of users and the type of competence that the learning process is aimed to develop. Different types of learning can be categorised according to the aims of the learning process⁴:

³ Danish Ministry of Science and Innovation: Perspectives for competence development: Report on E-learning, Copenhagen 2003.

1. Learning as a process for acquiring information;
2. Learning as a process for acquiring information and processing experience;
3. Learning as a process for acquiring information and processing experience that effects a long-term change in the consciousness of the learner;
4. Learning as a process for acquiring information and processing experience in which the learner integrates new information and experience into his/her current knowledge base;
5. Learning as a process for acquiring information and processing experience in which the learner perceives, selects and integrates new information and experience into his/her current knowledge base, thereby changing it;
6. Learning as a process for acquiring information and processing experience, in which the learner selects and constructs knowledge that is useful and appropriate for him/herself and in turn uses this to drive and determine his/her own continuous learning process;
7. Learning that becomes an individual process of interaction between the individual and his/her environment, in which the subjective reality of the learner is actively constructed.

Model A is most suitable for learning processes where little interaction is needed for instance acquiring of information. Model A may also provide individual exercises, but in many areas students will need at least some interaction with a tutor in order to discuss his/her solutions (model B). A long-term change in consciousness (3) may be difficult to obtain without any social interaction with fellow students. This points towards model C or model D. All models will however be able to include examples and exercises, which will be difficult to provide in a non IT environment.

E-learning at CICT

Current use in regular courses

As many other universities, the Technical University of Denmark uses an internal web-site for posting information to students. Each course maintains its own website with various

⁴ Graham Attwell a.o.: E-Learning in Europe Results and Recommendations – Thematic Monitoring under the LEONARDO DA VINCI-Programme. Nationale Agentur Bildung für Europa beim Bundesinstitut für Berufsbildung, Bonn 2003.

information on the course and access to course material etc. Tools for provision of interactive training is provided, but only few teachers use this opportunity, as it is very resource demanding to develop good quality material for this purpose.

Course in Hypermedia

Back in 1997-98 CICT established videoconferencing facilities in order co-operate with Intermedia at University of Aarhus (350 km from CICT). The facilities included two way-video transmission and the possibility of transmission of a PowerPoint presentations. The system was based on a 2 Mbit video link provided via the Nordic university network Nordunet. A video link established by a telecom operator would at that time be far too costly. Therefore the system could only be used for communication with other universities.

This system was used for providing a course in Hypermedia to DTU students. All lectures were conducted in Aarhus for students from Aarhus University and transmitted to DTU, so students from DTU were able to follow the teaching. Even oral examinations were done by use of the video link, so the same examiner could examine students from both Aarhus and DTU.

The technical performance of the system was not entirely stable, and it was necessary to have a technician in both ends to monitor the system during the lectures. The only reason that this way of teaching was acceptable to the students was that they had an interest in the technology itself.

Although this course was provided by use of e-learning methodologies, content and teaching methods remained unaffected. The course was developed as a traditional course with lectures, report writing followed by an oral examination. E-learning was used only to make the course available to more students.

mMIC – Master in Mobile Internet Education

When CICT created a new master education in 2001 in collaboration with Aalborg University, E-learning was a part of the concept from the very beginning. The master was designed especially for students working in the flourishing mobile communication sector. As most students had a full time job and were located in different parts of the country, it was not

possible to demand students to come to DTU or to Aalborg in order to attend courses lectures every week.

Therefore teaching was concentrated in 15 weekend seminars during a period of two years. The students were requested to deliver a short report 1-2 month after each seminar, and thereafter to present this report in an oral examination.

In order to reduce costs, the first day of the seminars was transmitted via a video link. In this way students from Aalborg only had to spend one night in Copenhagen.

Before each seminar, students were demanded to prepare themselves by reading selected textbooks and carrying out a number of partly interactive exercises provided by use of an e-learning tool.

The system applied was not particular advanced compared to what is available today. At that time DTU did not yet have a fully developed e-learning tool. Therefore a trial version of a system called Uniflex developed by researchers at Aalborg University was used.

Remote teaching during the seminars was done by use of a video conferencing system from Polycom. The conference system worked in real time, i.e., the students in the remote classroom could on one display see the students in other location. The lecturer was made visible at another display. The teacher was provided with his own display, where he was able to see the students in the remote classroom (Exh. 1).

Exh. 1 Distance learning at CICT



Apart from the live video connection, we used a data connection for the power point presentations. We tried by using these technologies to create a situation where the geographical distance didn't matter, and the lectures were given as in a traditional classroom environment.

In this way the students at both locations could see each other and participate in the discussions. There was a huge participation in the teaching from the remote site. The students felt like the video barrier was almost absent.

The teachers had to go through a learning and adaptation process before they felt comfortable with the new teaching environment. Although it was possible to see all students, it was much more difficult to secure a lively interaction with the students located at the remote site than with the students located just in front of the teacher.

All students were very enthusiastic about the program, but suggested to shorten lectures conducted on video. This indicates that lectures on video are more difficult to follow than ordinary lectures. On the other hand the students appreciated the flexibility enabled by use of e-learning.

It was clear from the responses that the quality of both video and sound was essential for the learning. Also the lightening of the classroom was important. A few lectures were transmitted by use of an ordinary ADSL line. Both video and sound went through without technical difficulties, but a lower picture resolution and a poorer voice quality affected the learning.

The students felt that it was important that only a part of the training was done by use of video. It was felt that it was important to be able to talk to the teacher directly at least a few times. This increased efficiency of the training – also the subsequent training made by video.

E-learning in Ghana

Late 2006 CICT will commence a remote teaching program in Ghana, using the same concept as the above mentioned master program. The program is a one year full time master program in ICT. Teaching is distributed over a period of two years, so the programme can be followed as a part time study. The target groups are professionals with a B.SC. in Computer Science or engineering with a minimum of two years working experience.

The objective of the education is to provide the participants:

- advanced and up-to-date knowledge in the fields they work, and
- necessary knowledge to make them better decision makers, by covering different key fields of ICTs.

This is done by:

- providing advanced teaching in the key fields of ICTs, and
- giving the participants proper tools to apply this knowledge in solving problems.

The program is offered in a co-operation between Ghana Telecom University College (GTUC) and Technical University of Denmark.

The participants are mainly designers of ICT systems and networks, engineers involved with strategy and planning for present and future use ICT and technical managers who want to make the right technological and industrial decisions. Target companies are equipment producers, software companies, network operators and information service providers.

Educational and teaching methods are based on 'Problem- based project- organised learning' with 50% project work and 50% courses. The teaching modes are a combination of:

- Seminars
- Video conference (lectures and discussions)
- WEB based Distance learning (courses, project work, etc)
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In this education we also use the live video conferencing system extensively in order to give lectures from Denmark to Ghana and also to do oral examinations. For supervision of group works we will rely mainly on e-mail communication, but we will use a video and audio conferencing system also.

The video system gives lots of possibilities for providing this type of education, but as mentioned above video and remote teaching will be supplemented with regular face to face teaching throughout the process. Face to face part teaching will be conducted in intensive 2-3 days seminars. These seminars will be organised by teachers from DTU coming to Ghana for the period of the seminar.

Before the seminars students must prepare for the course material, by reading course material and through interactive learning by use of an e-learning tool.

For the project supervision remote supervision may be sufficient but we have chosen to allocate both a local and a remote supervisor for each project group. The remote supervisor will provide special technical expertise while the local supervisor through regular meetings will facilitate more general aspects of the project work.

Is there a market for E-learning?

E-learning expands the potential for supplementary training offered by universities.

Official statistics measuring the level of e-learning activities are rather scanty, but a number of indicators exist. They all indicate that the market for e-learning is growing rapidly and that e-learning will become widespread in most types of private and public institutions engaged in training.

One of the most substantive surveys has been made by the British consulting firm Alphametrics on behalf of the EU Commission. Alphametrics has in co-operation with Bizmedia in 2001 and 2002 made surveys on the use of e-learning in Europe⁵. In 2002, 638 organisations involved in training (538 from Europe) responded in the survey. As many as 83% of the European respondents reported that they have used e-learning in some way as part of their training. Although organisations with an interest in e-learning will be more inclined to respond, this indicates that experiences with e-learning are widespread in Europe among institutions involved in training.

It must however be emphasized that the study by Alphametrics focuses on institutions involved in training. The penetration among private companies in general is much lower. For instance did only 6 out of 27 SMEs included in an Austrian survey use e-learning as part of their training⁶.

According to the survey prepared by Alphametrics in 2002, 45% of the time employees in the EU spent on training was spent in the classroom, 12% was spent on e-learning following model A or model B outlined above and 15% was spent on blended solutions following model C.

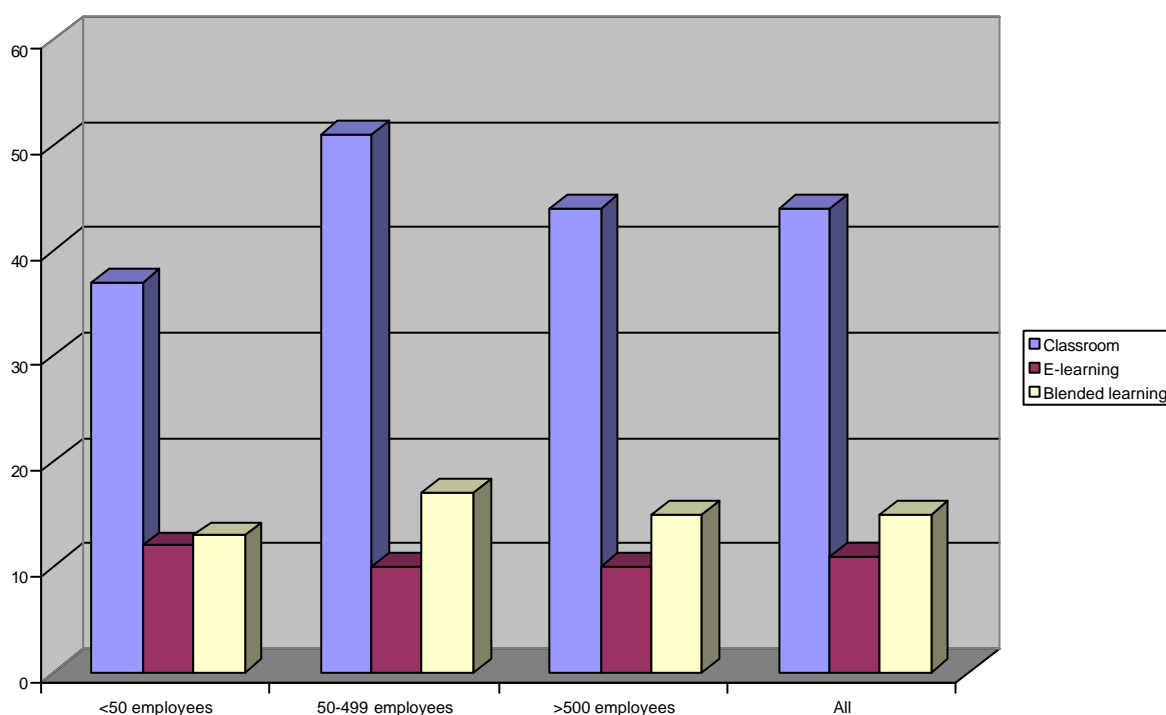
⁵ Jane Massy, Tim Harrison and Terry Ward: The European E-learning Market, BizMedia 2002.

⁶ Graham Attwell: The challenge of e-learning in small enterprises – Issues for policy and practise in Europe. Cedefop Panorama series; 82. Luxembourg: Office for Official Publications of the European Communities, 2003.

One interesting result is that the share of non-users is about the same in small and large organisations. This contrasts experiences made on diffusion patterns from a number of other new ICT based applications, where large organisations dominates the population of early adopters, while SMEs dominate the population of late adopters.

This indicates that e-learning is not only a technology, which provides economies of scale for large organisations, but also a technology, which can benefit small organisations. The survey indicates that classroom training is used less in small enterprises (37% of total time spent on training) than in middle sized (51%) and large enterprises (44%).

Figure 1. Users of training by time spent on e-learning, blended learning and classroom tuition by size of organisation in EU15



Source: Jane Massy, Tim Harrison And Terry Ward: The European E-learning Market, BizMedia 2002.

Although experiences with e-learning are widespread this does not indicate that the market for e-learning has matured. First of all the abovementioned survey only includes organisations involved in training. But the potential of e-learning goes far beyond such organisations. e-

learning is a flexible tool that can be used by any company or organisation in their daily business.

Second there is a potential to a more intense use of e-learning among those organisations already using this technology. And third there is room for qualitative changes in the technology and the opportunities it offers.

An indicator for the growth potential of e-learning is the growth in expenditures related to e-learning. According to the Alphametrics/Bizmedia survey users of e-learning reports that their growth in e-learning expenditures was more than 70% in 2001 and just under 50% in 2002. Suppliers of e-learning are reporting even higher rates of growth. This may be due to more optimistic market expectations than on the user side, but it may also be an indicator of increasing use of e-learning outside the traditional population of training organisations.

Connectivity is an important precondition for use of most types of e-learning, and provision of infrastructure and equipment was the first action line of the EU eLearning Action Plan⁷. Since then, much work has been done to ensure connectivity to educational institutions.

Use of e-learning is not equally widespread among industries. According to a survey conducted by Danish Technology Institute,⁸ e-learning is used most intensively in business services including consultancy firms, auditors and traders in real estate, while usage is least intensive in the building industry. A similar conclusion has been made by E-learning Circuits⁹. According to their survey Finance & Investment management is the largest user, followed by Consulting, Higher education and Manufacturing.

Looking at the subjects in which e-learning is used, all surveys indicate that e-learning is used most intensively for training in IT and computing, other important areas are teaching technical (non IT) and teaching in languages. E-learning is mainly used by professionals – particularly

⁷ Communication from the Commission to the Council and the European Parliament: The eLearning Action Plan Designing tomorrow's education COM(2001)172 final

⁸ Danish Technology Institute: E-learning in Practise (2003).

⁹ Ryann K. Ellis: E-learning Trends 2003. Learning Circuits
<http://www.learningcircuits.org/2003/nov2003/trends.htm>

IT-professionals – and technicians, while blue collar workers’ use of e-learning is very limited.

Table 1. Ranking of uses of e-Learning by time spent on e-learning as % of total time spent on training.

IT/computing	1
Technical (non IT)	2
Languages	3
Management	4
Process/production	5
Sales/marketing	6
Teamwork/communication	7
Quality	8
New products	9
Other	10

Source: The state of e-learning in Europe – Results of a Survey conducted by Alphametrics in collaboration with Cedefop. http://www.euolearn.net/docs/CEDEFOP_ELEARNING.PPT

In general the European market for e-learning is a very segmented market split into a large number of regions. One reason for this is language and cultural differences. There are however, signs of change particular in working place related e-learning, where the market is becoming more international oriented.

A preliminary study prepared by Danish Technology institute in cooperation with Alphametrics indicate that the majority of suppliers of e-learning are small businesses or even micro businesses without cash reserves and with limited growth potentials. There is however also a small number of large suppliers, mainly with a US parentage, e.g. publishers, universities and broadcasters providing their services in several countries.

Universities are not included in this survey. But there is a number of university institutions like CICT engaged in providing e-learning to external students. Many of these institutions are teaching in subject related to ICT, as they are the ones having the technical capability to set

up e-learning facilities. However, others are very reluctant to go into this business. They lack both funding and short term economic incentives. This is one of the reasons for setting up public funded e-learning programmes as it is done in a number of countries.

Box 1. E-learning provided by publishers

Publishers of university textbooks offer e-learning material, which supplements the textbooks. For instance, Prentice Hall has produced a number tests and exercises connected to each chapter in a textbook, which students can use for testing their understanding of the texts. These texts are made available on their web-site and can be used as part of the teaching at universities using books from Prentice Hall in their courses¹⁰.

Conclusion – E-learning at University institutions

E-learning offers a wide range of possibilities for universities. These relate to course content, teaching methodologies as well as extension of the population of students. In particular in supplementary training flexibility is important.

Moreover E-learning has helped in the shift from a teacher centred model (lecture, notes, examination) towards a learner centred model (problems, literature, information, investigation, discussions). This paradigm shift started before introduction of e-learning, however e-learning supports this change of direction.

This paper has focused on how the flexibility offered by use of e-learning tools can be used to offer supplementary training to students located either abroad or in other parts of the country. The most important lesson from the experiences learnt so far is that although substantial part of the learning can be done by use of ICT, it is essential for the students to meet occasionally. Once personal contacts to students and fellow teachers are established, interactive learning by use of on-line communication can be performed much more efficient.

¹⁰ See e.g. <http://www.prenhall.com/blanchard/>

Another experience is that preparation of an e-learning course demands substantial resources – even if the technology is in place. This limits the use of e-learning for specialised university courses with a limited target audience.

A third experience is that technology plays an important role. The quality of video and sound is more important than expected in order to ensure efficient learning.

There is a fast growing market for supplementary training also in areas where universities possess the relevant competences. However, substantial resources are needed if this potential is to be utilised. If successful, universities can use this opportunity, not only to expand their business, but also to upgrade teaching of their regular students.