The future of learning: From eLearning to mLearning

by

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This project is supported by the Leonardo da Vinci programme of the European Union

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CHAPTER 1. THE FUTURE OF LEARNING

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The project

The Leonardo da Vinci project From eLearning to mLearning is a harbinger of the future of learning.

The project sets out to design a learning environment for wireless technologies and provides this model of the environment:

The project seeks to put in place a new virtual learning environment which might be represented thus:

![Wireless Virtual Learning Environment of Tomorrow](image)

The project will do this by trialling and evaluating the didactic dimensions of three technologies, already developed, which are the harbingers of the wireless society of tomorrow.
It also set out to develop course materials for a range of devices in this learning environment and to trial the courses with real students in real learning situations.

At the dawn of the third millennium Ericsson and Nokia announced that there would be 1,000,000,000 mobile telephones in the world by 2002. The world population would be just over 6,000,000,000.

With the successful development of Bluetooth, WAP (Wireless Application Protocol), GPRS (General Packet Radio System) and UMTS (Universal Mobile Telecommunications System), the technological structures for wireless telephony and wireless computing are now firmly in place.

All over Europe today wireless technologies and applications are replacing wired ones: e-Commerce is moving to m-Commerce; m-Business is replacing e-Business; venture capitalists are snapping up WAP application providers as they appear; the site http://www.ericsson.se/letswap lists WAP applications for stock exchanges. booking flights the WAP way, instant mortgages over WAP, banking with WAP.

The list of 3G (third generation) wireless services is breathtaking, with applications already developed for refrigerators, business and the home. The move to wirelessness in telephony and computing is irreversible.

Only in the fields of education and training are there no applications in development or planning.

This project sets in place the first stage in the creation of a global provision of training on the wireless internet. It sets in place the first building block for the next generation of learning: the move from distance learning (d-Learning) and electronic learning (e-Learning) to mobile learning (m-Learning).

The status of learning

The evolution in education and training at a distance can be characterised as a move from dLearning (distance learning) to eLearning (electronic learning) to mLearning (mobile learning). These three stages of development correspond to the influence on society of the Industrial Revolution of the 18th to 19th centuries, the Electronics Revolution of the 1980s and the Wireless Revolution of the last years of the 20th century.

The Industrial Revolution
Distance education and training was born of the developments in technologies associated with the Industrial Revolution in Northern Europe and in North America in the late eighteenth and early nineteenth centuries.

It was no accident that teaching at a distance began with the development of industrial technologies, especially in postal communications and transport. The first trains and the first correspondence courses started at the same time.
Even today distance training would not be possible in a society that had not yet achieved an adequate level of industrialisation.

It is of interest that the government of North-Rhine Westphalia chose to locate its open university at Hagen, because the wire- and needle-making industries in the valleys of the Hönne, the Ihmertebach, the Oese and the Lenne, at towns around Hagen like Hemer, Iserlohn and Altena, were the harbingers of the Industrial Revolution from the 1680s onwards.

It is an interesting coincidence that the theory of distance training as the most industrialised form of teaching and learning was developed by Peters (1994) who was to become the first Rektor of the Distance University at Hagen.

**Electronics Revolution**
The telecommunications industry underwent swift and complex changes in the 1980s, which constitute an electronics revolution. These changes can be attributed to three factors:

- an urge to deregulate
- speeding up of chips
- introduction of broadband technologies.

Prior to the Electronics Revolution, governments regarded telecommunications as a lucrative, monopoly industry. It was linked to secret defence installations. There was total regulation. Development contracts were negotiated between the few monopoly providers and the military or government contractors.

Policies, however, associated with the Thatcher government in the United Kingdom led to open tenders, and a seeking for improved services, and better value for government money.

Policies associated with the Reagan government in the United States of America led to the breaking of monopolies, especially for the new cellular licences. Telecommunications became consumer driven.

Computing technology was introduced into telecommunications in the 1960s with the first public, analogue software switchboards dating from the mid-1970s. These were digitalised almost immediately, and were followed by the development of Integrated Services Digitalised Networking (ISDN) in the 1980s. In the 1990s, seamless digitalised connections between fixed and air networks were achieved. In all these developments, the ever-increasing speed of chips was crucial. The process will be accelerated with the replacement of silicon chips by nano-chips in the early 2000s.

The development of broadband technology is of vital importance for distance training, because one needs extensive bandwidth for pictures, audio, video and virtual realities. Broadband is usually defined as rates of more than 2 Mbits per second over a public switched network. Interactive multimedia, image processing, data and video are all large
consumers of bandwidth.

The electronics revolution of the 1980s led to group-based distance training and opened the way to the net and the web.

**A Mobile Revolution**

In late 1999 the population of the world reached six billion for the first time. Almost the same day Ericsson and Nokia announced that there were 500,000,000 mobile phones in the world and there would be one billion by 2004.

**The mobile revolution has arrived.**

The electronics revolution of the 1980s changed the nature of distance education, making it possible to teach face-to-face at a distance, to restore eye-to-eye contact electronically, and to teach groups as well as individuals at a distance. The mobile revolution of the late 1990s will change the distance student from a citizen who chooses not to go to college, to a person who not only chooses not to go to college, but is moving at a distance from the college.

The development of the didactic structures for the implementation of the mobile revolution will fall largely to the open universities and the government distance-training systems, as there is little likelihood that universities will focus didactically on students who choose to be mobile away from them.

If there is a rule about the choice of technology for distance training it is that technologies that are available to citizens may succeed. Rarely has a technology penetrated so quickly and so widely as the mobile telephone.

There is an unprecedented takeup of wireless telephones and wireless computers in developed and developing countries alike. The World Wide Web and the Internet are not enough, says the telecommunications industry: wireless access independent of location and Internet services everywhere is the requirement. The air interface is replacing the wire interface.

At the time of writing we have only seen the beginning of the wireless information society. But the protocols for provision are already being put in place: Bluetooth, GPRS, WAP.

Bluetooth is the universal radio interface for wireless connectivity. Previous portable devices used infrared links, were limited to 2m, were sensitive to direction, needed direct line-of-sight, could only link two devices. By contrast, the Bluetooth air connectivity uses radio links, which have much greater range, can function around objects, can go through certain materials, can connect to many devices at the same time.

General packet radio system (GPRS) brings official data and internet connectivity to mobile terminals giving instant, transparent, IP access with no call set up time. Wireless access protocol (WAP) brings web browser usability of the Internet to mobile terminals. It provides data-oriented, non-voice, services, anywhere and at any time The major manufacturers are committed to global standardisation of third generation mobile systems in radio environments like wide-band code division multiple access.
The challenge for distance systems at the dawn of the third millennium is to develop didactic environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion users. The mobile telephone is becoming a trusted, personal device with Internet access, smart card usage, and a range of possibilities for keeping the distance student in touch with the institution’s student support services, in contact with learning materials and fellow students, while at home, or at work, or travelling.

Statistics

The statistics of mobile telephone availability are an indicator of the need for mLearning.

In distance learning history, systems have always followed the availability of the technology near the distance students. Technologies with excellent didactic facilities, like 12” laser discs in the early 1990s, were not a success because they were not available in the homes of students.

There has never been a technology that has penetrated the world with the depth and rapidity of mobile telephony. Over 500,000,000 are available today with forecasts from Ericsson and Nokia stating that there will shortly be 1,000,000,000 in a world population of 6,000,000,000.

This penetration has been in both the developed and developing world. Statistics released by Ericsson in mid-2001 showed that communist China had the world’s greatest number of mobile phones at 170,000,000, ahead of both the USA and Japan.

Empowering Technologies provide in 2001 telling statistics about the Mobile Learning Era:

The Mobile Learning Era
The evidence is overwhelming that mobile learning is beginning to take hold:

- Over 50 percent of all employees spend up to half of their time outside the office.
- More than 75 percent of all Internet viewing will be carried out on wireless platforms by 2002.
- Mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.
- More than 525 million web-enabled phones will be shipped by 2003.
- Worldwide mobile commerce market will reach $200 billion by 2004.
- There will be more than 1 billion wireless internet subscribers worldwide by 2005.

Of particular importance is the statement that mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.
The nature of technology in learning

Throughout the 20th century there were developments of the role of technology in learning.

Pressey's testing machine of 1926-27 is well known but his main contribution to educational technology lay not so much in his machine as in his strong belief that an industrial revolution in education was about to dawn, bringing great benefits of more effective and more efficient learning. He pursued this dream for several decades, although he had little time for programmed learning or for teaching machines when these came along. Even his own machines were thrown away in favour of a small card with blobs of ink on it; the learner erased the blob over the answer he thought correct, and underneath was a symbol that told him whether he was right.

"We are on the threshold of an exciting and revolutionary period, in which the scientific study of man will be put to work in man's best interest. Education must play its part. It must accept that a sweeping revision of educational practices is possible and inevitable". With such evangelising zeal did Skinner write in his 1954 article The Science of Learning and the Art of Teaching.

Skinner saw four serious shortcomings in the educational system:

- The reinforcers used were still aversive
- They were used too long after responses had been elicited
- The progression towards the required behaviour was poorly arranged
- Reinforcement was provided too infrequently.

Skinner suggested that few teachers, if any, could remedy these shortcomings working alone with a group of pupils and proposed that machines might be employed to perform most of the function the teacher could not perform, as well as some of those she could. Skinner saw programmed learning and teaching machines as part (if not all) of an overall improvement in teaching techniques.

The use of technology in learning is different in its use in traditional group-based face-to-face teaching and in distance education, which is frequently individual-based and separates the learner not only from the teacher but also from the learning group.

Traditional group-based face-to-face education and training has used technology as a supplement to the teacher, and differs from distance education in which technology is a substitute for the teacher. However, in the late 1990s, with the arrival of the WWW and the provision of some universities of web based courses in place of lectures, the web has become an option on the campus as well as at a distance.

In distance education one can follow the development of a series of developments of the use of technology for teaching. The first generation uses the technology of printing and was basically the provision of print based materials for learning. A second generation added multimedia including audio, video and CD Roms to replace or supplement the print-based materials. The third generation of the 1990s was the impact of eLearning and the arrival of the WWW.
The future of technology

Present day technologies are presented by Bates in The Changing Facades of Virtual Education (2001) thus:

The Web is becoming a dominant technology where people have access to it. Because of its capacity to reach thousands of learners with a service of a defined standard, satellite broadcasting still plays a valuable role in many developing countries where a large number of learners do not have access to the Internet. Videoconferencing, on the other hand, has limited uses, is dependent on very low telecommunications costs and lacks the flexibility and potential of the Web.

The challenge for distance systems at the dawn of the third millennium is to develop didactic environments for mobile phones and mobile computers as the availability of mobile devices spreads to a billion users. The mobile telephone is becoming a trusted, personal device with Internet access, smart card usage, and a range of possibilities for keeping the distance student in touch with the institution's student support services, in contact with learning materials and fellow students, while at home, or at work, or travelling.

The mid 2000s seem to be the indication for the general availability of voice synthesis, voice recognition and voice input into telephones and computers, whether fixed or mobile. There should again be benefits for distance systems rather than on campus, because of the greater reliance of distance students on correspondence, assignment preparation, and assignment submission.

Far from seeing conflict in the tensions listed above, the vision here is of the richness and choice that confronts the learner in the twenty-first century for both education and training: schools, colleges and universities will continue to prosper, as will systems based on teaching at a distance. Teaching face-to-face at a distance in virtual and electronic systems will continue to prosper, as will training on the World Wide Web. To these will be added the boon of Bluetooth and mobile technologies, with the elimination of wiring and fixed installations for many applications, and the further blessing of voice input into machines.

The future of learning

E-Learning is the state of the art in distance learning at the time of writing.

Many have seen it as the 'killer application' for telelearning as in Collis' Telelearning in a digital world: The future of distance learning (1996). E-Learning means the award of nationally and internationally recognised university degrees, college diplomas and training certificates to students who spend all or much of their study programme sitting in front of a computer.

It is not yet clear that the distance learning market in Europe has been
transferred from print-based courses to eLearning but a growing number of institutions are providing some electronic component in their distance systems, even if it is only an email contact to the administration or the tutor. At conferences and groupings of distance educators, however, the talk is all of eLearning and pre-electronic forms of distance education are scarcely discussed.

The next task of the future is to build the same systems for wireless computing and telephony as eLearning has provided for wired computing and telephony.

The wired learning environment of today might be presented diagrammatically thus:

![Wired Virtual Learning Environment of Today](image1)

The project seeks to put in place a new virtual learning environment for the future which might be represented thus:

![Wireless Virtual Learning Environment of Tomorrow](image2)

The project will do this by trialling and evaluating the didactic dimensions of three technologies, already developed, which are the harbingers of the wireless society of tomorrow:

This will be followed by the mid 2000s by the introduction of voice input and voice recognition into wireless devices to create a more user-
friendly environment for learners.
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The nature of dLearning definition

dLearning refers to distance learning.

Distance education is used in this study in its legal sense for the provision, either public or private, of education and training for nationally recognised degrees, diplomas and certificates, to students who choose not to, or who are unable to, or who refuse to, attend the schools, the colleges, and the universities which society provides for the purposes of learning.

Clearly the choice of terminology like, ‘students who refuse to go to college’ is that of the analyst or the stocktaker, and would not be used by stakeholders who choose to champion distance learning or criticise campus universities.

There will always be a need for a term to characterise the sector of education which offers educational qualifications to those students who do not attend educational institutions, and it seems appropriate to use the well-established term distance education for this sector, whether the provision is made electronically or not.

Besides these legal dimensions, the study is based on a previously published definition: (Keegan 1996:50)

Distance education is a form of education characterised by:

- The quasi-permanent separation of teacher and learner throughout the length of the learning process (this distinguishes it from conventional face-to-face education);
- The influence of an educational organisation both in the planning and preparation of learning materials and in the provision of student support services (this distinguishes it from private study and teach-yourself programmes);
- The use of technical media - print, audio, video or computer, or the world wide web, to unite teacher and learner and carry the
content of the course;

- The provision of two-way communication so that the student may benefit from or even initiate dialogue (this distinguishes it from other uses of technology in education); and
- The quasi-permanent absence of the learning group through-out the length of the learning process so that people are usually taught as individuals rather than in groups, with the possibility of meetings, either face-to-face or by electronic means, for both didactic and socialisation purposes.

The World Bank web site gives shorter definitions in its glossary of distance education terms:

Distance education: Teaching and learning in which learning normally occurs in a different place from teaching.

Distance learning: Term often used as synonymous with distance education, not strictly correctly since distance education includes teaching as well as learning.

The question raised by these concepts for the analyst is that society has for some hundreds, if not thousands of years, provided itself with locations called schools, and higher level locations called universities, at which the teaching-learning interaction takes place. The question for the analyst is whether institutional learning is essentially linked to these privileged places for institutional learning created by society.

Distance education students choose to remain in employment, at home with their families. They refuse to give up their jobs to study. They expect to be given institutional learning at home and, more and more frequently as the new millennium starts, university degrees at home, isolated in front of a screen. The ideas of Von Humboldt, or Arnold, or Newman that universities are places where students come together for the purposes of learning, do not convince them to travel to colleges and to reside at them.

Historians of Western education trace the origins of conventional face-to-face education back through the centuries, showing how it evolved through the dialogue, lecture, seminar, tutorial, laboratory practical and library resource centre to the provision in schools, colleges and universities today. This is characterised by (i) face-to-face provision, (ii) between teacher and learner in the learning group. (iii) based on interpersonal communication.

Teaching at a distance (dLearning) is more recent going back only 150 years to the developments of technology associated with the Industrial Revolution, especially in transport and communications. It is characterised by the separation of the teacher and the learner and of the learner from the learning group, with the interpersonal communication of conventional education being replace by a mode of communication mediated by technology. Correspondence schools, open universities and other structures of today provide this complement and enrichment of conventional provision.

The first distance educators made it possible for the first time in history to learn at a distance by separating the teacher from the learner and separating the learner from the learning group. This brought great benefits to learners as it freed them from the timetabling of lectures and of training sessions in the company training centre and enabled them to learn at times of their own choosing and in places not specifically designed for learning.
Rapid advances in information technology associated with what may be called an electronics revolution of the 1980s made it possible for the first time in history to teach face-to-face at a distance. By electronically linking students and teacher at various locations by cable, microwave ion satellite it becomes possible to create a virtual classroom.

Two forms of dLearning

As the third millennium starts, the impact of distance systems is demonstrated by the development of both group-based distance training systems, and of systems for individual learners.

Group-based dLearning systems are referred to as 'distance learning' in the United States while individual-based systems are referred to as 'distance education' in Europe.

In this analysis group-based systems are divided into systems for full-time students and systems for part-time students, whereas systems for individual learners are best described as being based on pre-prepared learning materials, or not providing pre-prepared materials.

Group-based distance training links the teacher and the learners in several geographic locations by simultaneous audio, video, or satellite links, to a network of remote classrooms.

Group-based distance training for full-time students

Research on the Chinese Zhongguo guangbo dianshi daxue (Dianda) system in 1989 (Keegan 1993) showed that it was a network of radio and television universities for largely group-based, full-time students. The Dianda network uses satellite technologies to reach groups of students throughout the country.

Television and other distance learning materials are produced, mainly, by the Central Chinese Radio and Television University (CRTVU) in Beijing, which prepares the materials but does not enrol students. The television lectures are distributed by satellite links to students enrolled in, and grouped at, the forty-four open universities throughout the country, where tutors are present and learning materials are studied.

The statistics show that 97 per cent of the Dianda network enrolment in the mid 1980s was full-time students at a distance, with the figure dropping to 16 per cent recently. Total enrolment varied between 500,000 and 800,000 per year.

Today the percentage of full-time students is below 10 per cent as the spread of the capitalist ideology in China has largely eliminated study leave for distance training.

In the 1980s the full-time students in the Dianda system received three years study leave on full pay to complete their degree. They travelled on a daily basis to their factory or workplace, where they went to the education centre, rather than their place of work. Their daily study programme began with the first of the live television lectures from Beijing, and these lectures were interspersed with tutor-led discussions and assignment work.

In the category of group-based distance education for full-time students one should also include much of children's distance study.
Distance education for children was initiated by the Australian state governments from 1914. By the mid 1920s all the state and provincial governments of Australia, Canada and New Zealand had a full-time distance education provision for children. To these were later added the Schools of the Air for outback children in Queensland, New South Wales and South Australia where short wave radio links and, today, web-based links unite isolated students on large farming properties in class groupings.

More recently, since 1939, the French government through its Centre National d'Enseignement à Distance (CNED) provides a full-time distance education provision for children globally.

The scientific importance of studying group-based distance training for full-time students, is that it gives important data and can correct research viruses in studies which have been undertaken without counting the full-time students.

Full-time distance students, for instance, do not drop-out any more than students in full-time face-to-face provision. They take the same length of time to study a diploma or degree programme as students in conventional colleges or universities. Children also do not drop out from distance education programmes, nor do they take longer for their studies than their counterparts in schools.

*Group-based distance training for part-time students*

Just as the wondrous developments of technologies in the Industrial Revolution of the mid-nineteenth century brought to students worldwide the benefits of individual-based distance education, so the wondrous developments of technologies in an Electronics Revolution of the 1980s brought students the benefits of group-based distance education.

This is the dominant mode of provision in the United States of America, where distance learning has become a major form of educational provision and of business training. It has an active organisation, the United States Distance Learning Association (USDLA), to promote its interests. This professional distance education association groups multinational and corporate providers with the universities. This mode of distance education comprises preprepared materials, satellite lectures and individual study at home.

In practice, distance learning can mean that the university professor at a large number of US universities, proceeds to the lecture theatre to deliver his or her lecture to the students assembled there, and the lecture is up-linked to a satellite, from which it is down-linked to groupings of students assembled in other locations throughout the state or the nation. These students are usually linked to the central lecture theatre by a telephone hook-up.

One-way video, two-way audio satellite, or two-way video, two-way audio compressed videoconferencing, are perhaps the dominant technologies at the start of the third millennium, but a wide range of options is available.

At the turn of the millennium, most of the hundreds of thousands of students in the Chinese Dianda system are properly located in this category, as part-time training has replaced full-time study at a distance.
European theorists have been slow to acknowledge the rapid spread of group-based systems as a complement to the individualised systems with which they are more familiar. The dimensions of the field cannot be appreciated without considering both modes. Misunderstandings in the literature can arise from trying to treat both modes of provision identically, without appreciating the crucial didactic and logistical differences between teaching adults in groups or as individuals.

Similarly, another standard form of provision of group-based distance training in the United States of America: two-way video, two-way audio compressed digital video conferencing has also had little success in Europe.

In the United States, it is regarded as a form of provision for, say, a masters degree in nursing at the University of Albuquerque, in which full-time nurses, working in hospitals, as much as 300 kilometres from Albuquerque, take their courses. In American practice, it is considered sensible to provide these professional qualifications, even at a videoconferencing rate as low as 112k per second, to students who would otherwise have to drive 300 kilometres to Albuquerque, after a long day's work in the hospital, and then drive the 300 kilometres back, to resume work in their hospital.

**Individual-based distance training**

Over the last 150 years nearly all European distance training has been individual-based with pre-prepared materials. This has tended to focus European practitioners and theorists on this mode of provision. Again it is possible to identify two subsystems of this mode of provision: systems based on pre-prepared materials and systems without pre-prepared materials.

**Individual based distance education with pre-prepared materials**

Developments of communication technologies in the 1840s in Northern Europe and North America, laid the basis for training at a distance. For the first time it became possible to separate the teacher from the learner, and the learner from the learning group, and for students to learn from teachers individually at any place or at any time they chose.

Individual-based distance systems are to be found worldwide. The major characteristics of these systems are the scientific preparation of distance materials for individual learners, and the design of student support systems for students studying individually at a distance.

In this way, students worldwide benefit from being freed from the tyranny of timetabling: travelling at fixed times and on fixed days to join other persons at universities and training centres for the purpose of being trained. Learning systems were also freed from streaming: the inherent characteristic of conventional face-to-face group-based education and training in which students of varying intelligence and of varying studying backgrounds, and of varying degrees of motivation, are taught the same content in the same groups. The invariable result has been the holding back of the highly intelligent and the highly motivated, with slower or inferior learners learning less then they might.

The rapid development of the internet in the years 1995 to 1999 has created a new global dimension for this form of training provision, as individuals all over the world study for degrees or other qualifications from their computer screens either at home or at work.
In the period 1995 to 2000 the whole world was going mobile, as mobile telephones and mobile computers allowed individual students anywhere to study their courses and communicate with the university while travelling.

As the third millennium commenced, the wireless linking of students travelling at a distance in individual-based distance systems, with pre-prepared materials, is the latest possibility, creating not just students studying at a distance, but the student studying while travelling at a distance as well.

Most of the European systems are correctly located in this classification whichever of the four major models they follow: the open university model, the government distance training institution model, the private distance training institution model, or the provision of training at a distance from conventional universities model.

In spite of the extensive provision of group-based distance education in China, there is very extensive provision of individual-based distance education as well.

At least one million students in China are enrolled each year in programmes which can be labelled correspondence education. There are several kinds of correspondence education in China but by far the largest is that sponsored by the conventional universities. It is widely used in teacher training and general higher education, as, for example, at the People’s University in Beijing. Correspondence education has been localised in the various Chinese universities in their surrounding areas but has nationally become the biggest contributor of diploma and degree graduates at a distance to higher education.

In spite of the extensive provision of group-based distance education from conventional universities in the United States of America, there is a very large provision of individual-based distance education with pre-prepared materials as well.

In the proprietary sector, these providers are grouped in The Distance Education and Training Council (DETC), based in Washington DC, which groups military, church and business organisations providing training at a distance throughout the United States of America.

Allied to this is the provision through universities affiliated to the The National University Continuing Education Association (NUCEA), which groups departments in many United States universities, which provide distance training courses to individual students studying at a distance, rather than the electronic groupings of students analysed in the previous section.

There is now little doubt that the World Wide Web is the most successful educational and training tool to have appeared in a long time. It combines and integrates text, audio, and video, with interaction amongst participants. It can be used on global scale and is platform independent. While largely an asynchronous medium it can be used also for synchronous events. It is not surprising therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the web as a medium for training.

In spite of the possibility of linking distance students electronically and synchronously on the web, the vast bulk of web-based provision is
properly located in the category of individual-based distance education with pre-prepared materials. 

Individual-based distance education with pre-prepared materials is the proper location for nearly all the open universities throughout the world. Many of the open universities were founded in the 1970s and the 1980s and are now national institutions of great prestige and excellent quality. Few are new or experimental. Most have decades of experience and tens of thousands of graduates already integrated into the national workforce. Such institutions form an important focus for the study of distance training and underline the contribution that this form of provision makes in developed and emerging economies alike. 

Most Canadian and Australian systems would also correctly be located in the category of individual-based distance training with pre-prepared materials. Systems in the rest of the world, which do not clearly fall into the group-based distance training categories in the classification provided, are also located here. 

*Individual based distance training without pre-prepared materials*

The external degree programme of the University of London dates from about 1840 and lasts until today. This individual-based distance provision without pre-prepared materials predates the development of pre-prepared materials for distance systems, usually put in the years 1855 to 1880. 

Simply put, these systems enrol individual students at a distance and, in the case of the University of London, from all over the world, and provide the enrolled students with syllabuses, content description, reading lists and previous examination papers. 

The students then choose their method of study. They can study at a local college or a university - if they can find a programme that resembles the distance programme in which they are enrolled. Many of the British distance education colleges, like Wolsely Hall, started precisely to provide courses for the University of London External Degree programme. Alternatively the students can study completely individually, buy or borrow the textbooks on the reading list, and then present themselves for the examination. 

The distinctions between the American distance learning based largely on synchronous communication technologies and the European distance education based in the main on asynchronous technologies is important because it influences development in both eLearning and mLearning. 

*The history of dLearning*

Distance learning began in the second half of the 19th century when for the first time in history the first distance educators separated the teacher from the learner and the learner from the learning group. The first courses were proprietary but university courses followed in the closing decades of the 19th century. The University of Queensland in Australia in 1909 became the first university with obligations in its charter for the education of the whole population of the state and not just for the city in which the university was located. 

An essential feature of distance education is that the teaching acts are separated in time and place from the learning acts. The learning
materials may be offered to students, one five ion ten years after they were developed and to students spread throughout a nation or overseas. In distance education a teacher prepares learning materials from which he ion she may never teach. Another teacher may use the materials and evaluate students' learning. The pedagogical structuring of the learning materials, instructional design, and execution may be assigned to persons other than the teacher and to persons not skilled in the content to be taught. Teaching becomes institutionalized; the course may continue in use after the lecturer responsible for producing it has died or left the institution. Materials may be developed by a course team or staff group.

For all these reasons the first years of distance learning were difficult and the sector was looked down upon. It was difficult to get university credit ion accreditation for the courses taught and the awards offered. Until quite recently in the United States it was impossible to study for a whole degree at a distance and dLearning credits could only support a programme studied mainly on campus.

1970s and the foundation of the open universities

Giant strides in both quality and quantity of provision were made with the foundation of the European open universities at the start of the 1970s. The Open University of the United Kingdom at Milton Keynes was founded in 1969, the Universidade Nacional de Educacion a Distancia at Madrid in 1972 and the Fernuniversität-Gesamthochschule in Hagen in Germany in 1975.

These were national institutions of great prestige, linked to other national institutions like the BBC. With large numbers of full-time staff for research and development, these universities brought about an immediate rise in quality. The structuring of content and the design of learning materials brought it about that the learning materials were accepted by other universities in the country. To this was added student support services of a comprehensive style which provided support for students studying at a distance.

As national institutions of great prestige their university degrees were accepted as the equivalent of other university degrees in the country.

1990s and the impact of the WWW

The development of distance learning in the United States and its reliance on the synchronous communications technologies of an Electronics Revolution in the 1980s, paved the way for eLearning. Experience with satellite transmission of courses and videoconferencing and other communications technologies gave the impetus for training on the WWW and gave American universities and companies leadership in the emergence of web-based learning standards.

There is now little doubt that the World Wide Web is the most successful educational tool to have appeared in a long time. It combines and integrates text, audio and video with interaction amongst participants. It can be used on a global scale and is platform independent. While largely an asynchronous medium, it can also be used for synchronous events. It is not surprising therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the World Wide Web as a medium for course provision.
By 1998 the provision of education and training on the internet and on
the World Wide Web was already a mature field of distance training
 provision. This was demonstrated by the European Commission project,
Courses on the Internet: surveys, analyses, evaluation,
recommendations (CISAER), published on the net at
http://www.nki.no/~morten/cisaer.

In surveying and analysing training provision on the World Wide Web,
this project carried out a series of eighty in-depth interviews in mid
1998, with world leaders in virtual education. These experts, from a
wide range of countries, talked in long distance telephone interviews
with confidence and expertise on issues of server provision, of kernel
choice and of system design. They analysed changes in systems and
systems design, when one moved from 200 students on the web, to
2,000 students on the web, to 20,000 students on the web.

There could be no doubt from these interviews and the surveys
published on the CISAER website, that by 1998 training on the World
Wide Web was a mature and professional field of provision, with its own
rules, structures, achievements and literature.

This is remarkable because Collis (1996) in her Telelearning in a digital
world: the future of distance learning was able to identify the origins of
this field of training provision, to the period from late 1994 to early 1995.

By 1997, Fritsch, in Germany, had started the analysis of a new training
market. He identified students who:

● spent more than twenty hours a week working in front of a
  screen,
● had a company or university link to the internet,
● could write or edit a page in html
● wanted to be trained in front of their screen.

It seems remarkable that, by 1997, there was a new market of persons
who spent most of their day in front of a computer screen and wanted to
be trained in front of their screen too.

Systematic evaluation began early too. Boshier, a professor of adult
education at the University of British Columbia, tells how he led a team
of researchers to comb the web between 15 February 1997 and 10 April
1997 for courses. His findings, already published in major articles in
Distance Education in 1997 and 1998, under the jazzy titles ‘Best and
worst dressed web courses: Strutting into the twenty-first century in
comfort and style’ and ‘World Wide America? Think globally, click
locally’ state:

Web courses are constructed as the answer to fiscal crises evoked by
neo-liberal restructuring. They are also touted as an anarchist exemplar
of ‘de-schooling’ as envisaged by Ivan Illich. The trouble is, some
courses are vastly under-dressed and merely attempt to display a face-
to-face course on-line. At the other extreme are those laced with links,
animation and more than enough glitter and glam to make Liberace
wince. In this study the authors employed a 43-item coding schedule to
examine the accessibility, opportunities for interaction and

and:

The web assists the globalisation process but, as Canadians, we are
apprehensive about US dominance. The problem will partly be
overcome as more non-American sites are posted and search engines
deployed. In the meantime, educators outside the US committed to
building their own nation and preserving its culture and sense of itself,
should think about how to develop local Web resources so as to rely
Is the new area of web-based training to be regarded as a form
of conventional education, or a form of distance education, or does it
constitute a new sector of educational endeavour and a new field of
educational research?

The position taken up here is that web-based education is best
regarded as a subset of distance education and that the skills, literature,
and practical management decisions that have been developed in the
form of educational provision known as ‘distance education’, will be
applicable mutatis mutandis to web-based education. It also follows that
the literature of the field of educational research known as distance
education, is of value for those embarking on training on the web.

Not all would agree.

In her Telelearning in a digital world: the future of distance learning,
Collis sees the WWW as an innovation in education worldwide in which
children in schools will be taught on the web, students who travel daily
to universities will be taught on the web as well as or instead of the
lecture theatre, students at work will be taught on the web, students at
home will be taught on the web, and students globally will be taught on
the web.

In spite of the position of Collis and others who share similar positions
to hers, it is considered here that the legal distinctions should be
decisive. A student either contracts with a conventional school, college,
or university to attend that institution, to join its community of students,
and to receive its certificate or diploma or degree. Whether this student
receives the qualification by attending classes or lectures, working in
the library, or the laboratory, or at a computer screen, or on the WWW,
depends on the legal requirements stipulated in the statutes of the
institution.

Distance education is different. The student legally chooses not to
attend the institution, or is unable to (for example, if in prison), or
chooses not to (for example, if disabled), and requires the institution to
award him or her its certificate or diploma or degree without joining its
community of scholars. There need, in fact, be no physical institution for
the student to attend in distance training, because the educational
environment, in which the teaching-learning interaction which
constitutes the education process, is artificially created.

Whether this student receives the qualification by studying printed
materials, or audio materials, or video materials, or computer materials,
or on the WWW, and whether the student studies at an airport, or at
home, or at work, and whether communication between students is
compulsory or optional, face-to-face or electronic, depends on the
didactic and administrative decisions made by the institution.

In spite of the possibility of synchronous WWW didactic interactions, it is
considered that web-based training is predominantly an individual-
based form of educational provision. In spite of the possibility of full-
time, on-campus students using the web for part of their degree, it is
considered that web-based training can be accommodated within the
existing structures of distance training and there appears to be no
From e-learning to m-learning

necessity for the development of a new sector of educational endeavour or a new field of educational research to accommodate it.

The acceptance of dLearning
By the start of the third millennium, and in spite of the arrival of eLearning, distance learning had established itself as a valid field of educational endeavour complementary to and side by side with conventional provision.

University degrees won at a distance and college diplomas and training certification won at a distance were nationally and internationally accepted in the main.

Much of the groundwork for the acceptance of university degrees won by eLearning and eventually by mLearning provision was achieved by the field of dLearning.
CHAPTER 3. FROM eLEARNING TO mLEARNING

- Statistics
- The nature of eLearning - diagrams
- The status of eLearning
- The acceptance of eLearning
- EU documentation
- The arrival of mLearning

Statistics

The arrival of eLearning can best be demonstrated by statistics AT 1.1.2000 such as;

- there were about one million courses on the internet, 30,000 of them complying with a scientific definition of online, 22,000 of these were listed on the telecampus portal, with many of them making didactic use of the World Wide Web
- e-learning includes online learning, web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning
- WebCT Kernel alone was used by 5.100.000 students in 123.000 courses, developed by 33.000 university and college faculty at 1.100 institutions in 48 countries
- CISCO systems stated that more than half of all technical training will be done by e-learning by the year 2003
- That Irish e-learning company Riverdeep was launched on the New York Nasdaq exchange in March 2000 for the market capitalisation of $1000,000,000
- That the Irish schoolteacher P. McDonagh, promoter of Riverdeep, became one of Europe's richest industrialists in March 2000 with an e-learning valuation of €1000,000,000.
- The e-learning part of vocational education and training (VET) is now big business.
- The European Union's training deficit in this sector and that of EU government and proprietary providers is dramatic.
- In 1998, the Open University of the United Kingdom reported that 50.000 of its students were online and that they sent 70.000.000 emails and that these were read 700.000.000 times.
- In the year 1999, the Open University of Hong Kong, reported that it had 500.000 volumes in its online virtual library for distance students and that in 1999 these volumes were used 5.200.000 times by its 25.000 students.

The collapse of the New York Nasdaq Index since March 2000 has reduced the value of Riverdeep but it remains a worthwhile investment.
Collis of the University of Twente showed that training on the WWW commenced in 1995. The development of the field as indicated by the statistics above in less than five years is staggering.

Further statistical information can be got from the leading eLearning portal, that of TeleEducation, New Brunswick, Canada.

By late 1999, a catalogue of on-line course at TeleEducation, New Brunswick had reached 17,000 entries out of their global estimate of 30,000 courses available.

The 17,000 entries are listed on the web:
The TeleEducation New Brunswick survey of courses deals only with online courses.

An online course as defined by TeleEducation New Brunswick, is one that can be followed completely online. This does not mean that all course materials need to be online. Books, CD Roms, video and audio tapes, laboratory kits could be shipped out directly to students. Examinations for these online courses may be taken at local institutions or testing centres. The TeleEducation New Brunswick database excludes courses with no online component and also includes courses which require compulsory attendance at the university or training institution.

The TeleEducation course directory provides a full text search engine for users who can search by courses, or by subject categories, or by institution. A category list allows users to search by subject for example: biology, architecture, classics, computer technology. Other research features are at present in (early 2000), being built into the system, such as searching by program, by level, by country, or state or province. The aim is to keep the database as simple and useful as possible for users. The database has been built on an open architecture, so that additional fields can be added as needed. The TeleCampus online course directory provides useful analyses of the 17,000 plus courses that were in the database in the definition of online courses accepted for its survey.

The TeleCampus online course directory only houses courses that can be taken on the Internet from anywhere with no residence requirements or need to attend sessions at a physical location. More than 17 000 courses are included in the TeleCampus Online Course Directory. These courses are delivered from more than 30 countries in over 10 languages.

More than 90% of online courses emanate from North America. The USA dominates with more than 75% of all online courses world wide. Canada is second with 16% of online courses. Australia, a country with a relatively small population is third with 5%. Some northern European countries like Finland, Norway and Sweden deliver many courses online, but these courses all require a residency period on site, so they are not included in the TeleCampus Online Course Directory. The Open University of Catalonia is a European leader in web-based education, but they too insist on a face-to-face component in each course, and are not included here.

The nature of eLearning

E Learning represents the awarding of nationally and internationally recognised university degrees, college diplomas or training certificates to students who spend all ion some of their study period in front of computer screens.

It might be represented diagrammatically thus:

Wired Virtual Learning Environment of Today
In this diagram the computer screen represents the study area - the equivalent of the lecture theatre in a classroom or practical training session of conventional education, or the student's home in distance education.

In the diagram course content is provided on the computer screen and student support services are provided electronically to the student in the form of electronic communication or feedback on assignments or other questioning. Access to the WWW is provided for other resources, suggested readings and library resources. Other materials can be CD Roms, floppy discs, or audio, video or paper-based resources.

In the diagram student to student communication is by emails, bulletin boards or chat rooms in which students can communicate with other students in their class or institution mainly by typed interactions. Student to tutor communication is also mainly by email, with tutor intervention in listservs a further possibility and tutor reaction to student assignments, quizzes and other forms of summative or formative evaluation.

The status of eLearning

In early 1998 newspapers worldwide carried an article claiming that 'web-based training is better than traditional training'.

Reuters had syndicated an article about the research of Professor Jerald G Schutte of the California State University on web-based training. Professor Schutte had proved, the press reported, that students on the web score 20 per cent better than students in traditional universities.

Professor Schutte reports his finding thus:

Students in a Social Statistics course at California State University, Northridge, were randomly divided into two groups, one taught in a traditional classroom and the other taught virtually on the World Wide Web. Text, lectures and exams were standardised between the conditions. Contrary to the proposed hypotheses, quantitative results demonstrated the virtual class scored an average of 20 per cent higher than the traditional class on both examinations. (http://www.csun.edu/sociology/virexp.htm).

The syndicated report was widely used, and is often referred to, because of its striking claims.

Other claims abound:

If the growing numbers of educators, book publishers and entrepreneurs are right,
going to school will increasingly mean going online because training and education are already booming on the Web.

While entertainment-oriented Web sites continue to wrestle with revenue models, educational sites are providing a familiar service, only improved by the Web's inherent advantages in terms of geography and time. Students can learn whenever they want, wherever they want, and only what they want. (http://www.webreview.com/97/01/31/feature/index.html).

These presentations carry forecasts and threats that either or both conventional education and distance education is about to be swamped by web-based education. Invariably these claims show little or no familiarity with the literature, little or no familiarity with educational success or failure at a distance in the past, and little or no research to justify the claims made: but they can be highly influential.

At the time of writing it would appear that the market is still with the traditional paper-and multimedia-based distance education providers who maintain their leadership in fee-paying course enrolments. But in journal articles, conference papers and academic discussion on the web and on paper it is eLearning that is the flavour of the month and the centre of interest, with little attention being paid any longer to the field of traditional distance education.

The status of eLearning is high in corporate training and business providers like SmartForce, Cisco Systems and Click2Learn have developed a compelling presence in corporate training for eLearning.

### The acceptance of eLearning

The crucial test for any dLearning or eLearning is the acceptability of qualifications at university degree won by students studying in these systems. Although the award of university degrees for studying on the web is not yet generally acknowledged, there is a growing acceptance of web components of courses contributing to the award of a degree.

Another measure of the acceptance of eLearning is the growing availability of commercially available Learning Management Systems (LMSs) for the organisation of web-based learning. A listing provided by a Canadian website (www.c2t2.ca/landonline/evalapp0s.asp) is as follows:

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European Union documentation

European Union documentation on eLearning begins late: there is little before early 2000 as the following listing of major documents shows:

Council Resolution of 13 July 2000 on eLearning

The European eLearning Summit - (Summit Declaration)

The eLearning Action Plan - Designing tomorrow's education

The eLearning Action Plan : Guide to related programmes and instruments

Communication from the Commission eLearning - Designing tomorrow's education (May 2000)

Report from the Commission to the Council and the European Parliament "Designing tomorrow's education - Promoting innovation with new technologies" (January 2000)

Learning in the information society - Action plan for a European education initiative (1996-98)

Press Releases:

Brussels, 8 May 2001
Europe's First eLearning Summit in Brussels (10-11 May)

Brussels, 28 March 2001
Commission adopts the eLearning Action Plan to give new communication technologies a greater role in education

Brussels, 24 May 2000
Commission adopts "eLearning" to adapt our education and training systems to the knowledge economy and digital culture

Brussels, 9 March 2000
The Commission launches the "eLearning" initiative to speed up the adjustment of education and training in Europe to the digital age

It is clear that a great deal of the European Commission's interest in eLearning and the launching of its eLearning initiative is due to the recommendation of a meeting of Heads of Governments in Lisbon on 23-24 March 2000.

The Commission has adopted the "eLearning" initiative to adapt the EU's education and training systems to the knowledge economy and digital culture.

At the Lisbon European Council on 23 and 24 March 2000, the Heads of State and Government set the Union the objective of becoming "the most competitive and dynamic knowledge-driven economy in the world". Europe which, enjoys one of the highest levels of education, and has the necessary investment capacity, still lags far behind in the use of the new information and communication technologies. eLearning is designed to enable Europe to catch up by intensifying its efforts. It implements and extends into education and training the eEurope action plan, including in particular the guidelines for employment.

This initiative has four components: to equip schools with multimedia computers, to train European teachers in digital technologies, to develop European educational services and software and to speed up the networking of schools and teachers. Most of the resources to be mobilised will be national, but they should be backed by all the adequate Community instruments (the education, training and youth programmes for innovative actions and exchange of good practice, the Structural Funds for assistance in the eligible regions, the IST to support research and to promote European digital contents) and by the development of partnerships between public authorities and industry.

"Everyone in Europe will in the very near future have to come to terms with the new information and communication technologies if they are to play an active role in an increasingly knowledge-driven society" is the conclusion of the European Commission's policy document e-Learning - Designing tomorrow's education of 24 May 2000 (COM(2000) 318 final).

This was based on the Lisbon European Council of 23 and 24 May 2000 underlining of "the importance of acting swiftly and makes it a priority to successfully incorporate these technologies in our education and training systems". This is the challenge the eLearning initiative aims to meet.

In September 2001 the EU published a study titled Where Is E-Learning Headed?:

Not that anyone has a crystal ball here, but educated guesses can be made about the future of e-learning, which is what this on-line article does, outlining the top ten dominant challenges and trends in e-learning -the driving forces, it says, that will influence users, vendors, and service providers in the years to come.

Here's a summary of what they are:

One, global interest is growing in e-learning. Prediction - 80 percent of the top U.S. and European universities will offer global courses by 2004.
Two, national, state, and local governments will be investing more and more. While, on the one hand, in underdeveloped countries, e-learning can raise the level of education, literacy, and economic development, on the other, in public services, e-learning will help in developing or supplementing skills and practices in areas such as health, medical, and agriculture.

Three, technology will have to offer easier implementation, lower cost per unit, and better content. Part of meeting these challenges and overcoming these obstacles will be a parallel rise in demand for people who can develop diverse courseware that is multilingual, addresses various topics, and takes advantage of Web functionality. Indeed, estimates are that by 2005, one of the top 10 most in-demand positions among Global 1000 companies will be online learning designers.

Four, hosted e-learning will offer alternative infrastructure. Since companies need ways to meet their immediate, tactical training and reskilling needs, hosted e-learning can offer an alternative to meet those needs, letting companies focus on strategic development instead.

Five, business-to-employee initiatives will address e-learning for recruiting, retention, and employee-relationship management.

Six, collaboration and extended enterprises will expand the employee base by providing delivery and access for every key and enterprise.

Seven, e-learning will also extend to customers, customers who will be looking for diverse kinds of value-added services. By 2005, the report says, e-learning will be an accepted practice on 70 percent of customer Web sites.

Eight, simulation, gaming, and interactivity will enrich e-learning, given that studies show that learning by experience improves learner’s retention and understanding. Therefore, technologies such as collaboration, interactivity, modeling, simulations, virtual reality interfaces, and gaming will help students experience the skill being taught.

Nine, wireless e-learning will be adopted where no wires exist and may become the lowest cost for networking.

And, finally, ten: there will never be enough of the "right" skills. Not just employees but also businesses will use e-learning to reskill and keep pace with the fast-changing technological and business world.

The arrival of mLearning

In the short space of time between 1995 and 2000 eLearning became the state of the art for the use of technology in education. Many predicted that it was the final solution for corporate training and university programmes alike.

But by 2000 wired telephones and wired computers were beginning to be replaced by wireless ones. This has important didactic dimensions as it frees the learner, who may have spent much of his or her working day in front of a wired computer, from studying in front of a computer screen too. Although there is much evidence from eLearning research of the interactive value of emailing, the validity of typed interactions for learning purposes can be questioned when compared with spoken interaction.

From dimensions such as these came the birth of mLearning, the provision of learning on wireless and mobile devices.
CHAPTER 4. mLEARNING INITIATIVES IN 2001

- Telenor mLearning Wap project
- Mobilearn
- EMobility 2001 conference
- UniWap (Univ of Helsinki/ICL)
- MobiLearn: Mobile computing in learning environments
- AvantGo
- IBrite
- Isopia
- Experient.com
- Insead/Nokia/icus
- Univ of Birmingham HandLeR
- MLearning IST project (Ultrasound)
- MLearning forum
- Audrey Choden Wireless learning in your pocket
- Empowering Technologies The mobile learning era
- Codeonline
- Pjb associates latest news
- Setero Distance learning through wireless devices
- Palmpowerenterprise (Knowledgenet and Smartforce)
- The changing faces of virtual learning
- Supermemo
- Go Reader
- Learning circuits Goin Mobile
- Global Learning Systems UK
- Stanford Learning Lab
- Globalknowledge.com

In this chapter 30 mobile learning initiatives in 2001 are presented and analysed. They give the background and context to the project and demonstrate the growing importance of mLearning as a field of educational research and endeavour.

1. **Telenor mLearning Wap project**

The project was run in Norway in spring 2001 with four partners:

- Ericsson
- Insite
- Telenor Mobil
- IT Fornebu Knowation (project leader).
The project report, written by Tove Kristiansen of IT Fornebu Knowation is divided into four parts:

- International trends
- Project description
- The pilot course
- User experiences.

The project gives a definition of mLearning: the use of mobile terminals in learning and attributes its growth to an increasing mobility and the growing need for flexible learning.

**International trends**

Details are given of the expected growth of both eLearning and mLearning with a quotation from Brandon Hall 'I have the sense when I look at the Palm VII or a wireless phone that I am staring at the future'.

**Project description**

The aim of the project was to use some simple WAP solutions as an add-on to an ordinary course given in a classroom.

The course was an Ericsson course Introduction to 3G applications which focuses on UMTS technology and future applications and services.

All the 18 participants were employees of Telenor Mobil and each was given an Ericsson R380 WAP phone to use during the course.

The phones were used for demonstrating future services, repetition, a quiz, an idea box and course evaluation.

Future services were demonstrated by getting each participant to order their lunch via WAP from a local hotel. Repetition was for the revision of certain parts of the course outside the course hours. In the quiz a total of 18 statements were given and the participants had to answer 'true' or 'false' and submit their answers. Each person could immediately see their scores, and the scores of the other participants for comparison. The idea box was set up to allow participants to write down their thoughts about the mobile internet and the potentials of mLearning. In the course evaluation the participants were asked to fill in and submit the questionnaire. The course organizer could then read the evaluations immediately on the World Wide Web.

The tool for creating the course for WAP-telephones is presented thus at [http://www.insiteint.com/e3g](http://www.insiteint.com/e3g)
From e-learning to m-learning

User experiences

The overall impression was that the participants experienced the use of WAP telephones as a very positive supplement to the course. The possibility of revision while going back home at night was rated highly. The immediate feedback to the quiz and the ability to do it anywhere and anytime were also appreciated.

In conclusion, Kristiansen writes

The potential for improvements is obvious. When broadband multimedia becomes accessible and mobile terminals get larger colour screens within a few years, there will be no limitations as to what kind of content is will be possible to provide. Thus, the challenge for further development of mLearning lies more within pedagogical and organisational aspects than with technological ones.

2. Mobilearn

There are two projects on mobile learning using the title Mobilearn: one, based at the Viktoria Institute at Gothenburg in Sweden is described here; the other, a German/Brasilian partnership is presented in section 4 below.

The partners in the Mobilearn project are:

- Viktoria Institute, Gothenburg
- Ericsson Radio Systems AB
- ADB-Kontaret, Gothenburg
- Ericsson Microwave Systems AB.

In an article titled 'Mobilearn: competence development for nomads' the aims of the project are presented:

Organizations in the new economy are dependent on organizational knowledge and competence. Workers in these organizations are to a large extent mobile. They need new competence development opportunities unrestrained by time and space. We have developed and successfully tested models, applications and activities (e.g. multimedia scenarios) supporting competence development. We are transferring this competence development activity to mobile settings to achieve successful competence development for nomads. The goal is identifying applications and services in the competence development realm suitable for 3G (third generation cellular networks). Combining our models and activities with the new technology we rethink how competence
development can be conducted and managed.

To be able to redesign and evaluate multimedia scenarios on handheld devices the project used Compaq iPAQs Pocket PC and Sony VAIO C1 Picturebook. iPAQs were used for simulation of the expected small screens of the 3G - terminals. The Vaio (small size, built in video camera) is excellent for testing videoconference with a wireless LAN (simulating future 3G networks).

In another article 'Mobile competence development for nomads' it is stated that the project is attempting to create a human-computer environment on handheld devices that encourages and simplifies communication between groups as well as having support for educational models in order to facilitate collaborative learning. The project is based on the availability of 3G technologies for transferring already existing multimedia scenarios for collaborative learning to mobile multimedia scenarios.

Here is a multimedia scenario proposed by the project:

Jack is traveling by train to meet a customer. He has to get prepared for the meeting but after reading through the background material of the customer he has time to engage in some 3G competence development. He connects to the e-business education that started this week, and views a short video that introduces the first week's topic (see Figure).

The video raises some interesting points. Jack is especially interested in the point about customer relations' management (CRM). He decides to initiate a videoconference with a colleague in his group to discuss the issue right away. The 3G platform indicates that his colleague will accept incoming videoconference calls related to the e-business education. Jack makes the call and they talk for five minutes and reach the opinion that CRM seems to be a fad. Jack decides to share their thoughts with the rest of the group and posts a short written message in the common discussion area.

The project's use of the English word 'nomads' for 'mobile workers' or 'mobile people' seems unfortunate as the English word is not usually regarded as synonymous with the other concepts.

3. eMobility 2001 conference

From 31 May 2001 to 1 June 2001 there was an international conference at Gothenburg, Sweden with European Commission participation on all aspects of e-Mobility. A number of the papers dealt with mobile learning, including a presentation of the Viktoria Institute MobiLearn project. This was the conference presentation:
This conference shows the growing importance of mobile solutions and of mobile learning amongst them.

Also proposed for the first time at the e-Mobility conference was the mLearning project Ultralab described in no 12 below. This is a United Kingdom IST (Information Society Technologies) project which will develop two prototype microportals; one for use with WAP/3G phones, and one for palmtop PCs and similar devices.

4. UniWap (University of Helsinki/ICL)

The aim of the UniWap project is to develop educational use of mobile technology and to find out pedagogical applications to be of benefit in the virtual university. The project deals with the WAP technology to be tested, piloted and completed in order to facilitate teaching and learning in the university. An environment of activities will be developed in order to provide services for flexible learning and to discover new forms of publishing of learning material.

The UniWap project is a joint venture of the Helsinki University and ICL Invia. The mCastor technology has an essential role in the project. This technology enables the user, who may have several terminals like WAP, PC or Communicator, to use the same information service or system adapted to the actual user environment.

The First Stage
The first stage of the project will concentrate on discovering new ideas and pedagogical applications in which mobility could be of benefit in the in-service education of university teachers.

The Second Stage
At the second stage, the Educational Centre for ICT will support departments and multi-disciplinary research groups by training and consulting. The centre will make efforts to network different academic fields together in order to create collaborative development projects during 2001 to 2002. Also contacts to companies will be fostered in this process. The companies will provide the project with equipment, software and information systems.

The Third Stage
The third stage focuses on diffusion of innovation by training and commodification throughout the Helsinki University and, perhaps, to be also used in the Finnish Virtual University.
5. MobiLearn: Mobile Computing in Learning Environments

This is a project in mobile computing funded by the German DAAD (Deutscher Akademischer Austauschdienst) and the Brasilian CAPES (Fundacao Coordenacao de Aperfeicoamentos de Pessoal de Nivel Superior).

There are two partners:

- Technische Universitat Darmstadt, Darmstadt, Germany
- Universidade Estadual de Campinas, Campinas, Brasil.

The aim is to enable students to interact through a computer-supported learning environment not just from conventional desktop computers, connected to high-speed networks, but also from mobile terminals with low-speed wireless connections.

The project started on 1 January 1999 and ended on 31 December 2000.

The technological goal of the project is to develop and to study forms of integrating appropriate mobile computing capabilities into computer-supported learning environments. The project intends to evaluate the effectiveness of portable computers (such as light-weight notepads and laptops), connected to information servers, either through a terrestrial network or through low-speed wireless connections, as delivery terminals for courses with multimedia and hypermedia contents.

It intends to exploit the adaptability of multimedia and hypermedia information (e.g., the form of presenting the content material, user interactivity, and information structuring) to the resources available at the user terminals and to the communication network conditions.

The project plan is to apply intelligent mobile agents in order to offer a context-sensitive resource utilization and suitable data access within the learning environment.

6. AvantGo

AvantGo is a producer of mBusiness products for palmtops and pocket pcs. Here is their presentation of their product for producing a mobile version of Lotus Notes.
7. IBrite

IBrite has developed an authoring product for putting content together for the Palm PC.

Together with Global Knowledge, the leading US IT training provider, it has developed two courses for the PC Palm, Telecommunications Fundamentals 1 and Telecommunications Fundamentals 2. Both of these courses are offered by Global Knowledge as classroom offerings but these new developments as PalmOS software enable the courses to be taken at any time anywhere.

Telecommunications Fundamentals 1 is 9 chapters long and has 48 graphics which work on colour and black and white Palms. It has 417 pages of text.

Telecommunications Fundamentals 2 is also 9 chapters long and has 65 graphics, both for colour and black and white Palms. It has 524 pages of text. An demo version of 1 chapter, 34 pages and 6 graphics can be downloaded from http://www.ibrite.com/download_software.htm.

8 Isopia

Isopia provides this definition of mLearning: ‘With the power and functionality of Sun LearnTone LMS extended to mobile devices, Sun enables enterprises to offer a seamless, blended learning experience extending from classrooms and desktops, to PDAs, two-way pagers, mobile phones and hybrid devices’.

It claims that mobile learning or mLearning, is resulting in a paradigm shift in the way people learn. Learning has moved from the classroom, onto your desktop and with mLearning, into your pocket. Acknowledged by industry experts for its superior standards-based technology platform, Sun LearnTone LMS is the only eLearning infrastructure in the marketplace that offers both eLearning and mLearning capabilities delivered entirely using Java.

On 29 March 2001 Isopia announced that anytime, anywhere learning materializes with courses available on PDAs, cell phones, and handheld devices. With oibkly a cell phone, hand-held device, Personal Digital Assistant or hybrid unit (combination cell/PDA) users can access administrative functions, download courses, and review their learning history through Isopia's Integrated Learning Management System (ILMS) or Learn Tone.

The mLearning solution is designed for flexibility, incorporating Sun Microsystem's Java 2 Micro Edition (J2ME). Unlike the Wireless Application Protocol (WAP) and Wireless Markup Language (WML), J2ME enables the user to take courses without being connected to the network. It also supports more complex courseware than the standard wireless protocol.

Isopia's mLearning solution allows the user to upload the mobile course edition from the online learning path, whether connected to or disconnected from the internet, and take courses on any device, then upoload information about their course progress and test scores to the ILMS the next time they reconnect to the network.

Isopia presents the following scenario:

You are checking in at the airport. The line is long - So how do fill your time? Before leaving for the airport you had downloaded a course on your PDA from your computer at the office. In the line-up, you now pull out your PDA and decide to brush up your knowledge on your company's latest product offerings. At the end of this course you take a short quiz to test your knowledge.

When you arrive at your destination, you check into your hotel room and set up your laptop. Setting your PDA into its cradle, you link up to your learning portal through the Internet. You connect- "hot-synch"-directly with your company's learning management system, ILMS™, which will read the results of your completed courses and automatically update your learner profile. You then decide to download a number of reference materials and courses for study on the road and at home.

In this real-life scenario, as you synchronize your device using a wireless or wireline connection, the
latest mobile versions of designated courses are loaded from Sun LearnTone LMS onto your device. You are then free to take the course or manage your training at leisure when disconnected from the network. The next time you connect to your learning environment to synchronize the information on your device, all the course progress and assessment scores are passed to the Learning Management System, updating your profile.

On 19 June 2001 Sun Microsystems bought Isopia and integrated it into its education division. There does not seem to be a link from the Sun home pages to the Isopia material.

9 Experient.com

Experient.com have published a white paper titled Mobile eLearning Systems which promotes its Calypso product. Calypso enhances current technologies, it is said, that do not adequately exploit the potential of the internet for learning. Calypso allows learning any time, any place, any where without constant access to, or persistent use of, the internet.

The system is designed to run on virtually any platform and bring the power of web-based eLearning to the learner in either online or offline mode, with the advantage of offline tracking. One connects to the internet only long enough to download the web-based courses from the central server of learning management system. Then, one disconnects and the system gives one complete browser functionality, along with learning aids, progress checks, and testing features all the actions are stored for later retrieval.

The basis of the mobile eLearning system is Calypso, a 100% Java-based application built by Experient Technologies. Calypso is a software engine designed to manage both the deployment and retrieval of distributed, rapidly changing data and functionality across differing client hardware including wireless. It can run on handhelds using Windows CE and PalmOS devices.

Calypso provides the Mobile eLearning System with a robust database for gathering data on learners whether a network connection is maintained or not. Once the learner goes online, the Mobile eLearning System automatically synchronizes the learner with the central LMS and an asynchronous exchange of data takes place. At the same time as the learner is receiving automatic eLearning updates, the data is collected on the learner and transmitted to the main LMS.

The Java-based Calypso product is built in 5 layers: user interface layer; content layer - for the course content; toolkit layer - including testing, studying and scoring; network layer - for connectivity; engine layer - provides a single interface to information so that other layers can read from or write to the internet of the computer.

LearnSomething.com, Inc, a leading developer of customized web-based continuing education programmes, and Experient have agreed to integrate LearnSomething's ASP-based learning management system with Experient's mobile learning access technology. Clients and partners of both companies will be able to create and download complete Web-enabled courses to a variety of mobile devices, such as laptop computers, pocket PCs, PDAs and other hand-held equipment. Learners will be able to complete those courses offline using their browser features. The software allows for comprehensive testing and offline tracking, enabling a complete, efficient, and mobile learning management solution.

10 INSEAD/Nokia/ICUS

INSEAD, NOKIA, and ICUS formed an Asia-Pacific consortium to pilot m-learning. The initial result of their endeavor was the development and deployment of an e-course delivered via WAP-enabled NOKIA phones. The course, eBusiness on the Move, was developed to make use of both WAP (wireless) and Web (wired) technologies, allowing participants to access content via phone and computer.

Evaluations tracking learner progress revealed that WAP technology delivered an average level of coaching support and higher than average level of technical support.
Based on an INSEAD classroom course, eBusiness on the Move offered an introductory look at current and future use of the Internet in business.

Learning activities comprised reading material, bulletin board discussions, multiple-choice quizzes, and writing assignments. Learners linked to video clips, PDF articles, and Websites. In addition, the course required two coaches to facilitate and track learner progress. For example, one coach provided feedback on an interactive bulletin board while the other coach used email to provide direct assistance to learners about course content and procedural matters. There was significant peer-to-peer and peer-to-coach interaction via bulletin boards, direct email, and voice applications.

The course was approximately 20 hours, and learners were expected to complete it over a period of four to five weeks. Participants received an INSEAD certificate upon successful course completion.

The WAP/ Web equation

This course used two delivery formats: Web and WAP. The WAP format requires short text, additional screens, and more titles than the Web version, resulting in a multilevel hierarchical menu system. An MS Word document that cross-referenced WAP chunks and Web topics was provided as a navigational aid.

Although 10 percent of the course was WAP-only accessible, 80 percent of the overall course was accessible via phone, including links to WAP sites, multiple-choice questionnaires, and quick reminders and alerts from the coaches. Likewise, approximately 20 percent of the course was Web-only, but nearly 90 percent of the overall course content was on the Web, including digital video clips, bulletin board discussions, email, and links to Websites. Obviously there was some redundancy.

Most learners accessed about 40 percent to 50 percent of WAP-delivered material and 70 percent to 80 percent of Web-delivered material. Reasons for accessing the course via the Web rather than WAP included small screen size, slow connections, and limited graphics.

Prior to taking the course, most learners believed they would make little use of the phone. In fact, only five of the 14 participants said they expected to like using WAP-enabled phones for learning. Their opinion was based primarily on the notion that the phone's screen size was too small to be useful.

Following the course, participants reported that WAP-delivered content added value to the learning experience, saying that anywhere, any time access provided a high level of convenience.

M-learning's potential

Today, wireless development focuses on integrating data and voice functionality in a single device. Whether a mobile phone with Internet access or a handheld data device with phone capability, the goal is for individuals to have wireless access to data applications. Handheld digital devices are becoming more common, and their quality and capability is increasing due to technological breakthroughs in miniaturization and advancements in wireless bandwidth and data networks.

Devices used in the project were the Palm Pilot IIIc and the Nokia 6210 WAP Phone:
Conclusion

M-learning has been slow to grow because most wireless devices have small screens, low resolution, slow processing, and limited storage capabilities. Likewise, difficulty connecting various types of devices to the same network is a real limitation. It seems likely that m-learning is better suited to such specific content areas as sales or language skills. Also, current WAP technology makes it best suited to particular aspects of e-learning courses, such as:

- quick reminders and alerts
- communication with peers and managers
- multiple-choice quizzes with immediate feedback
- daily tips
- glossary information
- browsing e-learning course material
- searching for specific information within a topic
- links to WAP sites
- course registration.

The course system for the project was illustrated thus:

11. University of Birmingham HandLeR project

The Educational Technology Research Group at the University of Birmingham runs the HandLeR programme whose aim is to develop mobile technologies for learning.

The concept HandLeR developed by the student group employs an animate mentor as the main interface metaphor and method of interaction. Figure 5 shows two screen displays from the implemented system. The mentor, shown as a cartoon rabbit, acts as an alter ego that could offer assistance with capturing events, solving problems and managing learning (these functions were not implemented in the demonstrator). The mentor also provides icons for the main tools of HandLeR, based on the mentor's body functions and displayed objects. Thus, clicking the mentor's eyes shows an image from the HandLeR's video camera, the palette brings up a set of drawing tools, the book opens the user's topic book, and the heart opens a profile of the user.
Basic functions provided by the system include still and video image capture, drawing, and text input through a screen keyboard or handwriting recognition. Data from each of these sources can be tagged by time and location (demonstrated using a GPS position location card). The user can copy and organise the images, drawings and text in the topic book.

Clicking on the mentor's "brain" opens up a map (shown at the right of Figure 5) showing linked concept words, named topics created by the user (from the topic book), and items of external information including web pages and documents. If the topic item is not available on the HandLeR then it automatically initiates a cellular phone connection to a web server and downloads the web page identified for that topic. For example, clicking on the "hurricane" topic item opens the web page http:\www.hurricanehunters.com. The aim for future versions of HandLeR is to enable the user to create new nodes in the topic map for drawings, notes or camera images, linked together by title, keywords and time and place of origin.

The user can navigate through the topic map either by clicking on one of the outer ovals, which brings it to the centre and displays the topics related to it, or by clicking "search" and writing a keyword or phrase that identifies the topic. Much further work is needed to enhance the navigation and search facilities and to provide other views such as a timeline that orders events by time of creation.

The main interface to the demonstrator system also provides a means to connect to other HandLeRs. Clicking on the face at the lower right of the screen opens a list of known contacts and selecting one brings up an image of that other person's mentor. The user can then click on the other mentor's body parts, such as the heart (to show the person's sharable profile). A click on the mouth or ears initiates a direct cellular phone connection that person's HandLeR.

The concept HandLeR runs on a Fujitsu Stylistic tablet computer with a Nokia GSM card phone. All the functions described above have been demonstrated on a handheld device consisting of a Fujitsu Stylistic pen-based tablet computer running Windows 95, a Nokia GSM card phone, a PCMCIA card GPS receiver, and a Kodak DVC 323 miniature digital video camera.

12 **mLearning IST project (Ultralab)**

Ultralab is a European Commission IST m-learning project addressing social and educational problems in young adults.

The m-learning project addresses 3 social/educational problems relating to many young adults in the EU:

- Poor literacy/numeracy - see e.g. Improving Literacy and Numeracy: A Fresh Start
- Non participation in conventional education/training
- Lack of access creating ICT "haves"/ "have nots" resulting in inequality of opportunity

m-learning will develop prototype products to provide information and modules of learning via inexpensive portable technologies which are already owned by, or readily accessible for, the majority of EU young adults.

The design of the prototypes will be informed by research including:
From e-learning to m-learning

- Research into the use of mobile phone technology: needs, preferences, attitudes and habits of young adult mobile phone users.
- Research into computer game design and their users' preferences.
- Research and development seeking appropriate knowledge representation, learner models and standards, including metadata standards to provide a framework for development and description which can be practically applied to very small modules of basic skills learning delivered via mobile communications technologies.

Description of the work

Research elements of m-learning will include:

1. An analysis of current standards in the field of learning object representation to inform development of an intelligent tutor and to inform development workpackage managers' decisions as to appropriate standards to apply.
2. An initial investigation followed by a continuously updated technology watch service to identify, review and select from current and emerging mobile communications technologies those with potential for use as delivery vehicles for m-learning information and learning modules, taking into account medical research into possible health hazards associated with excessive use of mobile phones.
3. A survey of young adults use of mobile technologies exploring needs, preferences, attitudes, habits and experiences. Followed by research focusing on the potential of m-learning for specific groups e.g. those with sensory impairments.
4. Research into the use of computer games consoles by young adults
5. Work with groups of learners to identify design approaches for internet micro portal user interfaces to m-learning modules which will encourage independent exploration of on-line resources and empower learners to exercise choice whilst facilitating ease of use and making m-learning enjoyable.
6. Initial and on-going desk research to identify other relevant research projects which might inform m-learning developments. Development work with m-learning will include:
7. Design, development and trialing of a prototype multi-agent “intelligent” tutor system to evaluate learner knowledge and preferred learning styles/strategies and assist with personal development planning including tailoring of micro-courses to suit individual needs.
8. Design, development and trialing of prototype multimedia modules, incorporating speech technology functionality, for use via mobile technologies to deliver aspects of literacy and numeracy skills learning. Incorporating advanced speech and languages technologies functionality to maximise the potential of handheld devices.
9. Development of microportals and interfaces tailored to the needs of specific groups of users within m-learning's target audiences and to different levels of technological sophistication in the handheld devices used.
10. Translation of prototypes and microportals developed to achieve both English and Italian versions.

Milestones and expected results

It is expected that commercial m-learning products will be developed based on the prototype literacy and numeracy modules and microportals developed by this project. The capability of mobile communications devices to deliver aspects of learning, and the design principles which motivate users to use such devices, will have been investigated and assessed.

Participants

Co-ordinating Partner is The Learning and Skills Development Agency whose office is at Citadel Place, Tinworth Street, Vauxhall, London SE11 5EH, UK. LSDA are also a Principal Contractor in the m-learning project. Other partners are:

CRMPA (Principal Contractor), Via Ponte don Melillo, 84084, Fisciano, (Salerno), Italy
CTAD (Principal Contractor), Lincoln House, The Paddocks, 347 Cherry, Hinton Road, Cambridge, CB1 8DH
The Learning Kernel (TLK) (Assistant Contractor), Sint-Krispijnstraat 7, 8900 IEPER, Belgium
Ultralab at Anglia Polytechnic University (Principal Contractor), Victoria Road South, Chelmsford,
13 The mLearning Forum

The m-Learning Forum is an initiative of Peter Bates, manager of P.J.B associates at Ely, Cambridgeshire, United Kingdom.

By clicking on m-learning on his website at http://www.pjb.co.uk one is taken to a listing of various activities related to m-Learning. There is a rationale for establishing a European m-Learning forum, details of a conference on the theme organised for 31 October to 1 November 2001 in Paris, presentations from the first meeting of the m-Learning forum on 24 September 2001, and a comprehensive listing of useful papers and articles.

Speakers at the first meeting of the forum included:

"Introduction - developing m-learning - the time is right?" - Peter Bates, pjb Associates
"Market Trends in Mobile and Wireless Developments - opportunities for m-learning" Phil Kendall, Director Strategy Analytics Global Wireless Practice
"Developing m-learning - Pedagogical and Design Perspectives" - Prof. Mike Sharples, Kodak/Royal Academy of Engineering Professor of Educational Technology, University of Birmingham (UK)
"Opportunities for European Research and Development in m-learning" - Joseph Bremer, European Commission. DG Information Society (Luxembourg)

14 Wireless learning in your palm by Audrey Choden

In an article posted on 28 December 2000, Choden draws attention to a study by Clark Quinn (http://www.i5ive.com/article.cfm/training_and_development/55907).

Clark Quinn, she writes, has a vision that he calls mobile or mLearning. If his vision comes true, learning will no longer be confined to the desktop or classroom.

As Director of Cognitive Systems at KnowledgePlanet, Quinn's vision involves using mobile computational devices or information appliances (IA), such as a Palm Pilot or a digital cell phone, to support learning and performance on the job. This pocket-sized computer would combine content, interactive practice activities and personalized feedback with a means of tracking performance, updating records and providing certification. It would be connected to a network (always on, no need to dial-up). You could input data with a pen, keyboard and/or speech.

There are two problems with m-Learning:
- managing learning through intermittent connection - today's devices are limited by dial-up access to a network, small screens, slow processing and limited storage capacities.
- Device-independent delivery. - Quinn sees a solution in XML.

15 Empowering Technologies, The mobile learning era

Empowering Technologies begin their presentation of their products with a list of statistics:

The evidence is overwhelming that mobile learning is beginning to take hold:

- Over 50 percent of all employees spend up to half of their time outside the office.
- More than 75 percent of all Internet viewing will be carried out on wireless platforms by 2002.
- Mobile devices will outnumber landline PCs by 2002 and exceed the 1 billion mark the following year.
- More than 525 million web-enabled phones will be shipped by 2003.
- Worldwide mobile commerce market will reach $200 billion by 2004.
- There will be more than 1 billion wireless internet subscribers worldwide by 2005.
The company plans to develop courses for the Palm V and offers this example:

16 Codeonline

This is an experiment in Espoo, Finland in which students prepared a series of quizzes in the subjects they were learning and published them to be answered via WAP phones or the internet. 'Making learning fun' is the motto in developing new solutions for mobile learning. The project used Codeonlines technological platform and solutions for creating and publishing question sets via any wireless end-user device, WAP phones provided by Ericsson and mobile connections by Radiolinja.

17 Pjb Associates latest news

Another service provided by Pjb Associates (see Chapter 13 above) is a listing of latest news on mobile communications and learning. Items of relevance to mLearning on 20 October 2001 included:

AlphaSmart to use Palm OS

AlphaSmart, Inc., a technology solutions provider for education, and Palm, Inc. have announced AlphaSmart has licensed the Palm OS® platform. The flagship AlphaSmart 3000 is a low-cost, portable technology solution used in thousands of classrooms in the United States and by millions of students throughout the world. A highly useful writing, keyboarding and test-taking tool, the AlphaSmart 3000 addresses a broad range of needs in K-12 education. It is offered at a fraction of the price of a full-featured computer, so an entire class can be economically outfitted with AlphaSmart 3000s, enabling students to learn and advance at their own pace. (see press release)

Medical Students Embrace Wireless Tools of Future

Students at the Wake Forest University School of Medicine are packing handheld IBM WorkPads with an array of special applications to give them an extra edge as they enter their clinical rotations. The clinical rotations are the point in the students' academic studies when they begin interviewing and examining patients and making diagnoses based on their observations. (see article)

First school in the US to actually require the use of PDAs

High school students at Forsyth Country Day School in Lewisville, N.C., will pick up more than books with their registration packets when school starts. Each student will get a Palm handheld loaded with educational software and a Palm portable keyboard. Forsyth, the first K-12 school in the nation to require the use of Palm handhelds, plans to use them throughout its curriculum. (see press release)

AvantGo Takes Its Own Advice, Offers M-Learning
Recognizing the market potential, AvantGo (Nasdaq: AVGO - news) has used some of its own technology to offer mobile, Web-based training to wireless developers throughout the world. (see press release) (see article)

Wireless Internet in Classroom Annoying?

Article in MSNBC that addresses the issue of wireless internet access during meetings and classes (see article)

M.kids: the future is mobile

Research conducted by NOP during January 2001 shows that nearly half of all 7-16-year-olds in Britain now have their own mobile phone. (see press release)

Free WAP-enabled mobile phone for Dutch university

According to an article in the Wall Street Journal the University of Twente in Enschede, Netherlands, is piloting a project called M-poort that "will create the first common wireless standard in Europe designed to support educational applications. Unlike many European academic institutions, the University of Twente is willing to work closely with businesses, particularly high-tech concerns such as KPN, Ericsson, and Lucent Technologies, to have cutting-edge technology. KPN has distributed free WAP-enabled mobile phones to the university's 10,000 students, who are able to contact teachers and fellow students and access such information as exam grades. Services are presently provided by WAP-5, a company founded by four students with seed money from the university, as the larger companies wait for newer technologies that will allow mobile phones to offer e-learning systems available for laptops and personal computers. This could include the university's Web-based e-learning software, Teletop, which is built on IBM's Lotus Learning Space program. The university's departments are working to make all classes available through the Teletop software."

Piloting the wireless classroom

Motorola, WorldCom and APTE are sponsoring a new pilot programme designed to introduce wireless technology to the classroom. It involves students and teachers in two US states. As part of the programme, Motorola presented students, teachers and a select group of parents from two schools with its Timeport P935 two-way devices embedded with APTE's Internet Coach Learn Together applications and wireless service from SkyTel, a WorldCom company. (see article)

m-Learning takes off

press conference, held by EFECOT, the European Federation for the Education of the Children of Occupational Travellers, two m-learning projects were presented, showing how education via GSM and satellite can be used for mobile, travelling learners, such as bargees, circus and fairground children. (further details)

Universities find wireless systems bring them convenience and savings

Claims that wireless technologies can connect up a classroom more cheaply and are more convenient. (see article)

Palm Reading Goes Educational

Students with Web-enabled handheld devices can seriously cut down their library time this school year according to a recent article. Dictionaries, daily preparatory tests, calculators, research from the Internet, and temperature-measuring probes for scientific experiments are all available to students on their mobile phones, pagers, or personal digital assistants (PDAs) - generally for free. (see article)
e-ducavia" - multi-media training services via the Internet, third generation mobile telephony and interactive television

Spain's Telefonica [TEF.MC], IBM [IBM.N] and Cisco Systems Inc [CSCO.O] said recently that they were creating an online business school for Spanish- and Portuguese speakers. The project, called "e-ducavia", will provide a range of multi-media training services through the Internet, third-generation mobile telephony and interactive television, the companies told a news conference. Telefonica will participate via its Media unit, and International Business Machines Corp (IBM) through its Spanish unit. Cisco is the world's top maker of data networking equipment for the Internet. The three companies will spend an initial 100 million euros ($95.42 million) on the education initiative, which is expected to begin offering courses in January 2001, Telefonica Media's Chairman Jose Antonio Rios said. The project will target individuals and companies, offering a range of courses up to the Masters level in areas such as management, marketing, communications and advertising.

18 Setaro, Distance learning through wireless devices

This is an analysis by Setaro of comments made by Elliott Masie at a conference that extensive use of handheld wireless devices such as PDAs and Web enabled cell phones would dominate the eLearning industry within three to five years.

Setaro lists a number of problems with this scenario including screen size, difficulties with graphics, restricted bandwidth and the claim that there was cultural resistance because wireless companies are not creating user-friendly products.

19 Palmpowerenterprise (Knowledgenet and Smartforce)

This is an analysis by J S Kossen of learning tools that run on Palm devices. It claims that few companies are very far along in actually making mLearning a reality. It suggests that two exceptions are KnowledgeNet and SmartForce.

It is claimed that KnowledgeNet are able rapidly to develop content for PDAs that is as rich and interactive as it is for the PC. The courseware for the PDA contains animation, high-quality sound and intuitive navigation.

SmartForce see the greatest value of PDAs in assessment. They are developing downloadable assessment exams that allow learners to test their knowledge and then rank and report their results. An example is given:

Let's take a look at an example. First, you need to go over the instructional material, like that shown in Figure A.

FIGURE A

First, you go over the lesson.

Then you're be given a series of questions to test your retention of what you read. A sample question is shown in Figure B.
From e-learning to m-learning

FIGURE B

Test yourself with a series of questions.

Finally, you receive your score, as shown in Figure C.

FIGURE C

The software tracks and reports your results

21 The changing faces of virtual learning

The changing faces of virtual learning is a comprehensive overview of virtual education published by the Commonwealth of Learning, Vancouver, British Columbia, Canada.

The chapter on Technology and virtual learning by Tony Bates of the University of British Columbia lists mobile technologies and voice recognition technologies as future assets for virtual learning.

22 Supermemo

Supermemo is a technology owned by Supermemo world of Poznan in Poland. The system will be used for a system of mLearning called 3GEMS. It is planned to use state-of-the-art technologies including Bluetooth and 3rd generation mobile.

23 goReader

GoReader is a Tablet PC, which is being used to provide k-12 (kindergarten to matriculation) education with web browsing, basic computing and ebook functionality. It is also claimed that its mobile learning solutions provides students, institutions and professors with access to all of their information. It has the following functionality:

- Connect to the Internet wirelessly, via a LAN or Dial-in connection.
- Enjoy full-page 800x600 Web browsing.
- Access your corporate network utilizing Citrix ICA or Microsoft’s RDP.
- Synchronize with Microsoft Outlook to download important emails and contact information.
- Download, revise and upload Office, PDF, HTML and many other documents with goReader's
From e-learning to m-learning

- Draft Word, Excel and email documents easily via a virtual keyboard, USB keyboard or handwriting recognition.
- Jot notes on screen in your own handwriting with Ink Memo.
- goReader weighs only 2.4 pounds, yet is secured by a durable magnesium housing.
- Windows CE operating system provides users an intuitive, familiar interface.
- Supports all Windows CE applications.
- Memory is easily expandable using CompactFlash or PC Card options.
- SuperVGA 10.4" TFT touchscreen provides a bright, easy read.

24 Learning Circuits Goin Mobile

Learning Circuits is a website of the American Society for Training and Development.

Four recent presentations from the site are discussed here:

Goin Mobile by Paul Harris
Get ready for mLearning by Donna Abernethy
Introducing WML by Steve Heckler
M is for Maybe by

Goin Mobile provides a definition of mLearning. It is the point at which mobile computing and eLearning intersect to produce an anytime, anywhere learning experience. It is the ability to enjoy an educational moment from a cell phone or personal digital assistant (PDA), but almost exclusively the latter. The ubiquitous laptop computer doesn't qualify in most definitions, even though it's the lifeline of the mobile workforce.

This definition is well formulated. It clearly includes mobile or cell telephones and PDAs but does not include laptop computers thus throwing the emphasis on wirelessness as the defining element.

The article then continues with caveats saying that despite the strides made by Palm and other handheld devices, PDAs have obvious limitations as learning tools. Screens are tiny, the processing is slow and storage is limited.

It then draws attention to the ISOPIA initiative, now taken over by Sun, to access their system through cell phones, handheld wireless devices and PDA handsets to check their learning activities, course information or training status. It continues with a description of Global Knowledge's development with Ibrite and concludes with a presentation of PDAs in the classroom.

Get Ready for M-Learning draws attention to the contribution of Clark Quinn to the promotion of mLearning at KnowledgePlanet, Introducing WML provides an introduction to writing code in WML and M is for Maybe gives a critical evaluation of the possibilities for mlearning.

25 Global Learning Systems

Global Learning Systems is a major eLearning provider. Its website at http://www.globallearningsystems.com/ has a simulation of a course on PDAs with text audio and graphics.

Their system is called 'Learning to Go'.

Learning to Go™ Mobile Learning, Wherever You Are, Right in the Palm of Your Hand.

The PDA that manages your work life so effectively is now a delivery system for training, knowledge management and just-in-time performance support. Imagine downloading exactly what you need, when you need it - with full-motion video, audio and maximum interactivity. The performance improvement potential is unlimited when you deliver custom learning on a PDA.

The greatest benefit of this delivery method for training is the combination of true interactivity...
coupled with portability. Learners are no longer tethered to a classroom or even their desktop PC. Just as the cellular phone has become the preferred (mobile) person-to-person communication device, the PDA is rapidly becoming the preferred personal information organizer and information delivery device. Now, that “information” can be “training.” The PDA gives learners the ability to learn wherever they are. That is a type of freedom we’ve not experienced before.

Learning to Go™, by the very nature of its instructional design infrastructure, leads organizations into true knowledge management. Using a series of unique 5-minute mentor lesson templates, virtually any type of training is modularized, stored in a database and reassembled on demand.

26 Stanford Learning Lab

Stanford University has a long history of leadership in distance learning in the US.

This is a highly innovative project to use mobile phones in language teaching at the university. It is grounded in the American tradition of using live lectures and teaching by satellite and videoconferencing as a characteristic of distance learning, rather than the individualized print based approach better known in Europe.

Cell phones, Palm Pilots, wireless Web - they help us check email, trade stocks and stay in touch - but can they help us learn? Can we, should we, try to fill in gaps of daily time with learning opportunities?

Last summer, the Stanford Learning Lab (SLL) developed a few rough prototypes for mobile learning. The SLL staff chose foreign language study as the content area, hypothesizing that mobile devices could help provide sorely needed opportunities for review, listening and speaking practice in a safe, authentic, personalized and on-demand environment.

The prototypes developed let users practice new words, take a quiz, access word and phrase translations, work with a live coach, and save vocabulary to a notebook - all in an integrated voice/data environment. The intent this summer was not yet to support an actual Stanford course, but instead to begin exploring recent technologies and fundamental human cognitive challenges involved in learning on-the-go.

Being mobile correlates with highly fragmented attention, and the challenge was to better understand what kind of learning can happen in those fragmented pieces of time.

Three User Modes and Technology Tests

SLL staff conducted three discrete technology explorations and informal tests on several language learners of varying skill, with the following general results:

Text Quiz: vocabulary quizzes over mobile phone-based wireless Web.

Pros - convenient small question chunks to test knowledge during opportunistic bits of time.
Cons - small screen is difficult to focus on while outdoors; small bits of text do not provide an immersive enough experience for learning new content.

Live Coach: live-voice coaching sessions over mobile telephones.

Pros - speaking with an expert is ideal for language practice.
Cons - comprehension can be difficult over the phone; time with real-live coaches is difficult to scale.

Interactive Audio: automated voice-controlled vocabulary and quiz sessions over mobile telephones

Pros - audio experience can coincide with other activities (driving, walking, waiting, etc.) instead of replacing those activities; automated system offers potential for scalable, personalized, database driven listening and speaking practice.
Cons - voice recognition technology, flaky and expensive mobile phone connections, and audio interface design complexities are just some of the potentially show-stopping technology challenges.

Automated Audio: General Responses and Guidelines for Design

While initial test results were mixed, SLL continues to be intrigued by the potential for interactive audio to provide a scalable, rich, and flexible language learning environment. A summary of their user test findings and suggestions for future development follows.

Mobile Learning is a Highly Fragmented Experience:

Learning can be hard work. It requires concentration and reflection. However, being on-the-go (driving, riding a train, sitting in a cafe, walking down the street) is fraught with distractions. Users are in situations that place intermittent, unpredictable, yet critically important demands on their attention. Where does this leave the mobile learner? With a highly distracted, highly fragmented experience. The learning application must be designed with this in mind.

Learning is a Personal and Emotional Process:

Feeling shy about speaking your new foreign language, even with your teacher? Afraid you'll accidentally insult someone, or that they'll laugh at you? Learning is a sensitive process and language learning especially requires opportunities to practice in an emotionally safe and supportive environment.

The SLL's current interface is friendly, congratulates you when you get something right, and encourages you to try again when you don't.

User Frustration Wrecks Trust and Decreases Learning:

Poor cellular connections and environmental noises can cause imperfect voice recognition and therefore failed menu navigation and incorrect responses to learning interactions (such as quizzes). User observations indicate that repeated voice recognition misunderstandings impact users in interesting ways: on the surface, frustration and a reluctance to continue the lesson; on a perhaps less conscious level, a perception of the system as stupid or uncaring and therefore not an effective, trustful way to learn.

Also, not all misunderstandings are created equal. Users were more forgiving when the system made an incorrect response to their attempted Spanish than when it made an incorrect response to a simple navigation command like “back”.

Did It Work?

This first attempt at supporting language learning over mobile phones was not perfect. While voice interface design and creating studio quality audio are not easy, these can be remedied with a more professional development process and budget than SLL had available last summer. What about the more fundamental question of learning over the phone and in a mobile environment? Is the technology far enough along? Can a threshold of usability be reached, even though it's not perfect? Yes, and no.

With care and attention some parts of the learning process can be supported. SLL's testing showed that simply having access to the application anytime, anywhere increased daily attention to learning Spanish and boosted motivation. However, highly fragmented attention and bleeding edge technology can result in an environment too frustrating for learning. The Learning Lab's advice is to keep it simple. Focus on those parts of the learning process most suited to audio, most suited to small chunks of time, and most suited to a highly distractable learner. Allow learners to personalize their experience - from personality to interaction mode - to match their own learning styles and situational needs.
Global Knowledge have developed four of their courses for Palm computers:

- Understanding Network Fundamentals (483 text pages, 120 figures, 2450k file size)
- Telecommunications Fundamentals 1 (417 text pages, 48 figures, 1240k file size)
- Telecommunications fundamentals II (524 text pages, 65 figures, 1555 file size)
- Syngress CCNA Study Guide (1648 text pages, 120 figures, 4421k file size).

This is how they describe their system:

We have selected some of our most popular courses and made them available for use on your handheld PDA. Mobile Learning is the perfect pre and post course enhancement. With Mobile Learning, opportunities to reinforce your technical competence are greatly expanded - while traveling, in-between meetings, while waiting in line, or anytime you have a few minutes.

The Mobile Learning interface simplifies content navigation using familiar controls and speeds learning through four learning modes. These features are built around adaptive learning technology that remembers what material has been covered and focuses students on areas that require improvement.
CHAPTER 5. MLEARNING ON THE SCREENPHONE

- The proposal
- Illustration
- Limitations
- Decision

The proposal

The original project proposal contained the trialing of mLearning on the Ericsson screenphone HS 210. In this way it was felt that all facets of mobile learning could be demonstrated: the screenphone, the Personal digital Assistant (PDA) and the mobile phone.

It was suggested that the project would use the HS 210 or a similar technology to achieve the following sub packages:

- The provision of course content to off-campus students
- The provision of feedback to off campus students
- The provision of student support services for off campus students
- Links to the WWW and other resources
- Student to student interactivity
- Student to tutor and institution interactivity.

Each of these dimensions would be analysed and evaluated on a four point grid for decision makers:

- Student userfriendliness
- Didactic effectiveness
- Technical feasibility
- Cost effectiveness.

Illustration

This is the HS 210 wireless screen phone first demonstrated in March 2000
The sereenphone offers the following functionality:

- An A4 size screen that would make studying feasible; this is important given the frequently expressed opinion that the screen size of a mobile phone would make studying difficult
- Wireless connectivity
- Bluetooth enabled functionality
- Internet access
- Email access
- Colour screen
- Touch sensitive screen
- Speaker telephone
- Hands-free telephone.

Limitations

With a large screen for studying course content, email access, internet access and telephony, the screenphone has much of the functionality needed for successful mobile learning.

Its major limitation was lack of availability.

The project was designed from the literature evidence that distance learning systems follow the availability of technologies to citizens and that technologies, no matter how pedagogically suitable, were not successful if they were not generally available to students.

It was the penetration of the mobile telephone worldwide that was the nucleus of the project with Noika and Ericsson forecasting that by the end of 2002 there would be 1,000,000,000 of them for a world population of 6,000,000,000.

It was never likely that students would purchase a device like the screenphone merely for the purposes of study. If the screenphone was not generally available in homes for students to use. Its value for mobile learning was minimal.

It was never likely that these large A4-sized phones would penetrate the mass market. This was confirmed in early 2001 when Ericsson suspended production of the screenphone HS 210.

Decision

At its first meeting the project Board of Management was informed that the screenphone had been discontinued and would not be produced.

The Board of Management decided to replace it with another device which was readily available.

This decision does not in any way weaken the project because it is
most unlikely that the screen phone would ever have played an important role in mobile learning.
CHAPTER 6. mLEARNING ON THE COMPAQ iPAQ

- Proposal
- Illustration
- Limitations
- Decision
- Development of system
- Development of courseware

CHAPTER 6 mLEARNING ON THE COMPAQ iPAQ

The original proposal contained the development of a didactic environment and the production of a course for a wireless palmtop. The device listed in the proposal document was the Ericsson MC 218. Ericsson discontinued development of this device in the period between the submission of the project and its approval.

The first meeting of the project Board of Management substituted the Compaq iPaq for the MC 218. This decision strengthens the project as the Compaq iPaq is the most popular and wide selling Personal Digital Assistant (PDA) on the market.

This meeting also produced the project's definition of mobile learning. It is couched in these terms:

During the course of the project to date it has become apparent that there are several interpretations of mobile learning. These include wireless LAN (WLAN) technologies and the combination of mobile phone and laptop computer supporting a learning event (a partner suggested the phrase "battery learning" to describe these combinations). The meeting accepted that these scenarios may be defined by some as mLearning and accepts that there is an element of mobility in each. The meeting constructed a grid contrasting mobility with functionality such that these scenarios score high on functionality but low on mobility. The project places its research at the opposite end of the grid whereby the emphasis is on mobility and the testing of functionality with devices clearly in the mobile technology arena. The meeting felt this would lead to a truer exploration and evaluation of the issues, positive and negative, of a mobile learning experience.

Thus the project definition of mobile learning coincides with the review of the literature presented in Chapter 4 above as considering that the term mobile learning should include learning scenarios with mobile phones, palmtops and PDAs, but regarding laptop computers as outside its focus.

Thus the development of learning scenarios and distance learning courses for PDAs, like the Compaq iPaq, is central to the project and as most of the work described in Chapter 4 is on the development of scenarios for palmtops and PDAs it would be quite unrealistic not to have a central focus on development for PDAs.

Illustration
The Compaq iPAQ is a handheld computer giving full internet access and a wide range of functionality which the project is harnessing for learning. It has a touch sensitive screen that can be activated with a stylus and has a fold-out keyboard that enables easy typing input.

Here is an illustration of the latest model:

Compaq iPAQ 3650 Pocket PC

Limitations

The screen size of the Compaq iPAQ or of any handheld palmtop or PDA is small and has inherent difficulties for the presentation of course content in a distance learning context. Most people using them, however, appear to be able to read data from them with a certain amount of ease.

The concept of mobile learning has a central relationship to mobile telephony and the absence of a telephone contact, and the necessity to use a mobile telephone, with them is an important consideration.

Decision

A central part of mobile learning as detailed in the literature search presented in Chapter 4 deals with handhelds, palm tops and PDAs. There is very little development at this stage for mobile or cell phones. The project decided therefore to put a major part of its development effort into explorations of didactic constructs and course provision on the Compaq iPAQ.

Development of system for Compaq iPAQ

Fagerberg, Rekkedal and Russell in their, Designing and Trying Out a Learning Environment for Mobile Learners and Teachers describe the development of the didactic environment system for the Compaq iPaq at NKI in Norway thus:

This paper summarises the work package carried out at NKI Distance Education during the year 2001 of the EU Leonardo Project, "From e-Learning to m-Learning".

Development of the wireless Compaq iPaq

The concepts, distance education, e-learning and m-learning are discussed with reference to NKI Distance Education philosophies, views on learning and experiences in developing learning materials for distance education and online learning.

During 2001 NKI project team studied International experiences concerning m-learning, analysed technological solutions and pedagogic/didactic needs based on our internal practical experiences and results from previous surveys and evaluation studies among our distance students.
The technical solution chosen was to try out the use of a Pocket PC/Personal Digital Assistant (PDA) in combination with a mobile phone for distribution of learning content and communication between tutor and students, between students and for students’ communication with the learning material. As technologies develop so fast that the specific technology available changes from one week to the next, it was important that the solutions chosen had some generic basis, i.e. also that the specific brands of PCs, mobile phones and keyboards etc. should not constitute any substantial restrictions concerning generalisability of our experiences.

When we had to make our choice in late spring 2001, we found that after analysing functionality of different brands of PDA/Pocket PC, we chose to build our learning environment around the Compaq iPAQ 3630 and 3660. The mobile phones chosen were Ericsson T39 and Ericsson R580.

The next steps for NKI Distance Education in the project will be to carry out the first experiment of a partly real and partly simulated distance learning setting including evaluation, and carry out a survey among distance learners on aspects of mobility and plan and conduct a second experiment in a fully realistic setting.

The actual course chosen, ‘The tutor in distance education’ was chosen for the following reasons:

- It is a course in the pedagogy of distance teaching, and as such represents an ideal course for combining the research on media, methods and technology with the substance or content of the learning

- It is taught by internal NKI staff, also involved in the project, thus combining internal competence development with development work in the project

- The fact that same staff are involved in development and teaching in the practical try outs to be carried out opens for real field research during try out and also makes it easier to transfer the experiences and results from the experiments to further developments in the operations of the NKI Internet College

- Students taking the course are prospective online teachers in the NKI Distance Education system, their experiences as mobile learners are transferred to their teaching after completing the course

In this section of their report Fagerberg et al present their decisions to develop mLearning systems for the PDA, Compaq iPaq. In the following section they present theoretical analyses of learning using the work of the German scholar, Dichanz.

Theoretical constructs on the nature of learning

‘Distance education’ and ‘distance learning’ are well-established concepts (Keegan 1996). The ‘distance learner’ is a person who, for some reason, will not or cannot take part in educational programmes that require presence at certain times or places.

Recently terms such as ‘e-learning’ and ‘m-learning’ have entered the scene. To us, learning is an activity or process and shown as a change in a person’s perceptions, attitudes or cognitive or physical skills. It cannot be ‘electronic’ (if that is what e-learning is supposed to stand for (?)).

The terms e-learning and d-learning deserve to be analysed. For instance, the term, e-learning, seems to be used to convince users that some supernatural things happen with your brain when you place yourself in front of a computer screen. This miracle is very unlikely to happen, as learning in the real world is mainly hard work. Most examples of so-called e-learning programmes seem to be extremely costly to develop and most often covers low-level knowledge and facts based on a simplistic view of what learning is (see e.g. Dichanz 2001 “E-learning, a linguistic, psychological and pedagogical analysis of a misleading term”).

However, as the term seems to be becoming part of accepted terminology, it is imperative for educational researchers and serious providers to define it and assign meaning that is in accordance
From e-learning to m-learning

with our views on teaching and learning. Seen from a university perspective, Dichanz, who is professor of education and the German FernUniversität ends his critical analysis of the term, e-learning with the following definition:

"E-learning is the collection of teaching – and information packages – in further education which is available at any time and any place and are delivered to learners electronically. They contain units of information, self-testing batteries and tests, which allow a quick self-evaluation for quick placement. E-learning offers more lower level learning goals. Higher order goals like understanding, reasoning and (moral) judging are more difficult to achieve. They require an individualised interactive discourse and can hardly be planned" (Dichanz 2001)

Even though we do not totally agree with Dichanz that higher level learning goals cannot be planned, we agree that such goals are much more difficult to plan, and that most so-called e-learning programmes do not demonstrate attention to higher level learning objectives.

Similar reflections can be raised concerning the term, ‘mobile learning’. Again, learning cannot be mobile. Learners are probably more and more mobile, and they use mobile technology. In connection with this project we would describe NKI’s main objective ‘to design and trial out a learning environment for mobile learners and teachers’ maintaining the flexibility of distance education for learners on the move. These reflections are in line with Sariola et al. (2001):

"The term ‘mLearning’ has lately emerged to be associated with the use of mobile technology in education. It seems, however, that it is used in commercial purposes rather than as an educational concept. We wonder if the term is a commercial trick to market technology and educational services or if it is an emerging concept that educationalists should take seriously." (Sariola et al. 2001, p 1)

It should be noted that, although m-learning is a new concept, serving mobile learners is not a new idea. Again, distance education has a history of more than 150 years, where institutions has offered high quality education to learners ‘free of time and place’. This means, that if we are willing to accept the concept m-learning, distance teaching institutions have provided m-learning since its invention. For example, the history of Hermods, once one of the worlds largest correspondence institutions, tells that the original idea that resulted in establishing the institution in 1898 came when Hermods as a local language teacher in Malmö started to support one of his students who moved to another city (Gaddén 1973).

Thus, distance education institutions have provided m-learning for many years. In fact, the ‘correspondence courses’ of the first generation of distance education could be studied at any time anywhere. Actually, the introduction of the desktop computer (and other learning technologies), which required the student to study at a certain place, often also at a certain time, reduced flexibility of distance learning. It is the introduction of mobile electronic equipment and communications technologies, which reintroduces mobility to the distance learner (and teacher). Kjell Askeland (2000) goes even further, and points to the fact that, if we disregard the need for an institution to plan and conduct teaching, mobile learning started when the printing technique was invented, and students could learn without coming to schools and universities.

Again, if we accept the term ‘mobile learning’ = m-learning’, what is it? Most definitions take technology as the starting point, e.g. Quinn (2000-2001): "...(mLearning)? It's elearning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone. Let's call them information appliances (IAs)...".

Others define m-learning closely to distance education, Chabra & Figueiredo (undated): “The ability to receive learning anytime, anywhere and on any device”, while Harris (2001) combines technology and the flexibility concept of distance education in his definition: “The point at which mobile computing and eLearning intersect to produce an anytime, anywhere learning experience”.

Sariola et al. (Ibid.) discusses the concept, m-learning, from the perspective of educational theory, technology-based definition is obviously not sufficient, and also tries to include aspects of technology. They introduce the characteristics, ‘portability’, i.e. the equipment is so light that we can carry the devices that we call mobile, ‘wireless’, there are no wires in the equipment, and ‘mobility’, we are moving when using the technology. Sariola et al. notes that it is the mobility that is most interesting
From e-learning to m-learning

Concerning mobility, they raise the question about 'who' is moving, 'why' and 'where'. If moving is not related to the learning activity as such, why a person is moving might be irrelevant from an educational viewpoint.

However, it is the challenge of the educational institution to satisfy learning needs for people on the move (and we could add to support teachers who move to continue their tasks concerning student support). Sariola et al. notes that conducting educational activities while moving, might deal with convenience, e.g. rational time management or expediency, e.g. the person is moving to a place relevant for the subject studied. Both situations concern NKI when designing an effective and efficient learning environment for the distance learner, although convenience has been most focussed till now.

In this presentation it is hard to agree with the authors when they claim that mobile learning has existed for 150 years and is thus identical with 'distance education'. The advent of elearning, in which students studied the whole or part of a course in front of a computer screen, brought a new electronic dimension to distance learning, which cannot be bypassed. This was a wired computer environment and what is unique and innovative about mLearning is its elimination of the dependence on wiring and the harnessing of the global presence of mobile telephones to training and learning.

Flexible teaching or teaching in the ‘extended classroom’

As stated earlier in this book there are two developments which are central to distance education: individual based systems, prevalent especially in Europe, and group-based systems prevalent in the USA and China. Fagerberg et al take up this theme in their next section:

A number of evaluation studies among distance and online learners at NKI demonstrate that students emphasize flexibility (see e.g. Rekkedal 1990, 1998, 1999).

In our view, distance education seems to develop in two quite different directions. The solution at one end of a flexibility continuum can be described as an individual, flexible solution allowing the student freedom to start at any time and follow his/her own progression according to personal needs for combining studies with work, family and social life – 'the individual flexible teaching model'.

This model represents a generic development of the model of distance teaching institutions and applies normally media and technologies independent of time (and place), such as asynchronous computer communication, video, audio and printed materials. The model on the opposite end of the scale, 'the extended classroom model', assumes that the students are organised into groups required to meet regularly at local study centres and applies technologies such as video conferencing, satellite distribution, radio and television (Gamlin 1995).

In this connection we have chosen the philosophy for the development of Internet based education at NKI: Flexible and individual distance teaching with the student group as social and academic support for learning. NKI offers more than 400 courses and over 100 study programmes by correspondence based and Internet based distance teaching and recruits 10,000 students every year. These students may enrol to any course of programme or combination of courses at any day of the year and progress at their own pace. This flexibility does not exclude group-based solutions in co-operation with one single employer, trade organisation or local organiser.

It is also clear from NKI experiences that already many of our students and teachers have experience as mobile learners and teachers. Till now this has been restricted mainly to students and teachers carrying their laptops, possibly including communication via mobile phones.

Our main objective in this part of the project has been to extend the distribution of learning materials and communication to lighter equipment, specifically PDA and mobile phone. The challenge is then to develop the system and server side to present materials in ways suitable for PDA technology, find acceptable solutions for distribution of materials and for administration to student, teacher to student/student to teacher and student communication.

It is our aim in designing the environment for the mobile learner to extend and increase the flexibility of distance education, that to some extent took a step backwards when converting from paper based to online learning, where students largely were required to study at a place (and at a time) where a
From e-learning to m-learning computer with access the Internet was available.

The authors then proceed with an in depth treatment of the nature of learning as it applies to mLearning and other possibilities.

Views on knowledge and learning

For NKI it was clear that the learning aims, content and teaching/learning methods in our online courses and programmes generally are far away from most e-learning courses. Most examples of m-learning experiments concern e-learning on mobile devices, often WAP and/or ‘smart-phones’ (see e.g. Kynäslahti 2001, Kristiansen 2001).

To us, learning is a change in the student’s perception of reality related to the problem areas studied and increased competence in solving problems in a field, ability to differ between focal and more peripheral questions, analytical skills and competence in using the tools within a field in appropriate ways. This means that learning results are shown in a qualitative change in the student's understanding, academic, social and technical competence. The learning is a result of active processing of learning material and solving problems individually and/or in groups.

This view is often different from what we can find in many so-called e-learning programmes, where knowledge often is seen as a larger amount of information or ability to recall and reproduce facts. In addition to cost considerations, this is why NKI in general has put little emphasis on using fancy effects in a behaviouristic pedagogical tradition, programmed learning and knowledge transmission (see Marton et al 1987, 1997, Morgan 1993 on students’ conceptions of learning, deep level and surface level approaches to learning). We also hold the view that learning is an individual process that can be supported by adequate interaction and/or collaboration in groups (Askeland 2001). With these considerations in mind the NKI solution for designing and trying out a new learning environment for online learners applying PDA and mobile communication seemed to be a sensible one. Our considerations and decisions are discussed below.

Internet based education at NKI today

The authors then present the experience of their own institution in the field of e-Learning and the transition to m-Learning.

NKI was probably the first European online college, and it has offered distance education online every day since 1987. Few - if any - online colleges in the world has been longer in continuous operation.

NKI Distance Education has today well above 200 courses and more than 60 complete study programmes on the Internet. October 2001 we had 3,000 registered active students. There will be more than 6,000 new course enrolments this year (2001). Contrary to many other educational providers where the Internet is used as a supplement to face-to-face teaching or other forms of distance education, we have followed the philosophy that in principle all communication can be taken care of through the Internet, and ideally no obligatory physical meetings should be required. (This does not mean that the students are not free to communicate by post, phone or fax or that study materials may include print, audio or video technologies.)

In connection with a previous EU Leonardo projects managed by LM Ericsson we described the programme and distribution system in Internet based learning as a ‘Multimedia World Wide Web Kernel for Distance Education’ (http://www.nki.no/eileen/) with the following elements:
In designing the learning environment with the mobile learner in mind, all these aspects and functionalities have to be taken into account. However, in this first pilot experiment we have not focussed on multi-media materials. Extending the functionalities to more multi-media content adapted to the PDA should be a main objective for another project.

**Development and Design of the Environment for the Mobile Learner Applying the Compaq iPAQ.**

As mentioned above, the aim for the NKI project team was to adapt a course so that it could be used on a wireless handheld device, in our case the Compaq iPAQ Pocket PC. After some discussions we have chose the course ‘The Tutor in Distance Education’ for this project. In addition, we also put some effort into adapting the course *Spice 601, Specialization Program in International Online Education*, to the Pocket PC. This was mainly done to demonstrate a course in English for the Leonardo project team.

These courses were already developed and distributed as courses from the NKI Internet College. The challenge was to design a solution to try out for mobile learners.

**Some background information on the Compaq iPAQ**

This device is a handheld pocket PC that puts the power of a desktop PC in a sleek little to-go box that gives access to Microsoft Pocket applications like Internet Explorer, Outlook, Word and Excel. Among this software is also Microsoft Reader with Clear Type, which is one of the technologies that we wish to try out in the project. It is also possible to install third party software. One can synchronize the device with one’s desktop PC to read e-mail, view attachments, update the calendar and the device can easily connect to a mobile phone via cable, infrared or bluetooth (3870 version) for online browsing. (See [http://www.compaq.com/products/handhelds/index.html](http://www.compaq.com/products/handhelds/index.html) for more details.) The screen keyboard is acceptable for short notes. However, many users would prefer to connect to Pocket PC with a foldable keyboard for more efficient writing. At the time of writing (December 2001) available keyboards are far from ideal concerning supporting Norwegian characters.
Studying online and offline

In line with the above discussions on learning and studying, most NKI courses are not designed to function as online interactive e-learning programmes, although some parts of the courses may imply such interaction with multi-media materials, tests and assignments. The courses normally involves intensive study, mainly of text based materials, solving problems, writing essays, submitting assignments and communicating with fellow students by e-mail or in the web based conferences. This means that most of the time the students will be offline when studying. From experience we know that the students often download content for reading offline and often also print out content for reading on paper.

It should also be emphasized that we assume that the NKI Internet students normally will have access to a desktop or laptop computer with Internet connection. This means that the equipment and technologies used when mobile are additions to the students’ equipment used when studying at home or at work.

When planning for the m-learning environment the NKI project team had long discussions whether to develop the learning materials for online or offline study. Taken the above experiences and also cost considerations concerning mobile access to online learning materials, we concluded that the learning environment should include the following aspects:

- Technology:
  - Pocket PC
  - Mobile phone
  - Portable keyboard

NKI distance student reading comments from his tutor in the garden of his hotel on business in Rome using PocketPC, portable keyboard and mobile phone.

Learning content and communication:

- Learning content to be downloaded on the mobile device to be studied offline. Downloaded content to include all course materials:
  - Content page
  - Preface
  - Introduction
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- All study units
- Resources (articles on the web, references to other resource materials)
- Online access to the discussion forum with the possibility of as quick as possible access for reading in the Forum and writing contributions
- E-mail for individual communication with tutor and fellow students and for submitting assignments. Assignments may be submitted as text-based e-mail or as Word or Text attachments.

Before taking the decision on distribution of course content to students via the Pocket PC, we analysed three alternative solutions that were discussed in depth. The discussions also included viewpoints on which materials and study activities were suited for offline or online work.

The authors then describe central decisions on the type of system they would design for the Compaq iPaq:

3 alternative solutions for distribution of course content

The 3 main solutions for distributing content were:

1. The AvantGo Mobile Internet service
2. Online access via mobile telephone to the entire course
3. ‘Download-on-demand’ version
4. 

Solution 1: The AvantGo Mobile Internet service

Technically we could choose the solution were the student easily could download the entire course content trough ‘The AvantGo Mobile Internet Service’. From the AvantGo website:

“*The AvantGo Mobile Internet service provides free interactive and personalized content and applications to your handheld device or Internet-enabled mobile phone real-time via wireless connection or desktop synchronization. With AvantGo you can seamlessly transition between wireless and offline modes to browse your favorite websites on your mobile device or select from our more than 1500 brand-name content and application channels for up-to-date news, financial, travel, entertainment, sports information and much more.*

The AvantGo Service allows the user to subscribe to a large number of channels of different categories. AvantGo offers a range of products for the synchronizing of PDAs. Including a range of hosting services. Unfortunately the hosting services are only suitable for the delivering of typical news channel information such as CNN headlines or stock quotes. These services are priced according to how many users use the service each day. AvantGo then uses advertising and revenue from the information provider to generate income. It is up to the information supplier to generate their own income based on these services. The hosted services also do not cover NKI Distance Education needs of personalized content and user interaction.

To be able to deliver content to PDAs via AvantGo we will be required to install our own AvantGo server, and then deliver content via this server to PDAs. AvantGo call their server Mbusiness server. The server is capable of being connected to our current web application (SESAM). And allow us to use our own database of user names and passwords, via a connection to our LDAP server for authenticating users. This would allow NKI to deliver customized content to each user. When using the Mbusiness server it is also possible to cater for user interactions. In that case a user could write a submission to the forum system and the next time the PDA was synchronized, the submission would be uploaded to our server

The Mbusiness server is available for many operating systems, including MS-Windows, Linux and SUN Solaris. All communication with the server is encrypted for security.

AvantGo’s pricing policy is based on the value the server product will add to the purchasing enterprise. So the price is highly variable. It is not possible to get a ‘definitive’ price for the Mbusiness...
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server without AvantGo evaluating how much 'value' the server will add to our organization. However, we were able to get a general guideline. The Mbusiness server would typically costs around 75,000 euros for a 250-user intranet. These are costs that would not be acceptable for use with NKI Internet students.

**Solution 2: Online access via mobile telephone to the entire course**

This is perhaps in principle the preferred solution. However, it requires higher speed and lower prices than we could find in Norway in 2000. It is also the most complex solution. An online version requires that we would have to redesign the entire site to fit the Pocket PC format. Before doing this we would have to make a cost-benefit analysis in front to see if the solution really is worth the effort. The other important issue is the availability of mobile communication technology and pricing. In this project we are using the Ericsson R520 and Ericsson T39 mobile phones connected with the PocketPC. These phone supports GPRS, General Packet Radio Services, and HSCSD (high-speed circuit switched data). So far in the project our experience with this technology is mixed. It proved quite difficult to set up and connect via GPRS, and the pricing policy chosen by our Norwegian GPRS providers makes it all to expensive to use. One pays no subscription fees, however, the amount paid Mb of information transferred is presently not acceptable. For data up to 1Mb one pays 0.10 NKR pr. Kb and 0.025 NKR pr. Kb for data exceeding 1Mb.

**Solution 3: 'Download-on-demand' version**

We have developed two different "download-on-demand" versions. The first one consists of a set of zipped HTML files, which one may download to the desktop PC, unzip and synchronize with the PocketPC. The second consists of a set of ready to use Microsoft Reader files, which also are synchronized to the PocketPC. These files are available from within the web course.

At this stage of the project we focused on this alternative. The HTML version is using Internet Explorer to browse the course material offline. The other version is also an offline version, using the software, *Microsoft Reader with ClearType*.

The choice of solution 3 was partly a result of limited time and resources available at this stage of the project. Solution 1 needs more research to 'the most ideal' solution for the future, i.e. to offer a complete PDA adapted version based on the same learning materials available in the web course for standard PCs. The principle of 'one file many versions' (html, pdf, reader, etc.) is achievable through the use of XML). Presently, through our preliminary analyses we found that explore opportunities, limitations and cost/benefit. Solution 2 would perhaps be there were too many limitations in mobile technology regarding transfer capacity vs. cost to be able to carry out the experiments that we wished to do. Solution 2 would also, as mentioned above, require a complete site redesign of the NKI Distance Education website.

The reason for supplying two alternatives of content is that we as part of the empirical testing are interested in examining attractiveness and user friendliness of the different solutions for the student. The student can manipulate the Microsoft Reader content by the possibility of *bookmarking, adding highlights, notes and drawings and look up words directly in the PocketPC Dictionary*. This means that the students can use the materials actively in ways that we recognise from students’ use of print materials and their personal notes. The student is, in other words, able to 'make the materials his own' while studying. It is reason to believe that these functionalities may help students organising the materials cognitively and support learning and remembering.

The decision to go for the choice of downloading content for offline study was based on previous experiences and also the following considerations: NKI Internet students study mainly offline. Communication concerns discussion with fellow students in the academic forums, cooperation on projects and group assignments, and individual communication with other students – and, most important, according to our evaluations (see e.g. Rekkedal & Paulsen 1997), communication with the tutor including submission of assignments with correction and feedback. All our analyses concluded that the students will have all these possibilities available on their desktop or laptop PCs, including online interaction with the learning materials.

When mobile – and using mobile technologies – it is generally satisfactory for the student (and the
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tutor) to have the course content available to study on the PocketPC. In addition, the following communication possibilities are necessary. When mobile, the student must be able to:

- Access the course forum to read messages
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration
- Submit assignments by e-mail including attachments
- Receiving assignments corrected and commented on by the tutor including attachments

To access e-mail and discussion forums, mobile phones will be used. We plan that in future versions it will be possible to synchronize discussions via the student’s desktop or laptop PC.

This software/technologies chosen are described in more detail below.

**Development of courseware for the Compaq iPaq**

The authors now describe the choice of courseware for the m-Learning development on the Compaq iPaq and the methodologies used in the development of this courseware.

We chose a course previously developed for Internet/web based learning, ‘*The Tutor in Distance Education*’ as courseware for this project. This course is one of our many ongoing Internet courses and therefore already available in a HTML version. Thus it was relatively easy to adapt the existing version of the course to the iPAQ since MS Internet Explorer is the browsing tool used. The main part of the adaptation was to create directories and file structures that insured that all content were present and worked as intended.

Some modifications had to be done, e.g. the table of content had to be changed, so that all links to introductions, study units, articles etc. could be placed on one page. The Content Page also contains links to examples of course pages such as class list, forum page, the student’s personal NKI college page and others. Students can also a link to the presentation of their tutor with contact information. The course includes reference links to many external resources, which also are available on the PocketPC, but accessible only when online through the mobile phone. The course also includes a number of articles available at the NKI Internet College Pages. We chose to include the whole library of distance education research reports, articles, conference papers etc. available on the NKI pages. This was done mainly because the course content concerns distance education pedagogy and didactics, thus as the storing capabilities of the iPAQ was sufficient, we considered this as an extra academic service.

As mentioned, the HTML version applies Microsoft Pocket Internet Explorer that is a web browser with far less functionality than the full scale PC version. The other version developed for the project uses Microsoft Reader on the Pocket PC as ‘browsing’ tool.

Microsoft Reader with ClearType is one of the programmes available to read e-books or content in the *.lit file format (MS Reader file format). Microsoft has developed Microsoft Reader with ClearType that enhances display resolution by as much as 300 percent by improving letter shapes and character spacing, making them appear more detailed, more finely crafted, and more like printed fonts. This gives powerful digital advantages like integrated dictionary support and electronic annotations, while Honouring the best traditions of typography to ensure proper kerning and leading, correct margins, and line justification, to name a few. The software also gives the opportunity to read e-books, Pocket Dictionaries etc. to downloaded from the Internet and synchronized to the PocketPC via the PC.
There are several methods to produce materials in the Microsoft Reader format. One may create on-the-fly Reader files via publishing websites like eBookExpress:

It's possible to outsource the entire or parts of the converting process. Several e-book consulting and content conversion services are available and offering services ranging from document conversion to complete e-commerce solutions. Overdrive is one example of a firm that offer ePublishing solutions, [http://www.overdrive.com](http://www.overdrive.com). The software builds the e-book, page-by-page, according to individual preferences to suit the device one is using.

One may also download software that converts publications into Reader files/e-books according to individual preferences. One of these is ReaderWorks. This is a third-party software recommended by Microsoft developed by OverDrive Inc. ReaderWorks is available in three versions, Standard, Publisher and Professional. The Standard version is freeware with less functionality than the Publisher and Professional versions. OverDrive and Microsoft also provides a software development kit (SDK) that software developers can use to build tools that generate Microsoft Readerfiles. Microsoft also offers an add-in functionality for Microsoft Word that makes it possible to convert a Word document to Reader format.

We have in the project produced a version of the learning materials for Microsoft Reader using the Standard version of ReaderWorks from OverDrive Inc. This version is a freeware application with some limitations regarding commercial sale and distribution. It also lacks the opportunity to provide cover pages and marketing information.

ReaderWorks Standard includes tools to convert html, text and image files to Reader format. It also allow for making a table of content based on heading formatting of HTML documents. Our experience so far is that this is a very well functional tool that also is quite easy to use. It has an intuitive user interface with many different options and functions. We had some problems with empty meta-tags that made the conversion fail. The software also showed some problems with documents containing internal style-sheets and script language. These errors caused the conversion to fail. The HTML code causing these errors had to be manually corrected. The software supplied good reports on what kind of errors arising and where they occurred.
The Solutions Exemplified

In this important section the authors describe the differences in presentation of the wired version of the course for e-Learning and the changes that are met in using the same materials in a mobile learning environment.

As described before all NKI Internet students, whether studying a course with a mobile supplement or not, will access the course materials and communication solutions via their ordinary PC at home, at the workplace or elsewhere. Course content for the mobile supplement is downloaded to the PC and synchronized to the PocketPC, while all the communication activities can be carried out through the PocketPC and the mobile phone when on the move.

After logging into the NKI Internet College with user name and password, the user (tutor or student) opens the person’s individual ‘Personal page’. This page contains general information and lists the courses and programmes the person has access to. On the screen above the tutor has access to ‘m-learning lærer’, which is the course developed and to be tried out during the first phase of the project. The course title links to the Course Front Page.

The course front page links to:

- The course content on the server
  - Preface
  - Introduction
  - Study Unit 1
  - Study Unit 2
  - Study Unit 3
  - Resources
- Information about copyrights
- Tutor and class list
- The course forum

In addition the m-learning version has a link named ‘Pocket PC’, which links to a page containing all necessary information for downloading the content in the two versions, HTML format and Microsoft Reader format.

Learning materials and communication on the PocketPC

The learning materials downloaded and synchronized to the PocketPC are presented as complete HTML files, and are, according to our subjective opinion, satisfactory for reading on the PocketPC screen. This will be evaluated during the try out.

The screen shots of the PocketPC are photographed using a digital camera. The results are not perfect, but give a reasonably good impression of how they look.

Below is presented the course content files as they appear downloaded in the HTML version:
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The Table of Content Page on the PocketPC.

The hyperlinks brings the student to the course content files. The last link seen at the screen, ‘Kurs i e-bokformat’ (Course in e-book format) opens the Microsoft Reader with a second full version of the course. The Content Page also has links (not seen on the screen) that opens the PocketPC e-mail programme or connects directly to the course online for reading and contributing to the course forum.

While the course content is presented in formats adapted to the screen of the PocketPC, the pages above are shown as they appear with the present solution (without having redesigned the materials on the server to fit the PocketPC). However, with some scrolling the pages are readable.

The authors then proceed with their conclusion on the provision of mobile learning environments for learners so far.

Conclusion course presentation and communication

At the present stage and with present technological limitations the NKI project team decided that we had found an acceptable solution for presentation of course content and facilities for studying the learning materials, for solving assignments and submission of assignments to the tutor. Sending and receiving e-mails also functions satisfactory.

It is the empirical try out that hopefully will give answers to how our solutions actually are accepted in practice. In connection with the second phase of the project, we will parallel to the empirical research look at possible solutions for redesigning the site to make the learning materials better adapted for online access and interaction from mobile equipment.

In this paper we have described the preparatory work, internal discussion and analyses and the development work concerning preparing for trying out a learning environment for mobile learners within the teaching and learning system of NKI Distance Education. The NKI Internet College is defined as the total system for Internet based distance education courses. The work during 2001 is carried out in close cooperation with the other partners in the project.

The solution is based on the assumption that students defined as ‘mobile learners’ have access to the
NKI Internet College through a standard PC and Internet connection, and that the mobile part is seen as a supplement for students when on the move. Our technical requirements was that the mobile learning platform had to allow more advanced presentation and communication possibilities than possible through the WAP phone, concerning storing capabilities, use of colours and graphics and size of files. The decision was taken to develop learning materials, i.e. complete courses for handheld PDAs/PocketPC and mobile phone for connection to the Internet. The solutions are supposed to be generic and based on state of the art technology and also representing technologies that would give experiences of value for future assumed probable developments in software and hardware. The actual equipment used as basis and trials during development was Compaq iPAQ and Ericsson T39 and R580.

One course, ‘The tutor in distance education’ was chosen as the first practical case in developing materials and communication solutions for the mobile learner. Before starting actual try outs, the project group feels that the technical solutions chosen constitute a good basis for experimenting and evaluating an environment for mobile learners in NKI Distance Education.

The authors then proceed with an indication of the next development of their provision of mobile learning environments for learners.

**Planning the Try Out**

We plan to try out the solution from early January 2002. Originally we wished to try out the course among ordinary students at NKI. We have found that access to equipment among our ordinary students for the time being is too limited. Thus, the first trial will be carried out in a partly real and partly simulated situation where one member of the project team will teach the course to an internal group of NKI employees, some members of the project team and some participants working in other projects and related areas. For the try out we have purchased 10 PDAs and a few mobile phones.

We will evaluate the results through the process applying qualitative research methods, such as diaries, interviews and discussions in the academic Forum focussing on the aspects of the mobile learning environment. Aspects to be evaluated are:

- Technical problems concerning downloading, synchronization, communication with forum and e-mail
- Studying on the move with the learning materials on mobile equipment (PDA and mobile phone)
- Use of learning materials, usefulness of HTML solutions and e-book
- Technology, such as use of screen and portable keyboards

The participants will be required to log experiences from the first experiences with the PDA and downloading till end of course, to study the materials and communicate with fellow students and participating in forum discussions via mobile equipment.
CHAPTER 7 MLEARNING ON THE SMARTPHONE R380

- Proposal
- Illustration
- Limitations
- Decision
- Development of system
- Pedagogical Issues
- Development of courseware

Proposal

The first Board of Management meeting added development of a didactic scenario for the smartphone R380 and the development of courses for running on it to the development of the WAP phone R520, to demonstrate the differences between development for the smartphone and the WAP phone.

Illustration

Here is an illustration of the smartphone R380:
The functionality of the smartphone is described by Ericsson thus:

Unique functionality offers you an all-in-one mobile communications and organizational tool. (Mobile Phone + PDA + Mobile Internet Browser)

Email with your phone. Use your own ISP and securely send/receive corporate and personal emails (Supports Secure ID and Safeword).


Fully-integrated PDA. Take your phonebook and calendar with you. Take notes and voice memos on the go.

Large, Graphics-rich Display. Easily view more information including graphic images, pull-down menus and charts.

Touch Screen. Stylus-based, Touch Sensitive Screen with Handwriting Recognition (JOT® by CIC) makes inputting text easy and natural. Even supports handwritten accents.

Voice Control Dialing and Answering. It responds to your voice.

Vibrating Alert. Discreetly notifies you of incoming calls.

Built-in Modem with Infrared (IrDA) Port. Get the information you need on the move, without wires, anywhere.

Infrared connection. Beam contacts to your colleague and exchange Virtual Business Cards.
PC Synchronization for office applications. Always have your most-recent information (Email, Calendar, Contacts, Notes and Tasklist) with you - no matter where you are.

Data Protection. The non-volatile memory makes it possible to keep data even if you lose power.

Melody Composer. Make your own tunes or choose among the 18 different tunes included. Melodies can also be sent by email, WAP or/and SMS.

Synchronization compatibility: MS Outlook 97/98/2000 MS Schedule+7.0 Lotus Organizer 4.1/5.0 Lotus Notes 4.5/4.6/5.0 (Lotus Organizer 5.0 is included in the kit)

Extras:
- Alarm
- Calculator
- Game
- PC Back-up/Restore
- Stylus-Based Virtual Keyboard
- World Clock displays home and local time
- Key lock
- Choice of 22 display languages

Network Supported Features Include: Automatic Time Zone (NITZ) Automatic Remote Configuration for Messaging and WAP Internet Services Call Wait / Call Hold / Call Forwarding / Call Transfer Conference Call

Caller Number Identification and Restriction, Combined list of successful, unsuccessful, received and rejected calls. International Roaming (World version covers larger areas) Short Message Service (SMS), send and receive. Voicemail USSD, SMS CB 50, RSMT Advice of Charge.

Ericsson presents the specifications of the R380 thus:

R380e brings together the functions of a mobile phone, calendar, address book and mobile Internet device with e-mail and WAP.

At first glance, it has the look, feel and performance of a regular high-spec mobile phone. But open the flip and you transform R380e into an advanced personal organizer with a large landscape display, an easy-to-use touchscreen keyboard and intuitive handwriting recognition for fast and easy input.

Send and receive e-mail and concatenated SMS1 wherever you are and send faxes over SMS2. Get WAP the way it should be with a large,
scrollable display and WAP 1.2.1 with WTLS class 2 enhanced security. That makes it safe to send confidential information such as credit card numbers and bank account details over the air.

R380’s calendar and contact features are powerful and simple to use. The calendar has day, week and month views, and a handy task list. The contact feature allows you to store names, addresses, e-mail addresses, several phone numbers and more. Everything is quickly and easily synchronizable with your PC, making sure both devices carry exactly the same information. Plus there’s a notepad, ink note feature, world clock, calculator, games and a useful voice memo feature.

Here are the R380 specifications:

Dual band for GSM 900/1800 and e-GSM

Battery (Li-Ion 1200 mAh) with stylus. Travel Charger. 3 extra styluses. Desk Stand. RS 232 Cable. Classic Belt Case. Portable Handsfree with answering button. CD-ROM with PC synchronization software.

Size: 130 x 50 x 26 mm

Weight: 164 g

R380e connects to: Windows®95/98/ME/2000/NT4.0 SP5 with minimum Pentium® 166MHz, CD player and 100MB free disk space

R380e synchronizes with: Most leading PIM applications (Microsoft® Outlook, Exchange and Schedule+ and Lotus® organizer and Notes)

Talk time* Up to 6 hrs

Standby time* Up to 130 hrs

Limitations

The R380 has a landscape display which greatly increases the screen space in comparison with normal mobile phones. Many will feel that it is still inadequate for successful study.

The lack of bandwidth available and the lack of memory are further difficulties in setting up a successful didactic system for the smartphone.

Almeida in her *The advantages and disadvantages of using WAP in developing an mLearning course* writes:

Transporting data in the mobile networks of today, for example GSM, has been compared to ‘Carrying an ice cube in a plastic bag in the desert heat of 40C’. The conditions of the mobile network are harsh. Hence, given these harsh conditions, it is essential to select an appropriate application environment and design the application for the mobile user and the challenges provided by the mobile network.

The mobile network is different, the bandwidth is narrow, and delays are greater than in the PC /Wired network which supports 2 Mbits per second. The mobile network in comparison provides resources of 9.6kbps for a user.
The challenges for developing an application for the mobile environment are mainly these obvious differences between the Mobile network and the Wired environment.

A mobile handheld device e.g. Mobile Phone or Smart phone is different to a PC/ Laptop. The screen size is small, the number of keys a user has access to is limited to 16 keys or less. The device also is limiting is memory storage, processing power and battery power.

**Decision**

The project Board of Management decided to develop the full functionality for mLearning for both the smartphone R380 and the WAP phone R520.

**Development of system for R380**

Almeida in her *The advantages and disadvantages of using WAP in developing an mLearning course* gives these guidelines for the development of a learning environment for the R380:

The application developer needs to consider the user when designing the mlearning course content and structure.

The following simple principles are recommended:

1. Keep it Simple
2. Avoid large amounts of data
3. Avoid underlined text as this will be mistaken for Links
4. Use Selection Lists for data entry
5. Consistency – place links in same place throughout application
6. Always provide link to Start page or Index
7. Use Titles on Cards to ease navigation
8. Use Tabloid format – headlines and summaries
9. Use short words

The only confirmation of usability is to test the application on sample users for ease of use, before the application is launched.

**Pedagogical Issues**

The main pedagogical issue to consider is the suitability of a course to the mLearning environment. Not all courses are suited to the mLearning environment. Purely technical and very practical courses are not suitable.

However, short courses and mainly theory and information type courses are suited to the mobile learning environment. The learning environment can be enhanced by the use of quizzes to test knowledge, summary of main learning points, and interaction with other students and the tutor via telephony integration.

**Development of courseware for the R380**

The courseware for the R380 was developed using WML and WML script. Here is a selection of the code used in the development:
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<?xml version="1.0"?
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD WML 1.1//EN" "http://www.wapforum.org/DTD/wml_1.1.xml">
<wml>
<!-- put template code for go back for all cards -->
<card title='Table of contents' id='c1'>
<p>Choose a Module:
<br/><a href='wap-past.wml#c1'>WAP Past</a>
<br/><a href='wap-future.wml#c1'>WAP Future</a>
<br/><a href='bus-values.wml#c1'>Business Values</a>
<br/><a href='applics.wml#c1'>Applications</a>
<br/><a href='techno.wml#c1'>Architecture</a>
<br/><a href='#help'>HELP</a>
<br/><a href='links.wml#c1'>LINKS</a>
<br/><a href='faq.wml#c1'>FAQ</a>
<br/><a href='wap-snapshots.wml#c1'>WAP NEWS</a>
<br/><a href='glossary.wml#c1'>TERMINOLOGY</a>
<br/><a href='quiz-new.wml#c1'>TEST YOURSELF</a>
<br/><a href='callme.wml#c1'>CALL ME</a>
<br/><a href='usage-scenario.wml#c1'>WAP Scenario</a>
<br/><a href='#end'>EXIT</a>
</p>
</card>
<card title='HELP' id='help'>
<p><br/><a href='help.wml#c1'>NEW USER</a>
<br/><a href='help.wml#how'>HOW to USE</a>
<br/><a href='help.wml#tips'>TIPs &amp; TRICKs</a>
<br/><anchor>Go back</anchor></p>
</card>
</wml>
This code gives an introduction to the wml and wml script used in the development.
CHAPTER 8. MLEARNING ON THE WAP TELEPHONE R520

- Proposal
- Illustration
- Limitations
- Decision
- Development of system
- Features of WAP
- Optimisation of WAP languages
- Development of courseware
- Network Challenges
- Device Challenges
- Usability Concepts

Proposal

The original project proposal contained a full development of mLearning for the WAP telephone R520 and considered WAP telephony as a major element in mLearning.

Illustration
The following outline of R520 functionality is provided:

The R520 is the first Ericsson phone to support GPRS which is a data transmission technology that provides cost efficient IP (Internet Protocol) communication between mobile devices and Internet or intranet service hosts.

GPRS keeps you permanently connected to the Mobile Internet but only uses the radio link for the duration of time that it transfers data. R520 will transfer data at approximately the same speed as a fixed line modem.

R520 has built-in Bluetooth wireless technology. This ensures there is no need to have cables running between your mobile phone and your headset or mobile computer. Using this reliable and secure connection, the R520 can communicate with your Bluetooth Headset or mobile computer via a radio link instead of a cable when the two devices are within 10 metres of each other.

The WAP functionality of the R520 supports WAP 1.2.1 the latest version of the Wireless Application Protocol. WAP 1.2.1 is more secure as it supports digital signature technology allowing you to transact m-commerce in a secure environment.

The R520 supports the GSM frequencies used on five continents and in over 120 countries. When you turn on your R520, the phone automatically scans the network to determine if it is GSM 900/1800 or a GSM 1900.

With R520, your e-mails are never far away. R520 has a built-in e-mail client for sending and receiving e-mail. This allows you to connect to the e-mail account normally used on the corporate network, or another e-mail service as preferred. You can have more than one e-mail account in the phone, for example one for your business e-mails and one for your private e-mails. R520 also lets you have e-mail attachments, such as a photo from a digital camera transferred to the phone via an infrared...
The advanced calendar contained within R520 is central to its communication abilities. It has different views: month, week, day and a "tasks" list. It also supports week numbering and lets you create, edit and delete both appointments and tasks. Automatic synchronisation to a PC via WAP/Internet, Bluetooth™ or infrared technology is also possible.

R520 features a hierarchical phone book in which you can save up to 511 contacts. For every contact placed in the book, you can store their name, home, work and mobile phone numbers, their pager number, their e-mail address and other information.

The R520 supports nine different input methods including three Chinese. This ensures that you can store names in the phone book and send and receive SMS messages in your own language: Latin, Arabic, Stroke. Pinyin, Bopomofo, Greek, Hebrew, Numeric, Cyrillic.

R520 features the very latest developments in voice recognition. It's no longer necessary to press a key to activate voice recognition. You can simply programme in a "magic word" (which can be any word of your choice) and then whenever you say this word the voice recognition function will activate automatically. With R520 you can use voice commands to change profile and answer and divert calls.

This innovative feature is found on the keypad and has the same functionality as the right button on a computer mouse and enhances usability by offering instant short cut menus.

This is predictive text input software that suggests words when you type in the first letter of the word you intend to write. It makes writing short messages easy and fast.

**Limitations**

The small size of the R520 screen is a major limitation. People are used to a computer screen and therefore have no objections to eLearning courses sitting in front of a computer screen. The small size of the R520 screen with just a few lines of text is a definite limitation.

The use of simulations, graphics both still and moving, and colour have become major features of both CR-Rom and eLearning courses and the inability of the R520 to reproduce these is another drawback.

Restrictions of memory and bandwidth will limit the downloading of course content in mLearning systems.

Almeida in her *The advantages and disadvantages of using WAP in developing an mLearning course* gives these limitations for the development of a learning environment for the R520.
The main limitations of WAP today are related to the devices used and the mobile networks. The limiting factors of the device means that large amounts of data, especially graphics and animations are not recommended. Although, WAP supports images today only black and white images are possible. Colour Images and Animations will be supported in future releases of WAP.

Other limitations that the user perceives are not really WAP limitations but restrictions due to the mobile networks. Many users identify that WAP is slow and that it can take up to 2 minutes to access content. Even with today's limitations it is possible to design applications well so that the best use of the scarce network resources are made. A well designed application can be accessed via WAP in less than 10 seconds.

The cost of using WAP is another disadvantage. The cost to upgrade to a WAP device and the additional cost to access content has limited WAP very much to the corporate user rather than the mass market.

**Decision**

The project Board of Management at its first meeting decided to maintain system development and courseware development of the WAP telephone as a major component of the project.

**Development of system for the R520**

Almeida in her *The advantages and disadvantages of using WAP in developing an mLearning course* gives these directions for the development of a learning environment for the R520:

Today there are more than 50 million mobile handsets that are WAP enabled. It is expected that all mobile handsets will be WAP enabled by the end of 2001. It is also predicted that by 2003/2004 there will be 1 billion handsets in the world.

Key players in Mobile Internet market support WAP. These include the Network Operators, Hardware Manufacturers, and Software Application Developers.

All the major handset manufacturers are committed to WAP and future mobile devices will support multiple technologies including WAP, GPRS and Bluetooth. As 3G (WCDMA, UMTS) is launched WAP will also evolve for these future networks.

Network operators are behind WAP and their support is clearly demonstrated by the deployment of WAP world-wide. There are more than 200 Operators that have WAP applications and services available to their customers. This is a huge investment in infrastructure, equipment and software applications and services.

Thousands of software application developers have been behind WAP and have created the applications and services for WAP. This commitment to WAP is clearly shown by the many thousands of WAP sites available in the word today.

**Features of WAP (Personalisation and WTA)**
When comparing the mobile network to the fixed network there seems to be many limitations, as already discussed. The mobile network also provides unique advantages or features such as the position or location of the device and personalisation (both user preferences and device capabilities).

The WAP language supports these features of Positioning and Personalisation. A WAP language component supports User Profiles which contains information on the user preferences and the device capabilities.

In addition, Telephony Integration is provided by the Wireless Telephony Application, or WTA component. This allows a developer to easily integrate a telephone call in any WAP application. Thus the user can select a link e.g. Make Call to call a number from the application rather than exit the application and enter the telephone number.

**Optimisation of WAP languages**

WML is Wireless Markup Language. It is based on HTML, but is optimised for mobile networks and small handheld devices. WML is used to create static content such as text to be displayed on the screen of the mobile device. WML, like HTML is a tagged based browsing language. However, WML has a limited number of tags and because of the limitations discussed earlier, these tags are sufficient for the purposes of creating mobile internet applications.

WML allows the developer to create the user interface which will be displayed on the screen of the mobile device. WML is straightforward and an easy to learn markup language. The type of content displayed on the mobile device screen such as text, links, images, data entry fields and selection lists are all easily created by the developer using the appropriate WML tag.

WMLScript is based on JavaScript, and is used to add intelligence to the static WML content. WMLScript is used for dynamic content such as data checks and error detection. When WMLScript is used together with WML it is possible to create powerful applications.

WML Script also provides the developer with access to standard libraries which offers re-use and efficient code. These libraries contain functions that are already coded, that can be called from WML or WML Script. They include conversion of string types, browser access and dialog access directly from WML Script.

The WAP languages, WML and WMLScript are supported by the WTA (Wireless Telephony Application) Libraries. These public libraries allow the use to build into the application easy access to telephony functionality. This telephony integration means that the user can select a link e.g. Call Tutor to contact the tutor from the application rather than exit the application and enter the telephone number.

The efficiency of WML and WML Script is further enhanced by the binary encoding of the application sent over the Mobile Network. This means that a series of 0’s and 1’s is sent instead of text. This makes it very efficient over a narrow bandwidth.

**Development of courseware for the R520**

The course material for the R520 was designed using WML and WML
Almeida in her *The advantages and disadvantages of using WAP in developing an mLearning course* gives these directions for the development of learning material for the R520.

The application developer needs to consider the following areas of limitations when designing applications for WAP.

**Network Challenges**

The Bandwidth and Delay factors are the main network restrictions. For the optimisation of the application using WAP is an advantage, as WAP already takes these limitations into account. The developer, in addition, can design the application so that data to be sent over the mobile network is kept to a minimum. In the case of mLearning content, this can be achieved by structuring the content into useful pieces of information or snapshots. Summary type of information as opposed to pages and pages of text. Also images and graphics must be kept to a minimum or avoided as these take up a lot of memory usage on the devices.

Using the WAP design concept of ‘Deck of Cards’ encourages the developer to redesign the structure of mobile learning training material. A Card is the amount of data that will be displayed on the screen of the device, including any scrolling the user may do. A Deck consists of a number of Cards, that the Device will download from the mobile network. This is used appropriately can give a very positive user experience as navigating the cards is the deck is very fast, less than a second as the data is already stored on the device.

**Device Challenges**

The user interface and the memory and processing power are the main limiting factors of the device. The developer can overcome these by ensuring that most user interaction is via the navigation of links. Thus the user can access different modules of the course and related information via an Index of Links. When the user needs to enter data, this can be handled by the Select Lists which allows the user to make a selection on a number of options rather than type in large amounts of data (not recommended for mobile phones).

All of the design principle talked about in the previous section are also relevant, as the conciseness of information and the ‘Deck of Cards’ structure will help render the course content on the small screens of the devices to the user’s satisfaction.

**Usability Concepts**

The application developer needs to consider the user when designing the mLearning course content and structure.

The only confirmation of usability is to test the application on sample users for ease of use, before the application is launched.
CHAPTER 9 CONCLUSION

The future of learning

Mobile learning, the study of the provision of education and training from wireless devices, is situated clearly in the future of learning.


They give the following reasons for the contemporary advances in the study of learning:

- Research from cognitive psychology has increased understanding of the nature of competent performance and the principles of knowledge organisation that underlie people's abilities to solve problems in a wide variety of areas, including mathematics, science, literature, social studies and history.
- Developmental researchers have shown that young children understand a great deal about basic principles of biology and physical causality, about number, narrative and personal intent, and that these capabilities make it possible to create innovative curricula that introduce important concepts for advanced reasoning at early ages.
- Research on learning and transfer has uncovered important principles for structuring learning experiences that enable people to use what they have learned in new settings.
- Work in social psychology, cognitive psychology, and anthropology is making clear that all learning takes place in settings that have particular sets of cultural and social norms and expectations and that these settings influence learning and transfer in powerful ways.
- Neuroscience is beginning to provide evidence for many principles of learning that have emerged from laboratory research, and it is showing how learning changes the physical structure of the brain and, with it, the functional organisation of the brain.
- Collaborative studies of the design and evaluation of learning environments, among cognitive and developmental
psychologists and educators, are yielding new knowledge about the nature of learning and teaching as it takes place in a variety of settings. In addition, researchers are discovering ways to learn from the 'wisdom of practice' that comes from successful teachers who can share their expertise.

- Emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago.

The 'emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimagined even a few years ago' that are studied in this book are the wireless technologies of the mobile revolution that has seen the world wide proliferation of wireless communication devices.

The evolution of distance learning has been detailed above.

The arrival of eLearning, the award of nationally and internationally recognised university degrees, college diplomas and training certification, to students who spend much or all of their study time in front of a computer screen, can be dated to 1995 and has spread globally since.

The penetration of mobile telephony worldwide dates from the 1990s. Recent statistics show that China is the country with the most mobile phones at 170.000.000 in mid-2001, closely followed by the United States and Japan. Ericsson statistics for mid 2001 give market penetration as:

- Taiwan 95%
- Austria 85%
- Finland 81%
- Iceland 90%
- Israel 90%
- Luxembourg 88%

with statistics being even higher for younger age groups.

The mixing of distance learning with mobile telephony to produce mLearning will provide the future of learning.
Resources - Mobile learning portals

Pjb Associates: The m-Learning Forum

http://www.pjb.co.uk/m-learning/

eCLIPSE

http://www.e-learningcentre.co.uk/eclipse/resources/mlearning.htm
Resources - Mobile learning conferences

Finland as a laboratory of mobile technologies

m-Learning Forum Meeting, Helsinki, Finland
26 April 2002
www.pjb.co.uk/m-learning/helsinki.htm

European Workshop on Mobile and Contextual learning
Birmingham University, UK
20-21 June 2002
www.eee.bham.ac.uk/mlearn

IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE 2002)
Teleborg Campus, Växjö University, Sweden
29-30 August 2002
http://lttf.ieee.org/wmte2002

The future of learning. From e-learning to mobile learning
Ericsson Competence Solutions, Dun Laoghaire, Ireland
22 November 2002
http://learning.ericsson.net/leonardo
Resources - Mobile learning articles

Audrey Choden, *Wireless learning in your palm*

[www.secondrights.com/archive/0086.shtml](http://www.secondrights.com/archive/0086.shtml)

Clark Quinn, *mLearning: mobile wireless, in-your-pocket learning*

[www.i5ive.com/article.cfm/training_and_development/55907](http://www.i5ive.com/article.cfm/training_and_development/55907)

John L Setaro, *Distance learning through wireless devices*


Paul Harris, *Goin Mobile*


Donna Abernethy, *Get ready for mLearning*


Clive Shepperd, *M is for Maybe*

[http://www.fastrak-consulting.co.uk/tactix/features/mlearning.htm](http://www.fastrak-consulting.co.uk/tactix/features/mlearning.htm)

Kimberly Hill, *AvantGo takes its own advice, offers mLearning*

[wireless.newsfactor.com/perl/story/12579.html](http://wireless.newsfactor.com/perl/story/12579.html)

Experient, Learnsomething alliance extends online courses into mobile environments

[industry.java.sun.com/javanews/stories/story2/0,1072,33601,00.html](http://industry.java.sun.com/javanews/stories/story2/0,1072,33601,00.html)

Andrew Trotter, *Handheld computing: new best tech tool or just a fad?*


Geoffrey Ring, *Combining Web and WAP to deliver eLearning*

From e-learning to m-learning

Jeremy S Kossen, *When eLearning becomes mLearning*

www.palmpowerenterprises.com/issues/issue200106/elearning001.html

*The mobile learning era*

www.empoweringtechnologies.net/mobile.htm

*m-learning guide for IT students*

www.visorcentral.com/content/stories/747-1.htm

*Teaching and learning with palm handhelds*

www.palm.com/education/palmED

Joia Shillingford, *Mobilelessons: knowledge on the move*

http://specials.ft.com/elearning/FT3YOQOM2ZC.html

Sam S Adkins, *The 2002 US market for mobile eLearning*

www.brandon-hall.com/brandon-hall/market2mobile.html

David J ClarkIV and Jim Phillips, *Learning on the go*

www.tech.tv.com/callforhelp/howto/story/0,24330,3347851,00.html
**Resources - Mobile learning websites**

Telenor mLearning WAP project

www.insite.se/e3g

Mobilearn

www.viktoria.se/~lundin/mobilearn

UniWap (University of Helsinki/ICL)

ok.helsinki.fi/sivnt/inenglish/background.html

Mobilearn (Brasil)

www.dca.fee.unicamp.br/projects/mobilearn

AvantGo

http://avantgo.com

ibrite

http://www.ibrite.com

Experient

www.experientcorp.com

INSEAD/Nokia/ICUS


Isopia

Now Sun

University of Birmingham HandLeR

www.eee.bham.ac.uk/handler/default.asp
UltraLab IST project

www.ultralab.ac.uk/projects/m-learning/

The mLearning Forum

www.pjb.co.uk/m-learning

Empowering Technologies

www.empoweringtechnologies.com

goReader

www.goreader.com

Global Learning Systems

www.globallearningsystems.com

Stanford University Learning Lab

sll.stanford.edu/projects/tomprof/newtomprof/postings/289.html

Global Knowledge

www.globalknowledge.com

3Com University

www.latitude360.com

Virtual Learning

iol3.uibk.ac.at/virtuallearning/willkommen

Web Course

www.webcourse.net

Patrick McGhee

www.patrickmcghee.co.uk/wap.htm
mLearning: The Cutting Edge

Invitation

Ericsson Education Dublin 22 November 2002

What is it?

- training on Wireless devices: Personal Digital Assistants (PDAs), Palmtops and mobile phones.

How it works:

What you get:

- the results of one of the first mobile learning projects in Europe.
- the results of comprehensive tests into student study on mobile phones and PDAs.

What you see:

- innovative courses designed for PDAs.
- the first training courses in the world on mobile phones.
- the techniques, didactics and technical challenges of presenting training material on wireless handheld devices.

Ericsson Education, as part of Ericsson Services Ireland, is one of the leading providers of training solutions to the telecoms industry. These solutions create business value by enabling operators and service providers to develop and manage competence in an effective and efficient manner.
In addition to a broad portfolio of training courses, covering Mobile Systems, Multi-Service Networks, Data/IP, Open Systems and Marketing & Sales, Ericsson Education provides a range of competence managed value-adding services that can be customised to meet specific business needs. It is also the competence centre for Ericsson Education OnLine.

This conference is supported by the Leonardo de Vinci programme of the European Community. It forms part of the Leonardo de Vinci project From eLearning to mLearning led by Ericsson Education Dublin.

Where it's on:

The mlearning conference is held at: Ericsson Conference Solutions, Adelphi Centre, Upper Georges St., Dun Laoghaire, Co. Dublin.

The partners are:

- NKI Norway
- Distance Education International, Ireland
- FernUniversität - Gesamthochschule in Hagen Germany
- University of Rome III, Italy

Admission is Free!

There is no charge for admission to the conference. However, delegates must pay for their own travel, living and/or accommodation expenses.

To reserve your place at the conference, please register here.

Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.00</td>
<td>Welcome Address</td>
<td>Karen Lyons, Ericsson Education</td>
</tr>
<tr>
<td>09.15</td>
<td>The Future is Wireless</td>
<td>Bronagh McMullen, Ericsson Education</td>
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<tr>
<td>09.45</td>
<td>From eLearning to mLearning</td>
<td>Dr. Desmond Keegan, DEI, Ireland</td>
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<tr>
<td>10.15</td>
<td>Break</td>
<td></td>
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<tr>
<td>10.45</td>
<td>mLearning for WAP Phones</td>
<td>Paul Landers, Ericsson Education</td>
</tr>
<tr>
<td>11.15</td>
<td>mLearning for PDAs</td>
<td>Torstein Rekkedal, NKI, Norway</td>
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<tr>
<td>Time</td>
<td>Session</td>
<td>Speaker(s)</td>
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<tr>
<td>11.45</td>
<td>mLearning for Smartphones</td>
<td>Dr. Helmut Fritsch, FernUniversität; Germany</td>
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<tr>
<td>12.15</td>
<td>Lunch</td>
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<tr>
<td>13.30</td>
<td>Two parallel sessions (offered twice)</td>
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<td></td>
<td>1) Designing for the PDA Environment</td>
<td>Truls Fagerberg, NKI, Norway</td>
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<tr>
<td></td>
<td>2) Designing for the WAP (R520) and Smartphone (R380) Environment</td>
<td>Katy Graham, Ericsson Education and Dr. Georg Ströhlein, FernUniversität, Germany</td>
</tr>
<tr>
<td>15.30</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>15.45</td>
<td>The Future of Wireless Technology</td>
<td>Paul Gorey, Ericsson Education</td>
</tr>
<tr>
<td>16.30</td>
<td>Conclusion</td>
<td>Karen Lyons, Ericsson Education</td>
</tr>
</tbody>
</table>

Registration
Reservation Form:
To reserve your place at the conference, please fill out the following booking form and we will process your application as soon as possible.

First Name:  
Address:  
Second Name:  
Country:  
Company Name:  
Fixed number:  
Mobile number:  
I am interested in this mlearning conference because.......
What is Leonardo da Vinci II?


It aims to develop a European area of co-operation, supporting and supplementing Member States' policies on life-long learning, while fully respecting their responsibility for the content and organisation of vocational training.

Key Features of Leonardo da Vinci II

- The programme will run for 7 years (1.01.2000 - 31.12.2006)
- There is a budget of 1.150 Billion Euros (approximately 900 Million Irish Punts)
- Up to 31 European Countries can participate
- The deadlines and selections will be decided annually

The deadline for applications in the year 2000 was 27 March 2000.
The deadline for applications in the year 2001 is 19 January 2001.

Who Can Apply to the Programme?

- Private, public or semi-public organisations and institutions involved in vocational training
- Vocational training establishments, centres and bodies at all levels including
- Research centres and bodies
- Undertakings, particularly SMEs and craft industry
- Professional organisations, including Chambers of Commerce
- Social partners
- Local and regional bodies and organisations
- Non profit associations
- Voluntary bodies and NGOs

Private individuals may NOT submit proposals.

Which Countries Can Participate?
From e-learning to m-learning

- 15 Member States of the European Union: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and UK.

- The EFTA countries participating in the European Economic Area: Iceland, Liechtenstein and Norway.

- The Pre-Accession Countries and others: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia, Turkey.
The Project

At the dawn of the third millennium Ericsson and Nokia announced that there would be 1,000,000,000 mobile telephones in the world by 2002. The world population would be just over 6,000,000,000.

With the successful development of Bluetooth, WAP (Wireless Application Protocol), GPRS (General Packet Radio System) and UMTS (Universal Mobile Telecommunications System), the technological structures for wireless telephony and wireless computing are now firmly in place.

All over Europe today wireless technologies and applications are replacing wired ones: e-Commerce is moving to m-Commerce; m-Business is replacing e-Business; venture capitalists are snapping up WAP application providers as they appear; the site http://www.ericsson.se/letswap lists WAP applications for stock exchanges, booking flights the WAP way, instant mortgages over WAP, banking with WAP.

The list of 3G (third generation) wireless services is breathtaking, with applications already developed for refrigerators, business and the home. The move to wirelessness in telephony and computing is irreversible.

Only in the fields of training and learning are there no products in development or in planning.

This project sets in place the first stage in the creation of a global provision of training on the wireless internet. It sets in place the first building block for the next generation of learning: the move from distance learning (d-Learning) and electronic learning (e-Learning) to mobile learning (m-Learning).

In the year 2000 e-Learning is the state of the art for distance training.

There is now little doubt that the World Wide Web is the most successful educational tool to have appeared in a long time. It combines and integrates text, audio and video with interaction amongst participants. It can be used on a global scale and is platform independent. While largely an asynchronous medium, it can be used also for synchronous events. It is not surprising, therefore, that trainers, lecturers, distance education providers and teaching institutions at all levels are increasingly using the Web as a medium for delivery.

This project will put in place the first steps of the next generation of Vocational Education and Training (VET).

Specifically and practically this project will map the evolution from the wired virtual
From e-learning to m-learning

learning environment of today, to the wireless learning environment of tomorrow.

Last update: August 2002
Editor: Paul Landers
e-Learning and m-Learning, the differences.

Wired Virtual Learning Environment of Today

The project seeks to put in place a new virtual learning environment which might be represented thus:

Wireless Virtual Learning Environment of Tomorrow
From e-learning to m-learning

The project will do this by trialling and evaluating the didactic dimensions of three technologies, already developed, which are the harbingers of the wireless society of tomorrow:

- The Compaq iPAQ PDA
- The wireless palmtop R250
- The WAP telephone R380
The project is central to promoting and reinforcing the contribution of vocational training to the process of innovation. For rich and poor alike the central innovation of today is the move from the wired technologies of the 1990s to the new mobile technologies of today.

Priority 5 focuses on new technologies exploring the use of Information and Communication Technologies in training. ICT (Information and Communication Technologies) training is central to the policies of the Union and of the national governments and the major hope in combatting unemployment; in some countries like Ireland the absence of suitably qualified ICT staff is hampering competitiveness.

The innovative character of the Leonardo da Vinci programme shows that ICT training should not be limited to the use of ICT in training centres but also in training on the WWW and now harnessing the benefits of mobile technologies to training.

The practical character of the Leonardo da Vinci programme is ideal for this project which wishes to put in place practical innovative solutions which will work with real courses and real students.
Minutes of meetings

21-09-2001
26-06-2001
24-10-2001
16-11-2001
12-02-2002
15-03-2002
R380 Presentation

1. R380 Presentation (Video)
   - High Bandwith Version (100k)
   - Low Bandwidth Version (56k)

2. A website detailing work completed by Zentrales Institut für Fernstudienforschung (ZIFF) - (Central Institute for Distance Education Research - FernUniversität in Hagen) - on the R380 is available at: http://www.fernuni-hagen.de/ZIFF/befrag/mlearn/welcome.htm

3. Slides from presentation given by Michelle Almeida at Face to Face meeting 16/11/2001
   Michelle's Presentation

4. An emulator that allows you to view the wap course developed is available at the following URL:
   - Go to http://www.ericsson.com/mobilityworld/
   - Click on Application Development
   - Select Getting Started
   - Select Find tools and documentation in the Open Zone
   - Select WAP at the top of the page
   - Select Tools and enablers
   - Under the heading WapIDE 3.2 SDK there is the option to download both the SDK and/or the user guides
   - Students must also have at least JRE 1.3 (Java Runtime Environment) and Internet Explorer 5.0 on their machines to run the emulator. Both are available freely from http://www.java.sun.com and http://www.microsoft.com respectively.

The address of the wap course is:
   http://learning.ericsson.net/advancedwml/index.wml
R520 Presentation

1. R520 Presentation (Video)
   High Bandwith Version (100k) (coming soon)
   Low Bandwidth Version (56k) (coming soon)

2. Slides from presentation given by Michelle Almeida at Face to Face meeting 16/11/2001
   [Michelles Presentation](http://learning.ericsson.net/leonardo/presentation_r520.html)

3. An emulator that allows you to view the wap course developed is available at the following URL:

   - Go to [http://www.ericsson.com/mobilityworld/](http://www.ericsson.com/mobilityworld/)
   - Click on Application Development
   - Select Getting Started
   - Select Find tools and documentation in the Open Zone
   - Select WAP at the top of the page
   - Select Tools and enablers
   - Under the heading WapIDE 3.2 SDK there is the option to download both the SDK and/or the user guides
   - Students must also have at least JRE 1.3 (Java Runtime Environment) and Internet Explorer 5.0 on their machines to run the emulator. Both are available freely from [http://www.java.sun.com](http://www.java.sun.com) and [http://www.microsoft.com](http://www.microsoft.com) respectively.

The address of the wap course is:
[http://learning.ericsson.net/advancedwml/index.wml](http://learning.ericsson.net/advancedwml/index.wml)
Compaq iPaq

The NKI m-learning sub project 2001 "The tutor in distance education" as mobile learning

During 2001 NKI project team studied International experiences concerning m-learning, analysed technological solutions and pedagogic/didactic needs based on our internal practical experiences and results from previous surveys and evaluation studies among our distance students.

The technical solution chosen was to try out the use of Pocket PC/Personal Digital Assistant (PDA) in combination with mobile phone for distribution of learning content and communication between tutor and students, between students and for students' communication with the learning material. As technologies develop so fast that the specific technology available changes from one week to the next, it was important that the solutions chosen had some generic basis, i.e. also that the specific brands of PCs, mobile phones and keyboards etc. should not constitute any substantial restrictions concerning generalisability of our experiences.

When we had to do make our choice late spring 2001 after analysing functionality of different brands of PDA/Pocket PC, we found that the best solution was to build our learning environment around the Compaq iPAQ 3630 and 3660. The mobile phones chosen were Ericsson T39 and Ericsson R580. The course and environment for m-learning was completed autumn 2001, and the first experiment of a partly real and partly simulated distance learning setting including evaluation and a survey among distance learners on aspects of mobility, was carried out early 2002. A second experiment in a fully realistic setting in another distance learning course is planned for 2002.

The actual course chosen, 'The tutor in distance education' was chosen for the following reasons:

- It is a course in the pedagogy of distance teaching, and as such represents an ideal course for combining the research on media, methods and technology with the substance or content of the learning
- It is taught by internal NKI staff, also involved in the project, thus combining internal competence development with development work in the project
- The fact that same staff are involved in development and teaching in the practical try outs to be carried out opens for real field research during try out and also makes it easier to transfer the experiences and results from the experiments to further developments in the operations of the NKI Internet College
- Students taking the course are prospective online teachers in the NKI Distance Education system, their experiences as mobile learners are transferred to their teaching after completing the course

When planning for the m-learning environment the NKI project team had long discussions whether to develop the learning materials for online or offline study. Taken the above experiences and also cost considerations concerning mobile access to online learning materials, we concluded that the learning environment should include the following aspects:
From e-learning to m-learning

Technology:

- Pocket PC
- Mobile phone
- Portable keyboard

Learning content and communication:

- Learning content to be downloaded on the mobile device to be studied offline. Downloaded content to include all course materials:
  - Content page
  - Preface
  - Introduction
  - All study units
  - Resources (articles on the web, references to other resource materials)
- Online access to the discussion forum with the possibility of as quick as possible access for reading in the Forum and writing contributions
- E-mail for individual communication with tutor and fellow students and for submitting assignments. Assignments may be submitted as text-based e-mail or as Word or Text attachments.

Before taking the decision on distribution of course content to students via the Pocket PC, we analysed three alternative solutions that were discussed in depth. The discussions also included viewpoints on which materials and study activities were suited for offline or online work.

3 alternative solutions for distribution of course content

The 3 main solutions for distributing content were:

1. The AvantGo Mobile Internet service
2. Online access via mobile telephone to the entire course
3. ‘Download-on-demand’ version

After internal discussions and analysis of the real study situation of the ‘typical’ NKI distance student other aspects such as communication and other costs and functionality of alternative solutions, we decided to concentrate on solution 3. The choice of solution 3 was partly a result of limited time and resources available at this stage of the project. Solution 1 needs more research to explore opportunities, limitations and cost/benefit. Solution 2 would perhaps be ‘the most ideal’ solution for the future, i.e. to offer a complete PDA adapted version based on the same learning materials available in the web course for standard PCs. The principle of ‘one file many versions’ (html, pdf, reader, etc.) is achievable through the use of XML). Presently, through our preliminary analyses we found that there were too many limitations in mobile technology regarding transfer capacity vs. cost to be able to carry out the experiments that we wished to do. Solution 2 would also, as mentioned above, require a complete site redesign of the NKI Distance Education website.

The reason for supplying two alternatives of content is that we as part of the empirical testing are interested in examining attractiveness and user friendliness of the different solutions for the student. The student can manipulate the Microsoft Reader content by the possibility of bookmarking, adding highlights, notes and drawings and look up words directly in the PocketPC Dictionary. This means that the students can use the materials actively in ways that we recognise from students’ use of print materials and their personal notes. The student is, in other words, able to ‘make the materials his own’ while studying. It is reason to believe that these functionalities may help students organising the materials cognitively and support learning and remembering.

The decision to go for the choice of downloading content for offline study was based on previous experiences and also the following considerations: NKI Internet students study mainly offline. Communication concerns discussion with fellow students in the academic forums, cooperation on projects and group assignments, and individual communication with other students – and, most important, according to our evaluations (see e.g. Rekkedal & Paulsen 1997), communication with the tutor including submission of assignments with correction and feedback. All our analyses...
concluded that the students will have all these possibilities available on their desktop or laptop PCs, including online interaction with the learning materials.

When mobile – and using mobile technologies – it is generally satisfactory for the student (and the tutor) to have the course content available to study on the PocketPC. In addition, the following communication possibilities are necessary. When mobile, the student must be able to:

- Access the course forum to read messages
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration
- Submit assignments by e-mail including attachments
- Receiving assignments corrected and commented on by the tutor including attachments

To access e-mail and discussion forums, mobile phones will be used. We plan that in future versions it will be possible to synchronize discussions via the student’s desktop or laptop PC.

The analyses, software/technologies applied and the development process and results are described in more detail in the article, Designing and Trying Out a Learning Environment for Mobile Learners and Teachers http://www.nettskolen.com/forskning/55/NKI2001m-learning2.html

As the NKI course pages are available to authorized users (students, teachers and administrators), the real course is not accessible.

Our development work on m-learning is also explained in the video:

Video-presentation (ISDN-streaming, ca 14 min.)
You need RealPlayer for playing this video. Get it free.
Mobile learning in action

Report on the use of mobile telephones for training

This is a report on the effectiveness of mobile telephones in training.

In early 2002 nine students on work experience at Ericsson Competence Solutions at Dun Laoghaire in Ireland were enrolled in the Ericsson Wap Overview course to be studied by mobile learning. All completed the course and filled in the international Questionnaire on mobile learning which is being used also in Norway, Germany and Italy.

Five of the participants used the Ericsson R520 mobile phone, which is a WAP phone with standard small screen. Two of the participants used the Ericsson R380 smartphone, with a larger horizontal screen. One participant used the Ericsson R320, a WAP phone that is an earlier model of the R520. One participant used the R529, the R320 and the Ericsson T39, a smaller WAP phone with a smaller screen.

Personal background

All participants gave their employment status as ‘Student’ and stated that they were under 24 years of age. 55% were male and 44% female.

77% had had one to three years of post-secondary education and 22% had had four or more years of post-secondary education.

All owned mobile phones, but only one owned a PDA (personal digital assistant) as well.

Student userfriendliness

Participants were asked if it was easy to use the equipment in this mobile learning course. These were the replies:

*It was easy to use the equipment in this mobile learning course*

11% Strongly agree  
66% Agree  
11% Uncertain  
11% Disagree  
0% Strongly disagree

This is a satisfactory response rate with only 11% in disagreement.
The next question asked if the mobile learning experience was fun. This is a challenging question for a new and experimental area of training as it queries whether the course developers were able to create an attractive learning environment for the course participants and whether the participants found the new learning experience attractive. The answers were:

This mobile learning experience was fun

0% Strongly agree
44% Agree
22% Uncertain
33% Disagree
0% Strongly disagree

In spite of the 33% who disagree, this is a challenging question about any new and experimental form of training and the replies can be regarded as satisfactory.

Another challenging question followed, asking whether the participants would enrol in another mobile learning course. It is one thing to study a new and experimental course, it is quite different once the course has been studied and the student knows the didactic environment and the challenges of the course structure. The replies were:

According to my experience I would take another mobile learning course if relevant to my learning needs

11% Strongly agree
55% Agree
22% Uncertain
11% Disagree
0% Strongly disagree

Again the response of 55% in agreement with only 11% disagreeing is a satisfactory one.

Another tricky and challenging question followed. This asked if the participant would recommend mobile learning as a mode of study to friends or colleagues. To recommend a new and experimental mode of study to colleagues and others requires a definite level of commitment to the mode of study. The answers were:

I would recommend mobile learning as a method of study to others

0% Strongly agree
66% Agree
0% Uncertain
33% Disagree
0% Strongly disagree

Here the answers are clearly distinguished. No one is uncertain and no one strongly agrees or strongly disagrees. 66% are in agreement and 33% disagree.

As one of the values of mobile learning is that it restores the 'study at any time, at any place' characteristic of distance learning which was attenuated by e-Learning's placing the student in front of a powerful wired computer for the period of training, participants were asked whether they studied the course at home or at the office or work station, or while travelling. Because of the way the course was studied 100% replied 'at the office or work'.

Didactic efficiency
From e-learning to m-learning

If m-learning is seen as a development of e-learning, in which the state-of-the-art characteristics of e-learning today are enhanced and given new dimensions, it is important to know if mobile learning increases the quality of e-learning provision. Participants were asked:

**Mobile learning increases the quality of e-learning**

- 22% Strongly agree
- 55% Agree
- 22% Uncertain
- 0% Disagree
- 0% Strongly disagree

No one disagrees and 77% either agree or strongly agree.

If mobile learning is to be accepted as a valid form of training provision, it is important that learning objectives can be met by mobile learning courses. Participants were asked:

**Course learning objectives can be met by mobile learning**

- 11% Strongly agree
- 66% Agree
- 22% Uncertain
- 0% Disagree
- 0% Strongly disagree

No participants disagree and there are 77% who agree that course learning objectives can be met by mobile learning.

Among the difficulties to be met with mobile learning are questions related to the provision of course content. There are questions with the volume of content that can be provided in mlearning; with the structuring of the content in wml cards and decks; with the downloading of content from the server; with the display of content on mobile phone screens: the small standard of the WAP R520 phone and the somewhat larger rectangular and horizontal screen of the smartphone R380. Participants were asked how easy was it to download course content to a mobile phone:

**Downloading course content was easy**

- 44% Strongly agree
- 22% Agree
- 11% Uncertain
- 22% Disagree
- 0% Strongly disagree

The replies indicate that this course was done on a test network which could be down at times or that the WAP gateway could be down and therefore the students could not log on. This could cause frustration but also provided real network experience of the use of mobile learning.

An important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the tutor and the organisation providing the course. This is essential for feedback on student progress and for the solution of study and technical problems. In distance learning courses this is provided by correspondence with the tutor or by telephone, in email courses it can be by typed interaction or by telephone. In mobile learning it can be by using the mobile phone or...
by SMS or by email.

The answers to this question reflect that the communication with the tutor was in the form of preparatory meetings in which the system and procedures of mobile learning were explained, and then by either email, phone conversations (fixed line) or by formal meetings. The functionality for using the mobile phone or by SMS or by email will be added in later course developments.

Here are the student replies:

*Communication with and feedback from the tutor in this course was easy*

- 22% Strongly agree
- 55% Agree
- 11% Uncertain
- 11% Disagree
- 0% Strongly disagree

Another important feature of the design of a didactic environment for mobile learning is the ability to provide communication to and from the other students studying the course. The large percentage of students who replied 'undertain' to this question reflects the fact that this functionality was not available in this course but will be addressed in subsequent courses:

*Mobile learning is convenient for communication with other course students*

- 0% Strongly agree
- 33% Agree
- 55% Uncertain
- 11% Disagree
- 0% Strongly disagree

**Technical feasibility**

To evaluate any educational innovation one needs to assess its suitability under four headings:

- Student userfriendliness
- Didactic efficiency
- Technical feasibility
- Cost effectiveness

Technical feasibility is particularly important for mobile learning because many doubt students' ability to read course content from a mobile phone screen, many fear the slow processing and limited storage capacities of phones today. Students were therefore asked about how easy it was to navigate through the material in the course. This question queried the design of the course materials and the student's ability to navigate through the course and from module to module of the course, the student's ability to access the definitions and frequently asked questions section of the course and the student's ability to undertake the questions in the course and to receive the feedback from the system.

Participants were asked:

*Navigation through the mobile learning course was easy*

- 11% Strongly agree
- 55% Agree
- 11% Uncertain
Furthermore many doubt the ability of mobile phones to provide graphics, illustrations, moving images and simulations for course materials. Years of experience with CD-Rom based materials and elearning materials have led trainers and students to expect the use of illustrative materials in elearning courses and it is clear that they might expect their provision in mobile learning too. Participants were therefore asked:

*For mobile learning to be effective it is necessary to use graphics and illustrations*

- 33% Strongly agree
- 33% Agree
- 11% Uncertain
- 22% Disagree
- 0% Strongly disagree

Questioning and feedback is an integral part of any educational experience. Student assessment can be formative assessment, in which students are questioned and given feedback as a part of their learning experience, or summative assessment, in which students are examined and their results are graded for certification at the end of a course.

In distance learning assessment was of three kinds:

- Self-assessment questions (SAQs), which were provided for the student to check and evaluate their own progress in a course
- Tutor-marked assignments (TMAs), which were submitted by the students to their tutor at regular intervals during the course for correction, commentary and feedback
- Computer-marked assignments (CMAs), which were submitted by the students to their institution's computer at fixed intervals for correction, commentary and grading.

In elearning questioning frequently takes the form of quizzes or multiple-choice questions or other forms of machine-marked assessment.

The provision of adequate questioning and assessment structures is one of the major challenges in mobile learning.

Participants were asked:

*Evaluation and questioning in the mobile learning course was effective*

- 0% Strongly agree
- 66% Agree
- 22% Uncertain
- 11% Disagree
- 0% Strongly disagree

**Cost effectiveness**

One of the major factors in the development of mobile learning is that it increases access to training. Unlike distance training in which the trainee is located at home or at work at a distance from the institution, in mobile learning the trainee has the facility for being mobile at a distance from the institution. Unlike eLearning in which the trainee is situated in front of a wired computer, in mobile learning the trainee has the
benefits of wirelessness.

Participants were therefore asked:

Mobile learning increases access to education and training

11% Strongly agree
88% Agree
0% Uncertain
0% Disagree
0% Strongly disagree

For mobile learning to be a success it has to be cost effective both for the institution providing the course and for the students enrolled in it. Careful analysis needs to be undertaken on the cost of downloading a course to a mobile phone, studying it on a mobile phone, the cost of doing and submitting assignments on a mobile phone, the cost of communication with the institution, the tutor and other students studying the course via a mobile phone.

Participants were asked:

The cost of downloading the mobile course materials was acceptable

0% Strongly agree
11% Agree
88% Uncertain
0% Disagree
0% Strongly disagree

The high number of 'uncertain' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

The cost of communicating in the mobile learning course with the tutor and other students was acceptable.

0% Strongly agree
11% Agree
88% Uncertain
0% Disagree
0% Strongly disagree

Again the high number of 'uncertain' responses is due to the fact that the participants were downloading the course free of charge locally from the server.

Participants were also invited to comment on the mobile learning course, or on equipment functionality and user-friendliness. Here is a selection of replies:

Mobile learning is great for that 30min DART ride, otherwise I think people would not be too quick to use it. It's good to give yourself a quick test but if you want to learn something new, it might prove difficult with a small screen.

I felt that reading large amounts of text on a small screen wasn't very user friendly. It would be more efficient just to use bullet points or diagrams - people would not be using this method of learning to learn from scratch. I think it would be more widely used as a means of refreshing one's mind before an exam/interview etc. Therefore long pieces of text are unnecessary.

DART is the Dublin Area Rapid Transit which would correspond to an underground
From e-learning to m-learning railway in other cities. Both replies query the suitability of mobile learning for genuine courses of study but accept it for short summaries and revisions.

I thought the course was a great idea, and I am glad for having taken part in it. It has greatly increased both my knowledge and interest in WAP technology.

I thought the course was brilliant!

These replies are more positive and give the prospect of successful development of mobile learning for mobile telephones.

Links could have been a bit easier to follow, i.e a more linear approach may have been better with numbering of each module and sub-module.

The importance of numbering each module and sub-module for ease of navigation in mobile learning is a valid suggestion.

Really enjoyed the WAP overview course. It was a good first step into the world of WAP technology and m-learning. I think that m-learning is a really interesting concept.

Another very positive comment supporting the implementation on mobile learning on mobile telephones.

I used the R320, T39 and R520 to do the course it was much easier to read through on the R320 especially compared to the T39. I think if the course was short enough and something you wanted to learn about then doing it through your mobile would be effective.

It was easy enough to navigate around the course especially using the R320.

Important suggestions that mobile learning can be effective if the course is short enough, if the student is required to learn it and receives reward for successful study.
The advantages and disadvantages of using WAP in developing an mLearning course.

Introduction

This article gives an objective view of the advantages and disadvantages of using WAP in the development of mobile Learning (mLearning) training course material. The usage of mobile phones is widespread and more extensive than personal computers or laptops. The ease of use, mobility and personalisation aspects of mobile devices makes it an ideal medium for this next step in distance learning.

Advantages of using WAP

Transporting data in the mobile networks of today, for example GSM, has been compared to 'Carrying an ice cube in a plastic bag in the desert heat of 40C'. The conditions of the mobile network are harsh. Hence, given these harsh conditions, it is essential to select an appropriate application environment and design the application for the mobile user and the challenges provided by the mobile network.

The mobile network is different, the bandwidth is narrow, and delays are greater than in the PC /Wired network which supports 2 Mbits per second. The mobile network in comparison provides resources of 9.6kbps for a user. The challenges for developing an application for the mobile environment are mainly these obvious differences between the Mobile network and the Wired environment.

A mobile handheld device e.g. Mobile Phone or Smart phone is different to a PC/ Laptop. The screen size is small, the number of keys a user has access to is limited to 16 keys or less. The device also is limiting is memory storage, processing power and battery power.

The WAP protocol is designed with the network, device and user interface limitations in mind. This means that WAP is optimised for mobile networks with narrow bandwidths, mobile devices with small screens and limited keys for user entry, little memory storage, and limited processing and battery power. This makes WAP an ideal choice for developing an application for the mobile network. But any ideal in practice has pros and cons. Thus, this paper will further describe these advantages and give an insight into the limitations or disadvantages.

Data supporting WAP

Today there are more than 50 million mobile handsets that are WAP enabled. It is expected that all mobile handsets will be WAP enabled by the end of 2001. It is also predicted that by 2003/ 2004 there will be 1 billion handsets in the world.

Key players in Mobile Internet market support WAP. These include the Network Operators, Hardware Manufacturers, and Software Application Developers.
All the major handset manufacturers are committed to WAP and future mobile devices will support multiple technologies including WAP, GPRS and Bluetooth. As 3G (WCDMA, UMTS) is launched WAP will also evolve for these future networks.

Network operators are behind WAP and their support is clearly demonstrated by the deployment of WAP world-wide. There are more than 200 Operators that have WAP applications and services available to their customers. This is a huge investment in infrastructure, equipment and software applications and services. Thousands of software application developers have been behind WAP and have created the applications and services for WAP. This commitment to WAP is clearly shown by the many thousands of WAP sites available in the word today.

**Features of WAP (Personalisation and WTA)**

When comparing the mobile network to the fixed network there seems to be many limitations, as already discussed. The mobile network also provides unique advantages or features such as the position or location of the device and personalisation (both user preferences and device capabilities). The WAP language supports these features of Positioning and Personalisation. A WAP language component supports User Profiles which contains information on the user preferences and the device capabilities. In addition, Telephony Integration is provided by the the Wireless Telephony Application, or WTA component. This allows a developer to easily integrate a telephone call in any WAP application. Thus the user can select a link e.g. Make Call to call a number from the application rather than exit the application and enter the telephone number.

**Optimisation of WAP languages**

WML is Wireless Markup Language. It is based on HTML, but is optimised for mobile networks and small handheld devices. WML is used to create static content such as text to be displayed on the screen of the mobile device. WML, like HTML is a tagged based browsing language. However, WML has a limited number of tags and because of the limitations discussed earlier, these tags are sufficient for the purposes of creating mobile internet applications.

WML allows the developer to create the user interface which will be displayed on the screen of the mobile device. WML is straightforward and an easy to learn markup language. The type of content displayed on the mobile device screen such as text, links, images, data entry fields and selection lists are all easily created by the developer using the appropriate WML tag.

WMLScript is based on JavaScript, and is used to add intelligence to the static WML content. WMLScript is used for dynamic content such as data checks and error detection. When WMLScript is used together with WML it is possible to create powerful applications.

WML Script also provides the developer with access to standard libraries which offers re-use and efficient code. These libraries contain functions that are already coded, that can be called from WML or WML Script. They include conversion of string types, browser access and dialog access directly from WML Script. The WAP languages, WML and WMLScript are supported by the WTA (Wireless Telephony Application) Libraries. These public libraries allow the use to build into the application easy access to telephony functionality. This telephony integration means that the user can select a link e.g. Call Tutor to contact the tutor from the application rather than exit the application and enter the telephone number.

The efficiency of WML and WML Script is further enhanced by the binary encoding of the application sent over the Mobile Network. This means that a series of 0's and 1's is sent instead of text. This makes it very efficient over a narrow bandwidth.
Limitations of using WAP

The main limitations of WAP today are related to the devices used and the mobile networks. The limiting factors of the device means that large amounts of data, especially graphics and animations are not recommended. Although, WAP supports images today only black and white images are possible. Colour Images and Animations will be supported in future releases of WAP.

Other limitations that the user perceives are not really WAP limitations but restrictions due to the mobile networks. Many users identify that WAP is slow and that it can take up to 2 minutes to access content. Even with today's limitations it is possible to design applications well so that the best use of the scarce network resources are made. A well designed application can be accessed via WAP in less than 10 seconds. The cost of using WAP is another disadvantage. The cost to upgrade to a WAP device and the additional cost to access content has limited WAP very much to the corporate user rather than the mass market. However, these main limitations of WAP will soon be only challenges as the speed of the networks are already increasing with the launch of GPRS, and in the future the Third generation, 3G networks. Hopefully, GPRS will also address the cost issue of WAP and bring down the cost of using WAP. This is promised as the user will be always connected but will only pay for the usage of sending/receiving data.

Design Challenges

The application developer needs to consider the following three areas of limitations when designing applications for WAP.

Network Challenges

The Bandwidth and Delay factors are the main network restrictions. For the optimisation of the application using WAP is an advantage, as WAP already takes these limitations into account. The developer, in addition, can design the application so that data to be sent over the mobile network is kept to a minimum. In the case of mLearning content, this can be achieved by structuring the content into useful pieces of information or snapshots. Summary type of information as opposed to pages and pages of text. Also images and graphics must be kept to a minimum or avoided as these take up a lot of memory usage on the devices.

Using the WAP design concept of 'Deck of Cards' encourages the developer to redesign the structure of mobile learning training material. A Card is the amount of data that will be displayed on the screen of the device, including any scrolling the user may do. A Deck consists of a number of Cards, that the Device will download from the mobile network. This is used appropriately can give a very positive user experience as navigating the cards is the deck is very fast, less than a second as the data is already stored on the device.

Device Challenges

The user interface and the memory and processing power are the main limiting factors of the device. The developer can overcome these by ensuring that most user interaction is via the navigation of links. Thus the user can access different modules of the course and related information via an Index of Links. When the user needs to enter data, this can be handled by the Select Lists which allows the user to make a selection on a number of options rather than type in large amounts of data (not recommended for mobile phones).

All of the design principle talked about in the previous section are also relevant, as the conciseness of information and the 'Deck of Cards' structure will help render the course content on the small screens of the devices to the user's satisfaction.
Usability Concepts

The application developer needs to consider the user when designing the m-learning course content and structure. The following simple principles are recommended:

1. Keep it Simple
2. Avoid large amounts of data
3. Avoid underlined text as this will be mistaken for Links
4. Use Selection Lists for data entry
5. Consistency - place links in same place throughout application
6. Always provide link to Start page or Index
7. Use Titles on Cards to ease navigation
8. Use Tabloid format - headlines and summaries
9. Use short words

The only confirmation of usability is to test the application on sample users for ease of use, before the application is launched.

Pedagogical Issues

The main pedagogical issue to consider is the suitability of a course to the mLearning environment. Not all courses are suited to the mLearning environment. Purely technical and very practical courses are not suitable. However, short courses and mainly theory and information type courses are suited to the mobile learning environment. The learning environment can be enhanced by the use of quizzes to test knowledge, summary of main learning points, and interaction with other students and the tutor via telephony integration.

Conclusions

In conclusion, WAP is suitable for the creation of mobile learning training course material. The optimisation of WAP and the handling of the design challenges makes it feasible to use mobile handheld devices for distance learning in real-time. The application developer must always be aware of the user and take into account the usability issues if the application is to be a success.