Enhancing the flexibility of distance education through mobile learning

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Summary and introduction

The paper presents and discusses NKI (Norwegian Knowledge Institute) Distance Education basic philosophies of distance teaching and learning and their consequences for development of a learning environment supporting mobile distance learners.

For NKI it has been a major challenge to design solutions for users of mobile technology who wish to study also when on the move. Thus, when students are mobile and wishing to study, the equipment and technologies they use will be in addition to they equipment used at home or at work. The solutions must be designed in ways to allow both users and non-users of mobile technology to participate in the same course. This means that we have looked for solutions that are optimal for distributing content and communication in courses, independent on whether the students and tutors apply mobile technology or standard PC and Internet connection for teaching or learning. The learning environment must efficiently cater for both situations and both types of students. The solutions were developed for PDAs. During the time of the development and research the technologies have developed rapidly. Mobile phones are including PDA functionalities and vice versa. In principle the aim of developments is to design solutions that can be used on any kind of mobile devices.


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 involve 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 also know that the students often download content for reading offline and often also print out content for reading on paper. All aspects and functions of mobile learning in the NKI large scale distance learning system is clearly an additional service to the students.
The context of mobile learning developments at NKI

NKI was one of the first institutions worldwide to offer online distance education when we started the first trials on our in-house developed Learning Management System, **EKKO** (*Norwegian acronym for “electronic combined education”), in 1987. Since then online education has continuously been offered to an increasing student population. In March 2008 NKI has approximately 9,000 active online students, studying one of more than 80 study programmes or over 400 courses offered on the Internet/Web. This spring we will pass 100,000 course enrolments to NKI online distance education since 1987. In 2001 we launched what we considered to be the 4th generation online distance education system at NKI when introducing the internally developed LMS, **SESAM (Scalable Educational System for Administration and Management)**, that totally integrates the web-based Learning Management System with the overall Student Administration System and a number of other applications for efficient operation and administration of the logistics and student support measures in online distance education (see figure 1). The total integration of distance education IT systems is in our view the major prerequisite for operating efficient and effective large-scale distance education, including a mobile learning environment. A description of SESAM and functionalities has been given by Paulsen et al. (2003).

![Figure 1. NKI’s integrated systems for online administration and student support.](image)

**Increasing the flexibility of distance education**

One of the overall aims when engaging in mobile learning projects has been to extend the distribution of learning materials and communication solutions to lighter equipment and to increase the flexibility in distance education, i.e. refining the total distance learning environment to meet the needs of the ‘mobile distance learner’. A number of evaluation studies among distance and online learners at NKI have demonstrated that students emphasize flexibility (see e.g. Rekkedal 1990, 1998, 1999, Rekkedal & Paulsen 1997, Rekkedal et al. 2003).

We have argued that distance education generally 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, and pre-produced video, audio and printed materials to be accessed anytime and anywhere. 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 either at local study centres or virtually, and applies synchronous technologies such as video, audio or text based conferencing, satellite distribution, radio and television (Gamlin 1995). Today most uses of synchronous technologies are also distributed on the Internet.

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 Distance Education is the largest distance teaching institution in Norway, recruiting 7,000-10,000 students every year. The students may enrol to any of 400 courses or 80 study programmes or any combination of courses at any day of the year and progress at their own pace. This flexibility does not exclude group-based solutions in cooperation with one single employer, trade organisation or local organiser, or that individual students on their own initiative or by the initiative of the tutor are collaborating on learning tasks. NKI philosophy on online distance learning is expressed in the strategic document (NKI 2007): “NKI Distance Education aims to offer distance education solutions that make the students attain their learning objectives through optimum individual flexibility where the students shall represent resources for each other without being dependent on each other.” This philosophy sets the premises for of the development of flexible education and system for Internet based learning and sets the guidelines for both technical and didactical development – including the environment for mobile learning and new solutions related to web 2.0 technology. The potential of social software for developing solutions, which allow students within ‘maximum freedom and flexibility’ modes of distance learning to engage in cooperative learning activities has been presented by Anderson (2005).

NKI are developing different kinds of social software solutions within the SESAM LMS-system, based on the concept of ‘learning partner’, e.g. all students are urged to present themselves in ways that invite to social interaction for learning purposes. This information may be open to all members of the learning society, to fellow students studying the same programme, or to tutors and administration only. Student lists contain information about where students live and which module they are studying at any time. Software solutions for inviting and accepting learning partners and for establishing connections have been developed parallel to the research on mobile learning Paulsen (2003, 2007). There is no doubt that mobile technology may increase possibilities for efficient interaction between distance students, making them more independent of time and space.

**Views on knowledge and learning**

When starting the first discussions on m-learning and planning for the first m-learning development, it was for the NKI research group very clear that the learning aims, content and teaching/learning methods in the NKI online courses and programmes generally were very different from most e-learning courses (often designed with self-instructional programmed learning materials) (see e.g. Dichanz 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 differentiate 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 materials and solving problems individually and/or in groups. This view is different from what often 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 developing interactive programmed learning courses or modules based on a tradition more related to behaviouristic pedagogy and knowledge transmission (see Marton et al. 1987, Marton et al. 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 2000), as stated in the NKI strategic plan (2007). Our main objective in the first m-learning project was to extend the distribution of learning materials and communication to lighter equipment, specifically PDA and mobile phone. We should also add that NKI parallel to the m-learning projects have been engaged in projects on developing ‘universal accessibility of distance learning’ (Mortensen 2003) (which has similar consequences concerning server side solutions for making content available to anyone independent of physical handicaps or technology on the receiver side).

It was our aim in designing the environment for the mobile learner to extend and enhance (or, in fact, restore) 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 computer with access to the Internet was available. This aim has still been in focus during the subsequent, including the present, m-learning projects.

**Designing and trying out the environment for mobile learners in the project “From e-learning to m-learning”**

**Design and Development**

**Studying online and offline**

During the first mobile learning project NKI decided to develop and try out two courses with the materials as ‘download-on-demand’. Alternatives were seen to be the AvantGo Mobile Internet Service or online access via mobile telephone to the entire course. Cost considerations at that time were determining the decision, supported by the fact that in the NKI system the students did not have to be online when studying course materials and that, according to our evaluations (see e.g. Rekkedal & Paulsen 1997), communication with the tutor, including submission of assignments with correction and feedback, is considered to be the most valued learning activity.

The course materials were provided in two versions, HTML and E-book using Microsoft Reader with ClearType.
Figure 2. Screen shots of course page on the PDA

Technical solution
The learning environment included the following aspects (Fagerberg et al. 2002, Rekkedal 2002a):

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

Learning content and communication:
- Learning content to be downloaded on the mobile device to be studied offline.
- 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 to be submitted as text-based e-mail or as Word or Text attachments.

Students’ and tutor’s use of technology when mobile
When mobile – and using mobile technologies – we found that it was generally satisfactory for the student (and the tutor) to have the course content available to study on the PDA. In addition, the following communication possibilities were seen as necessary. When mobile, the student should be able to:
- Access the course forum archive to read messages (if necessary) (messages on the forum are also sent to participants as e-mails)
- Access the course forum to submit contributions to the discussions
- Send e-mail to fellow students, to the teacher and to the administration (study advisor)
- Receive e-mail from fellow students, from the tutor and from the administration
- Submit assignments by e-mail including attachments
- Receive assignments corrected and commented on by the tutor including attachments.
To access e-mail and discussion forums, mobile phones with infrared connection to the PDA were used.

The first course was tried out in a simulated distance teaching setting with 9 students. The second course was tried out in a real setting with 3 students studying in a group with other students not using mobile technology.

**Main conclusions from Project 1 trials**

We learned that downloading and synchronizing learning materials to the students’ PDAs caused few (or rather no) problems. As the preference for the e-book format was so clear from the trial in the first course, the second course applied e-book materials only. Illustrations were considered unacceptable on the PDA. Taking notes was found to be a problem, so for the second trial we found it necessary to equip the students with keyboards that actually solved the problem, including writing longer texts in connection with assignments etc.

Communication via mobile phones for submitting assignments and writing messages to the course forums were found to be easy, involving few problems and with acceptable costs – on the condition that texts normally were produced offline.

As mentioned, our main aim in designing solutions for mobile learners was to maximize student freedom and to support online learners who also are mobile when studying. This effect was also clearly indicated by all the participants in the pilot trials – the main advantage of m-learning as designed in these trials, was, according to the participating students, the **increased flexibility of online distance education** (Rekkedal 2002b, 2002c).

![Figure 3. The tutor on the move writing and sending e-mails to the students from Düsseldorf ‘Himmelturm’ and a student on holiday communicating from the garden of his hotel in Rome.](image)
Designing and Testing an Always-Online Environment for Mobile Learners

As a result of the experiences from the first project, NKI wished to continue the research on m-learning based on the PDA solutions available in 2004-2005 as part of the project, ‘Mobile Learning: the Next Generation of Learning’. The solutions were developed for the follower of the previous devices, HP iPAQ Pocket PC 5500 series with built-in wireless network card. At the same time all developments were done with the main objective to develop generic solutions independent on devices on the user side.

Already when planning the first project we considered online access to course content probably to be the best solution. However, at that time this was seen as neither technologically nor economically possible. Since then, the technological developments had made it more attractive to start developing and experimentation with solutions based on the assumption that an ‘always-online environment’ would be available for mobile learners in the near future.

Provisional developments during year 1 of the project

In principle, the NKI project team had committed itself to develop one course, the Norwegian version of a standard course, Sales and Services, to an “always-online mobile learning environment” during the first year, and a second course, Administration Systems and Support Services for Online Education, during the second year.

The first course was developed with an additional version with specific materials for mobile learners. This version was produced on the server in a format adapted to the PDA screen and multi-media materials specifically developed to be accessed by the PDA. These developments have been described by Dye et al. (2004).

Figure 4. Screen shot from a PC of the specific version of the course, Sales and Services.

The text was perfectly adapted to the screen of the PDA. The menu link was fixed at the bottom of the PDA screen to allow easy navigation. Multi-media elements were developed in
Macromedia Flash and were also specifically developed for the PDA version. Different solutions were tested to get the multi-media elements readable on the PDA, actually without finding really good solutions. The conclusion both during development trials and testing with students was that most multi-media elements have details that are difficult to present in acceptable form on the PDA. It is also important not to use negative text and to be more focused on the readability of the colour combinations of the background and text. The choice of fonts is also important. Below are two screens shots from the PDA of these assignments (in Norwegian).

Figure 5. Screen shots from the PDA of multi-media multiple-choice question and “drag and drop” assignment.

It was clear during internal testing that the solutions functioned according to expectations and that the solutions allowed mobile learners and other online students to participate and communicate in the same course. However, as specific additional materials had to be developed for the mobile learners, the solutions could never be applied cost-effectively on a large scale.

**Functionalities of the “always-online environment”**

During planning of the project solutions for m-learning where students and tutors using PDA/PocketPC through wireless systems could benefit from teaching and learning in an “always-online” environment were emphasized.

Although downloaded content gives access to the course at any time, this solution has some disadvantages, such as:

- Little incentive to log into the Internet College and take advantage of a learning community
- No possibility of taking advantage of interactive materials
- No (or slow) access to other Internet resources
- Restricted communication possibilities

We found the following aspects of an always-online solution to possibly increase the quality of the services for mobile learners:

- High bandwidth gives fast downloading of course content and use of audio, video and advanced graphics
- Independence of synchronization with desktop PC
- Access to resources on the Internet at all times
• Easy access to e-mail at all times
• Possibilities for online assessment and assignments and ‘in-course-activities’
• Options for easier co-operation with fellow students
• Possibilities for synchronous communication, chat and IP telephony
• ADSL or free access to WLAN give control over costs

An assumed ‘ideal’ requirements description of a mobile learning management system (mLMS) for the NKI context was developed by Dye & Fagerberg (2004). The requirements were based on the assumption that the NKI Learning Management System, SESAM, would be further developed to accommodate the needs of mobile learners with priority to learners using PocketPC

Overall framework needs
The mLMS must be a part of an LMS and support the mobile client as well as traditional clients, it should provide different types of content to different devices automatically, and it must create a comfortable learning environment for students studying with mobile devices.

Course content
The mLMS must be able to store course content in the system, should provide easy navigation and also provide a zoom function for illustrations and pictures.

Access to courseware
The mLMS should provide access to resources, library, references, glossary and exam database and to a course planning tool and calendar. Students must have the possibility for submitting assignments, and tutors must have the possibility to comment on and return assignments. Students must have access to a contact list with tutor and student information, and also have the possibility to answer multiple choice questions, drag and drop test/exercises, etc. Text to speech possibilities (that are available as standard on PCs in all NKI courses) would be very helpful. Further, the mLMS must support graphics, audio and video, moving image and provide immediate response and feedback on test/exercises, and it should provide a search function for course content.

Communication
The system must provide access to online synchronous communication such as chat and to an asynchronous communication system such as e-mail, and also support Short Messages Service (SMS) between students and teachers and possibly for distributing information such as grades on assignments. Multimedia Messaging Service (MMS) should be supported. Students and tutors must have access to message boards for announcements and to course forums to read and write messages and to the list with both tutor and student information.

Other
The mLMS should give the possibility to enrol on a course from a web page and should also provide export features to have course access even when offline. Adjustment of personal settings such as changing password or e-mail address should be possible. The system should provide access to technical support services, frequently asked questions, to contact information, to general study information such as exams dates, student handbooks, regulations, etc. and to a site map. Ideally the system should provide possibility to print from the device and access to an area where the user may upload and store personal files.
What are the characteristics of online learners?

Online learners are often adults with full time jobs and family obligations. NIKU's major group of students are between 25-40 years old and has their part-time education as secondary job after family, friends and job. They are often very motivated and self-disciplined in their planning and conducting their studies.

What are the special needs of online learners?

Online learners need education that is flexible and relevant directly in their job. They want immediate feedback on assignments and progression and describe online learners' attitudes toward online education?

According to Rokkedsal report, Courses on the WWW - Student Experiences and Attitudes Towards WWW Courses - II (1999), students think that online education facilitates efficient learning and good learning outcome. Students also states that they will enrol to a online course again and are in general very satisfied with courses taught on the web.
Conclusions from testing

Related to the requirements above during year 2 of the project NKI developed SESAM into a functioning mLMS. The system was tried out with 18 test students registered on the course ‘Sales and services’ (Dye & Rekkedal 2005).

The test was carried out in a sort of laboratory situation after a period of three weeks when the students had had opportunity to study the course on standard equipment. The test was administered by two of the researchers in the project, were one functioned as tutor and the other as observer. The evaluation was carried out using a number of 5 point Likert attitude scales plus some open answers, as in the first project. In addition, the researchers observed the test persons, made note of viewpoints and asked questions on the use of technology in connection with assignments, forum contributions and e-mails between students and between individual students and the tutor.

User friendliness

Concerning student user-friendliness of mobile learning in the context examined, nearly all the test persons found the equipment easy to use and also found that the “experience was fun”. The answers to the questions whether they would like to take another m-learning course or recommend m-learning to others were somewhat more reserved – not surprisingly as their experiences from the test situation probably were too short in time and a little restricted to enable them to answer these questions firmly.

Didactic efficiency

Concerning didactic efficiency, taken the assumed context of m-learning as a supplement to the distance online learning environment, the test students believed that “m-learning increases quality, that objectives can be met by m-learning, that accessing course content and communication with the tutor was easy, and that m-learning is convenient for communication with other students.”

Technical feasibility

Most of the students found navigation easy. They did not agree whether graphics and illustrations were necessary. More than half of the test students were uncertain or actually disagreed with the statement that “graphics and illustrations are necessary for m-learning to be effective”. This opinion can partly be a result of the assumed context that the students would also have the possibility to study learning materials on standard equipment, and also to the fact that most of NKI learning programmes are quite theoretical and mainly based on the study of text materials.

Cost efficiency

Most of the participants agreed that m-learning increases access to learning. On the negative side is, of course, that general access to technology is still lacking. Mobile phones with more PocketPC-like functionalities, which now have reached the market, may largely solve this problem. We have previously shown that communication costs, even when communicating by mobile phone were acceptable. In these trials, we assumed that the learning could take place in an always-online environment with free access.

The test students tried synchronous communication both by chat and IP telephony. According to the test persons assumed, the chat function was similar in functionality with chatting on an
ordinary PC. The majority also answered that they believed that the chat function could be useful in m-learning.

Figure 8. Video on the PDA.

Functionalities and quality

Video on the PDA with small video clips worked quite well using the Windows Media Player and there were no problems viewing the files with relatively high quality both on picture and audio. However, the PDA was not capable of streaming video directly from the web browser. One had to copy the URL into the Media Player and watch the video from the Media Player.

As a result of previous development projects working with Universal Accessibility at NKI (Mortensen 2003), we also tested out the use of synthetic speech on the PDA. We have implemented a technology that makes it possible to save the text on a web page as an mp3 file and have it “read” afterwards by the use of synthetic speech. The test students were generally positive concerning the quality of both human and synthetic sound on the PDA – all responding on the positive side of the scale. The quality of both digital human voice and synthetic speech was found to be fully sufficient.

The test persons generally also expressed that they were impressed by the quality of IP telephony on the PDAs. Most of the students also agreed with the statement that IP telephony could be useful in mobile learning.

According to the students, sending and receiving e-mails, writing to the course forum, answering assignments with Word attachments and sending/receiving assignments functioned well. There were few responses on the negative side.

The test students were generally very positive towards reading text on the PDA. Although the majority of the students responded quite positively to most of the questions concerning the m-learning environment, they did not find the solutions of sufficient quality for mobile access only. This is in line with our assumptions that m-learning in the NKI online distance education system is seen as an addition to increase access and flexibility of learning.
The students agreed that the always-online mobile solutions increase the flexibility of distance learning. To a large extent they also agreed that the m-learning solutions increase the quality of course arrangements. More than half of the students were uncertain whether the solutions tried out actually increase the quality of learning outcomes. This is, of course, a very difficult question to answer based on the experiences from a laboratory like test situation. (Papers from the two first mobile learning projects at NKI have been collected in a separate volume (Rekkedal et al. 2005).)

**Incorporating mobile learning into the mainstream of education and training**

*Introduction*

The project ‘Incorporation of mobile learning into mainstream education and training’ was started in October 2005 and was finished in September 2007. The project was based on the partners’ experiences during the two preceding projects, and also on the views that it is now time for mobile learning to transform from its project status and enter into mainstream education and training in Europe, not least in distance education. Important aims of the project were to develop and test solutions for mobile technology in distance education and to disseminate information to interested parties in Europe and worldwide.

For NKI, the project builds on the situation described above that all online distance courses are available on PDAs, and also on smart phones with web browser without any need for adaptation of the individual courses. In this situation the project sought to develop services using primarily SMS technology to support online distance education within the context of cost-efficient large-scale distance education. The infrastructure for the additional new services was developed to be applied in all courses.

**Specification for the project**

Mobile technologies can be divided into two basic categories:

**Push:** MMS and SMS are the two leading push technologies for mobile devices.

**Pull:** Key technologies will include WAP, different versions of HTML and e-mail.

The more valuable – or critical – a service is to the student, the more important it is to make certain that the student has technology to make use of the service. Hence, important/valuable services had to be delivered on SMS because of its availability and reliability.

**Hardware**

To set up a basic infrastructure we needed an SMS/MMS gateway that should include the ability to send and receive SMS/MMS messages. Received SMS/MMS messages should be made available to a computer, so that they could be processed either by a student counsellor or by other staff for handling of errors etc. An in-house SMS service will normally consist of one or more GSM modem terminals, some software to ‘talk’ to the terminals and a server to run the software.

**Service requirements**

The mobile service development process started with the smallest and easiest service that delivers a business function to NKI, which means increasing to quality of distance education, and then moved onwards to dealing with more complex and advanced services. All services
should handle error messages and log them; it was also required that a record of the costs of mobile services to NKI was registered.

As mentioned in connection with the above projects, NKI focussed on services for the use of mobile phones for all online courses and programmes.

**SMS services tried out in the project**

- The first service tried out in the project was an SMS message containing practical information on ‘how-to’ log on to the NKI Internet College with username, password, etc. This was sent to new students whom we for some reason were not able to reach by e-mail.
- We also included a link to the course called ‘Learning to learn’ (introductory course in all online programmes) describing how to study and what to expect as an online student at NKI. This was designed and developed as a lightweight WAP version of the original course.
- SMS message to get in touch with students who were registered with invalid e-mail addresses
- SMS message for reminding students to register for exams
- SMS message to students having lost their password for logging on
- SMS message informing that assignments had been commented on by the teacher
- SMS message on exam results
- SMS messages from students to order prospectus
- One tutor sent SMS welcome message to students whose e-mail welcome generated error message

In the project the SMS message system was handled manually. The system seemed to function well, e.g. concerning students with invalid e-mail addresses, resulted in 70 percent of the students who received the SMS messages corrected their e-mail address. Although integrating SMS services into the online learning system involves some extra costs, these costs may seem marginal relative to the increased level of service.

The project concluded that there are numerous possibilities for the use of SMS/MMS services that could be suitable for supporting online distance learners. As NKI practices flexible pacing and free start-up times, advanced support systems for following up both students and tutors have been developed and should be integrated into the mobile learning context.

**The role of mobile learning in European education**

In connection with this project NKI carried out an internal survey on students views on mobile learning services in the frame of online studies based on a questionnaire published on the NKI SESAM LMS web pages. The questionnaire was accessible for nearly 8 weeks from August till October 2007. The questionnaire could be accessed from the introductory course *Learning to learn* and from 12 different study programmes (3 higher education studies, 2 secondary school studies and 7 vocational training studies). During the period that the questionnaire was active on the web it was answered by totally 279 students. Although the number of respondents only represent a small percentage of the NKI online students, there is little or no reason to assume that the respondents in this survey should be biased in any way concerning attitudes towards mobile learning and applications of mobile technology as part of their distance study, except for the fact that relatively newly enrolled students were overrepresented among the respondents. As new students have less experience with online
learning, they may be less certain about their needs for and/or the usefulness of mobile access and services. Presently, the technology behind the web based questionnaire makes cross tabulations difficult, so we do not know about possible differences in attitudes between new students and more experienced students. As we also were in the process of finishing the above project on SMS services the questionnaire contained a number of questions specifically on SMS services.

Results

SMS services in online learning

Table 1. What is your opinion on receiving SMS on incorrect e-mail address when NKI is not able to contact you by e-mail?

<table>
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<th>N</th>
<th>%</th>
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<tbody>
<tr>
<td>Very positive</td>
<td>196</td>
<td>71</td>
</tr>
<tr>
<td>Positive</td>
<td>70</td>
<td>25</td>
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<tr>
<td>Neutral</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Negative</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Very negative</td>
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</tr>
<tr>
<td><strong>Sum</strong></td>
<td>278</td>
<td>100</td>
</tr>
</tbody>
</table>

There is no doubt that an overwhelming majority of NKI online students are positive to a system sending out SMS messages in a situation where they are not reached by e-mail. 96 percent is positive towards such a service, while only 1 percent is negative.

Table 2. What is your opinion on receiving SMS for following you up if you fall behind your personal study schedule?

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<th>N</th>
<th>%</th>
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<tbody>
<tr>
<td>Very positive</td>
<td>117</td>
<td>42</td>
</tr>
<tr>
<td>Positive</td>
<td>110</td>
<td>40</td>
</tr>
<tr>
<td>Neutral</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>Negative</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Very negative</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>276</td>
<td>100</td>
</tr>
</tbody>
</table>

A large majority also expresses positive attitudes towards SMS in connection with student follow-up. A few more students are neutral or negative to this type of service. It is a general experience that a small minority of students is negative to being followed up when falling behind their schedule. It is mainly the same group that is generally against planning as well. They wish to be completely free and autonomous in their studies with no intervention related to study progress. It is probably mainly the same group of students that is negative to SMS following up services that is negative in general towards the planning and following up system.
Table 3. What is your opinion on receiving SMS for reminding you about time and place for examinations?

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<tr>
<th></th>
<th>N</th>
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<tbody>
<tr>
<td>Very positive</td>
<td>207</td>
<td>75</td>
</tr>
<tr>
<td>Positive</td>
<td>57</td>
<td>21</td>
</tr>
<tr>
<td>Neutral</td>
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<td>4</td>
</tr>
<tr>
<td>Negative</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Very negative</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>277</td>
<td>101</td>
</tr>
</tbody>
</table>

Again, most of the students, over 95 percent are positive to a service by SMS that reminds them of time and place for examinations. Only 1 percent (3 students) expresses negative attitudes to such a service.

Table 4. What is your opinion on receiving SMS about examination results?

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<thead>
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<th></th>
<th>N</th>
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</thead>
<tbody>
<tr>
<td>Very positive</td>
<td>193</td>
<td>70</td>
</tr>
<tr>
<td>Positive</td>
<td>52</td>
<td>19</td>
</tr>
<tr>
<td>Neutral</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Negative</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Very negative</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>277</td>
<td>101</td>
</tr>
</tbody>
</table>

Very few students express negative attitudes to receiving information on examination results on SMS.

At the end of the above sequence of questions on different SMS services, we asked if they could think of other desirable SMS services.

These possible services were mentioned:
- When there are new contributions to the forum and when the commented assignment is returned from the tutor.
- I believe it would be an advantage if the students could tick which type of messages or reminders they wished to receive by SMS.
- Information when assignments for submissions were returned.
- It would have been positive if grades on submissions could be sent by SMS.
- Specific information, such as when tutors or advisors were reported ill.
- Deadlines for project work.
- Information about new NKI courses within my interest/subject field.
- Grades perhaps – light up the ordinary day with some good news :-)    
- Send and receive questions and answers, communicate with the tutor when one has a small question.
- Information about interesting links related to the course.
- Messages from the tutor when commenting is delayed for some reason.
- Reminder on assignment submission if it is a long time since one submitted an assignment.
- Everything that relates to my online studies.
From the different answers/suggestions above one may conclude that the students have many suggestions and seems to express a positive attitude towards receiving SMS messages related to their studies. Information about grades and the return of assignments from the tutor are mentioned by several students.

SMS services are among the most used, and perhaps useful, applications for mobile phones. SMS services have also proved to be very useful in distance education, especially in developing countries (see e.g. Brown 2004). Brown (ibid.) at the University of Pretoria in South Africa has shown that the use of SMS services has a wide variety of application possibilities for both administrative and academic support to distance students. While Brown’s experiences have taken place in a developing country, our research has shown that these services also can be useful and are positively accepted by the students in an advanced online learning system in Norway.

**Technology and access**

Table 5. Modern mobile phones include possibilities for access to web pages. Do you know whether your mobile phone includes this function?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>219</td>
<td>79</td>
</tr>
<tr>
<td>No</td>
<td>58</td>
<td>21</td>
</tr>
<tr>
<td>Sum</td>
<td>277</td>
<td>100</td>
</tr>
</tbody>
</table>

79 percent of the respondents say that their mobile phone can access web pages. Whether the remaining 21 percent of the students have mobile phones without web access functionality or whether they do not know is not certain. But we can conclude that at least approximately 80 percent of NKI online students possess a mobile phone that can access web pages (if the respondents are representative for the population of NKI online students).

Table 6. If your phone has the possibility, do you use your phone for accessing web pages?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>No</td>
<td>167</td>
<td>70</td>
</tr>
<tr>
<td>Sum</td>
<td>237</td>
<td>100</td>
</tr>
</tbody>
</table>

This question should have been answered by only the 219 students who answered that their mobile phone had the possibility of accessing web pages. But at least we may conclude that 70 respondents, i.e. 25%, use their mobile phone for accessing web pages.

Table 7. Today all NKI course pages can be accessed by mobile phones or handheld devices. Did you know about this possibility?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>35</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td>243</td>
<td>87</td>
</tr>
<tr>
<td>Sum</td>
<td>278</td>
<td>100</td>
</tr>
</tbody>
</table>
As a result of the projects on mobile learning all NKI online courses are made accessible via mobile phones. This functionality seems not to be sufficiently known. Only 35 students (13%) answer that they knew about the possibility of accessing the NKI course pages. It is good reason to increase the information work concerning mobile learning possibilities for NKI online students.

Among the students who knew about the possibility of accessing and reading NKI web pages on mobile phones and other handheld devices, only 9 of the respondents say that they use the possibility of reading the NKI course pages on their handheld device.

We also asked whether they found this functionality useful in their studies. Although this question should be answered by those 9 students only, it was actually answered by 74 students of whom 30 (41%) answered that they found the functionality useful. However, as we have no possibility of separating the responses from the 9 students who have experience of accessing the NKI course pages, these answers are of little value.

The following questions were to be answered by all the students and concern the students’ attitudes toward mobile phone applications in connection with online studies at NKI.

**Attitudes toward different applications of mobile phones in online learning**

Table 8. Would you find it useful to receive NKI course pages on your mobile phone?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>78</td>
<td>29</td>
</tr>
<tr>
<td>Don’t know</td>
<td>99</td>
<td>36</td>
</tr>
<tr>
<td>No</td>
<td>96</td>
<td>35</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>273</td>
<td>100</td>
</tr>
</tbody>
</table>

The respondents are nearly equally divided in three groups, who are positive, uncertain, and negative to the usefulness of accessing the course pages via handheld devices.

Table 9. Would you find it useful to be able to plan your studies, submit assignments or update your personal data from your mobile phone?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>75</td>
<td>27</td>
</tr>
<tr>
<td>Don’t know</td>
<td>73</td>
<td>27</td>
</tr>
<tr>
<td>No</td>
<td>126</td>
<td>46</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>274</td>
<td>100</td>
</tr>
</tbody>
</table>

There are some more students (nearly half of the respondents) who are sceptical to the usefulness of planning studies, submitting assignments or changing personal data from their mobile phone or handheld device.
Table 10. Would you find it useful to be able to read forum contributions from your mobile phone?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>123</td>
<td>45</td>
</tr>
<tr>
<td>Don’t know</td>
<td>51</td>
<td>19</td>
</tr>
<tr>
<td>No</td>
<td>99</td>
<td>36</td>
</tr>
<tr>
<td>Sum</td>
<td>273</td>
<td>100</td>
</tr>
</tbody>
</table>

When it comes to reading forum contributions, there is a much larger group of students who believes that this is a useful functionality to have on the mobile phone. Nearly half of the students believe that reading forum messages on the mobile phone would be useful, while only about 1/3 find this functionality not useful.

Table 11. Would you find it useful to be able to write contributions to the forum from your mobile phone?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>115</td>
<td>42</td>
</tr>
<tr>
<td>Don’t know</td>
<td>58</td>
<td>21</td>
</tr>
<tr>
<td>No</td>
<td>98</td>
<td>36</td>
</tr>
<tr>
<td>Sum</td>
<td>271</td>
<td>100</td>
</tr>
</tbody>
</table>

It is also over 40 percent of the students who believe that it would be useful to be able to contribute to the forums from their mobile phone.

Table 12. Would you find it useful to be able to access and read course literature and study guides from your mobile phone?

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>96</td>
<td>35</td>
</tr>
<tr>
<td>Don’t know</td>
<td>77</td>
<td>28</td>
</tr>
<tr>
<td>No</td>
<td>103</td>
<td>37</td>
</tr>
<tr>
<td>Sum</td>
<td>276</td>
<td>100</td>
</tr>
</tbody>
</table>

About 1/3 of the respondents believe that it would be useful to be able to access and read course literature from their mobile phone.

While a very large majority of the students express positive or very positive attitudes towards SMS messages from NKI related to their studies. The number of students who believes in the useful of the other functionalities of mobile access and mobile applications related to their online studies is considerably lower.

Still it is all reason to emphasise many online students would appreciate to be able to use their mobile phone for different learning activities, such as reading the course pages, planning studies and submit assignments and communicating with other students in the course forums.
Discussion and conclusions

The NKI developments and research on mobile learning in connection with the four EU supported projects have resulted in better solutions for serving distance online learners. We have learned that cost efficiency considerations do not allow for developing parallel versions of courses. Courses must be developed, presented and distributed in ways that allow both mobile and not mobile learners to participate and enrol in the same course and that course materials can be assessed both by standard and mobile technology with acceptable quality of all content elements. Interaction with course content and multi-media materials and communication with tutors and fellow students must also function adequately both through standard and mobile technology.

It is still a question of what the “ideal” device and solution for mobile learning really is. Probably is the answer a result of the learner’s individual preferences. That is why NKI has found it extremely important to experiment with different solutions that have inspired developments towards finding course design and systems solutions that may serve the needs of the learner independent of the technology used by the students.

It has been our aim in these projects in designing an environment for mobile distance learners to extend and enhance (or restore) the flexibility of distance education, that to some extent took a step backwards when converting from paper based to online learning, which created a situation where students largely were required to study at a place (and at a time) where a computer with access to the Internet was available. In our view, the research on mobile learning and developing new services to students on the move have been an important step in the right direction.

NKI is presently developing a new generation of its LMS. The first version, SESAM 6.0 was launched December 18th 2007 and is continuously updated with releases of new and better functionalities. As adaptation of the learning environment for mobile access is an additional service to online learners, it is important to make sure whether the extra resources and costs connected with the development and operation of these services in the new system are acceptable in relation to the value of the services as experienced by the students.

Our experiences so far from previous and present research and evaluations indicate that NKI should continue its effort to design its learning environment to function on mobile phones, including SMS services.
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