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NOKIA

TURNING ON MOBILE LEARNING IN EUROPE

> Illustrative Initiatives and Policy Implications

POLICY FOCUS

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Authored for UNESCO by: Jan Hylén
Coordinating editors: Steven Vosloo and Mark West
Editing and graphic design: Rebecca Kraut
Cover design: Aurélia Mazoyer

ABOUT THE SERIES

This paper is part of the UNESCO Working Paper Series on Mobile Learning. The Series seeks to better understand how mobile technologies can be used to improve educational access, equity and quality around the world. It comprises fourteen individual papers that will be published throughout 2012.

The Series is divided into two broad subsets: six papers examine mobile learning initiatives and their policy implications, and six papers examine how mobile technologies can support teachers and improve their practice.

Within the two subsets there are five geographical divisions: Africa and the Middle East, Asia, Europe, Latin America, and North America. Each subset also contains a 'Global Themes' paper that synthesizes central findings from the five regional papers.

Two additional 'Issues' papers round out the Series. One paper highlights characteristics shared by successful mobile learning initiatives and identifies supportive policies. A separate paper discusses how mobile technologies are likely to impact education in the future.

As a whole, the Series provides a current snapshot of mobile learning efforts around the world. Collectively and individually, the papers consolidate lessons learned in different regions to provide policy-makers, educators and other stakeholders with a valuable tool for leveraging mobile technology to enhance learning, both now and in the future.

UNESCO has plans to add additional titles to the Series after 2012. The Organization hopes that these resources will help diverse audiences better understand the educational potential of mobile technologies.

To access existing and forthcoming titles in the Series, please see:
http://www.unesco.org/new/en/unesco/themes/icts/m4ed/

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ABSTRACT

This paper identifies strategies, initiatives and projects for mobile learning in formal education in Europe. Data collection has mainly been done through research inquiry. A questionnaire sent out to thirty Ministries of Education resulted in only two responses, probably reflecting the low priority given to mobile learning at the policy level in Europe today.

Many research and development (R&D) projects regarding the use of mobile technology in education have been carried out in Europe. There has also been a growing recent interest in experimenting with tablets and similar devices in schools, with pilot projects typically conducted on a small scale and driven by enthusiastic teachers. However, the practice of using mobile phones for education is still emergent, and the concept of mobile learning, with few exceptions, has not yet reached the policy level.

The European Commission, which is the executive body of the European Union and is responsible for proposing legislation, implementing decisions, and running the general day-to-day affairs of the EU, has funded a number of successful R&D projects focused on mobile learning. Over the years those projects have gradually evolved from developing hardware and software, a primarily technology-driven process, to a learner-centred approach in which mobile technologies play a part, alongside more fixed technologies, in supporting learning at any time and in any place.

On the national level, the United Kingdom has launched the greatest number of mobile learning projects as well as the largest mobile learning project in Europe to date. This effort has been driven by interest and economic support from the UK government and a number of strong research teams. A policy reorientation introduced last year by the new Government relegates the responsibility for integrating education with information and communications technology (ICT) and mobile technology to the local level. Government funding for school projects has ceased, and it remains to be seen to what extent mobile learning will continue to grow.

Denmark appears to be the most promising country in the field of mobile learning at the moment, with national guidelines and instructional materials in place to support the use of mobile devices in teaching and learning. In January 2012 the Danish government issued a digital strategy plan which includes investment in the development and distribution of digital learning materials for fixed and mobile devices, as well as access to individual computers and wireless networks for all students by 2014. However, in order to reach this target, it is projected that a majority of students will need to bring their own devices to school. This approach raises questions about equity that will have to be addressed by the Danish government as well as any other countries or schools considering a bring-your-own-technology (BYOT) strategy.

In the Netherlands strong support for using mobile technology in schools comes from two publicly-funded organizations that are not governed by national policy. Other European countries show limited if any interest in mobile learning at the policy level.

The barriers to mobile learning include a lack of interest and awareness on the part of policy-makers and the public, and negative social attitudes that see mobile phones as disruptive devices that students use primarily to play games, chat with friends and potentially engage in inappropriate behaviours such as cheating and cyber-bullying. In spite of these barriers, it is likely that the number of mobile learning projects in Europe will continue to grow, as powerful mobile devices like smartphones and tablets become increasingly inexpensive and user-friendly. However, research suggests that mobile devices should not replace desktop computers but rather should be used to complement fixed technologies. ICT is a powerful vehicle for enhancing learning, and mobile devices form an essential part of that vehicle. If current ICT strategies for education begin to include mobile devices along with digital learning materials, support for teachers, and guidelines on best practices, mobile learning will soon become an important part of European education.

BACKGROUND

On its official website, the European Commission declares that in a changing world, the EU strives to become a smart, sustainable and inclusive economy (European Commission, 2012). These three 'mutually reinforcing priorities' should help the EU and its member states stimulate high levels of employment, productivity and social cohesion. The EU's Europe 2020 growth strategy includes five objectives on employment, innovation, education, social inclusion, and climate and energy to be reached by 2020. Each member state has adopted its own national targets in these areas and will be responsible for implementing the actions needed to achieve them with the help of the European Commission.

Education will play a fundamental role in achieving the Europe 2020 objectives, notably by equipping citizens with the knowledge and skills that the European economy needs in order to remain competitive and innovative. The EU has set two distinct targets for education: reducing school drop-out rates to less than 10% and increasing to at least 40% the proportion of 30- to 34-year-olds who complete tertiary education.

In order to reach these targets, EU member states will need to make significant improvements in education. Europe is currently facing a considerable number of educational challenges: one-quarter of Europeans under the age of 15 attain only the lowest level of proficiency in reading; 15% of those aged 18 to 24 leave school prematurely; only 78% of all 22-year-olds have completed upper-secondary education; and the level of interest in certain critical subjects, such as science and mathematics, is low. Education ministers throughout Europe have pledged to improve national school systems, with special attention to teacher education, language learning, mathematics, and science and technology. They have charged schools with helping students take responsibility for their own learning and personal development throughout their lives by providing them with essential 'competencies' (knowledge, skills and attitudes) for successful participation in society and the workforce.

Among these core competencies, digital literacy and the ability to use technology effectively are particularly vital in preparing students for the twenty-first century global economy. The integration of ICT into European education systems is seen as crucial to the health and renewal of the European economy and forms a key component of the region's educational policies (EACEA/Eurydice, 2011). However, because policies are designed and implemented on a national level, there are many disparities between countries with regard to access to ICT in schools and the use of ICT in teaching and learning.

Mobile learning – learning using mobile technologies – can help address some of these disparities by providing low-cost and easy-to-implement solutions to make education more accessible to all students. Presently, the use of mobile devices in education has not been mentioned explicitly in any overarching European strategy, and mobile learning is not viewed as an independent branch of ICT policy. This is probably due to a lack of awareness among policy-makers about the potential of mobile learning to support educational goals, as well as a reluctance to challenge negative social attitudes about the use of mobile phones in schools. However, two factors suggest that this situation may change in the near future. First, the current economic crisis has reduced or delayed many countries' investments in ICT for

education. Yet more and more students in Europe have a smartphone, tablet device or laptop of their own, which may lead policy-makers to realize that they can achieve their goal of increasing the use of ICT in education by allowing students to bring their own devices to school. Denmark is currently implementing such a policy, which will be discussed in the sections that follow. Secondly, mobile technology is advancing rapidly, with mobile devices increasingly resembling personal computers in their functionalities and processing speeds. The vast majority of policy-makers, parents, teachers and students already agree that computers can and do support learning, and it is likely that this positive attitude will soon extend to mobile technology as well.

This paper identifies relevant mobile learning initiatives in Europe and describes the policies in place to support them at the regional, national and local levels. At present, information on efforts to leverage mobile technology for learning is limited, probably because mobile learning is still a relatively new concept. Nevertheless, the use of mobile devices in education is growing, and this paper aims to provide a preliminary survey of an emergent field to help guide the design and implementation of mobile learning policies and projects.

For the purposes of this paper, Europe is defined primarily as the twenty-seven member states of the EU. The choice to limit this review to the EU was mainly practical. Information about education policy in non-EU countries is difficult to access, and attempts to obtain concrete information about mobile learning initiatives in countries outside the EU proved futile. For a complete list of EU member states, see Appendix A.

This paper offers a working definition of mobile learning that is based on the mobility of the learner as well as the technology. Mobile learning is learning that occurs in or outside of a classroom or formal education setting, is not fixed to a particular time or place, and is supported by the use of a mobile device. Mobile devices range from standard mobile phones to tablet devices and include personal digital assistants (PDAs), MP3 players, flash drives, electronic-book readers (e-readers) and smartphones (UNESCO, 2011). This paper will focus primarily on learning facilitated by mobile phones – both standard mobile phones and smartphones – because of their high prevalence in Europe and the rest of the world. Occasionally the review will look at how tablet devices such as iPads are being used to support learning as well. Preliminary research suggests that these devices, perhaps due to their significantly larger screen size, are rapidly being adopted by schools throughout Europe, although their higher cost and lower availability do not necessarily make tablets a feasible option for large-scale mobile learning projects at the present time.

METHODOLOGY

Data for this paper were collected through bibliographic and internet research from August 2011 to January 2012. In addition, a questionnaire was sent out between September and October 2011 to the Ministries of Education or equivalent government agencies in thirty countries in Europe. The questionnaire was distributed by the European Schoolnet, a network of Ministries of Education in Europe and beyond that conducts research on ICT in education and provides policy-makers, educators and schools with strategies and resources for incorporating innovative technology into teaching and learning. The countries that received the questionnaire include the twenty-seven member states of the EU as well as Norway, Iceland and Israel. The questionnaire asked respondents to specify whether their governments were actively supporting the use of mobile phones in education through specific projects or programmes; the level of mobile learning activity in different education subsectors (primary, secondary or tertiary); whether their governments were actively trying to prevent the use of mobile phones in education; and if their governments had a clear strategy or policy regarding the use of mobile phones in education. For a copy of the questionnaire, see Appendix B. Unfortunately, the survey had a very low response rate; to date only two countries – France and the Netherlands – have returned their questionnaires.

A representative from the Czech Republic's Ministry of Education sent a response stating that there are no national initiatives or initiatives run by local authorities aimed specifically at the use of mobile phones in education. The representative referenced two small projects – one international project that includes Czech schools, and one small local project – as well as one electronic learning (e-learning) course on mobile learning. The representative chose not to fill out the official questionnaire because 'none of these activities is national or has a broader impact on our education in general'. The dearth of mobile learning programmes and initiatives in the Czech Republic is most likely indicative of the situation in other EU countries, which may explain the lack of response from the majority of countries surveyed.

MOBILE LEARNING INITIATIVES

Mobile learning in Europe began in the 1980s when hand-held devices were first tested in a few schools. Beginning in the mid-1990s numerous research projects explored how graphics tablets, PDAs and other hand-held devices could be used to facilitate learning. Early mobile learning projects in Europe usually focused on the development of educational software for mobile devices. These projects often investigated ways to support learning in informal settings, such as museums or neighbourhood training centres for at-risk youth. As the proliferation of mobile technologies increased and educational content and applications became more widely available, the emphasis shifted toward using mobile technologies to transform pedagogical models and promote innovative practices in teaching and learning, both in and outside of school. In the 1990s and early 2000s, mobile learning activities were mainly concentrated in tertiary education, while recent projects have tended to focus on primary and secondary education, possibly because hand-held devices have become more user-friendly and thus easier for younger children to use.

The European Commission has been the most important player in promoting mobile learning, primarily by funding R&D projects in the fields of education and technology. Since 1984, the research and innovation activities of the EU have been grouped into a single entity, called the Framework Programmes for Research and Technological Development (FPs). FPs are the main financing tools through which the EU supports and encourages research in almost all scientific areas (CORDIS, 2011). Individual FPs typically run for a funding period of five to seven years, with specific objectives and actions varying for each programme. Currently the Seventh Framework Programme (FP7) is being implemented, and FP8 is scheduled to begin in 2014. EU member states channel a significant portion of their research funding into the FPs.

In addition to FPs, other EU-funded programmes have advanced the use of mobile devices in education. These programmes tend to be less focused on scientific breakthroughs and cutting-edge technology than on learning and pedagogy. Examples include the Leonardo da Vinci Programme, which funds practical projects in the field of vocational education and training (VET) as part of the European Commission's Lifelong Learning Programme. A few European countries – most notably the United Kingdom – have also initiated national or co-financed international mobile learning projects.

The following sections discuss the major EU- and nationally-funded mobile learning initiatives in Europe, as well as a variety of local or privately-funded projects. The projects are described mainly in chronological order, since later efforts tend to build on the results of previous projects.

EU-FUNDED PROJECTS

This review of relevant mobile learning projects draws heavily on a research paper by Kukulska-Hulme et al. (2011) that describes the most important EU-funded R&D projects over the past decade. Education-related projects did not privilege formal schooling or teacher-centred education and were often intended to support learning outside of school contexts. The EU-funded mobile learning projects described in the sections below were all designed to assist learners of varying ages in a wide variety of fields, from schoolchildren on field trips to graduate students working on professional degrees, outside of a traditional classroom setting.

HANDLER

The Handheld Learning Resources Project (HandLER) was a mobile learning project launched in 1998 by the School of Engineering's Education Technology Research Group at the University of Birmingham in the UK. The project aimed to develop mobile technologies and methodologies that could support lifelong learning in multiple contexts. Mobile devices, software and strategies were designed to assist learners in a wide range of educational scenarios; examples include 'an 11-year-old child on a school field trip, a radiologist in her first year of specialist training in neuroradiology, and a senior citizen recalling and organizing a lifetime of memories' (Kukulska-Hulme et al., 2011, p. 153). To support the school field trip scenario, the project designed a hand-held tablet device equipped with a camera, wireless internet connectivity and a mobile phone connection. Software for the device was developed through interviews and questionnaires administered to children ages 11 to 12 to create an interactive application that was more appropriate for learning in the field than the software on stationary desktop computers. Results revealed that the technology available at the time had severe limitations that made it almost impossible to use while walking or moving. Handwriting recognition was poor, battery life was short, and the weight of the devices made them difficult to use, especially for younger children.

The main success of the HandLER project was to establish the concept of mobile and contextual learning outside the classroom. The project also developed some baseline requirements for mobile technologies that support learning outside of school settings. According to project researchers, these technologies should be:

- **Highly portable:** The technology is available whenever the user needs to learn.
- **Individual:** The technology can be personalized to suit the individual learner's abilities, knowledge and learning style, and is designed to support personal learning rather than general office work.
- **Unobtrusive:** The learner can capture situations and retrieve knowledge without the technology becoming overly noticeable or imposing on the situation.
- **Available:** The learner can use the technology anywhere, to enable communication with teachers, experts and peers.

- **Adaptable:** The technology can be adapted to the context for learning and the learner's evolving skills and knowledge.

- **Persistent:** The learner can use the technology to manage learning throughout a lifetime, so that the learner's personal accumulation of resources and knowledge will be immediately accessible despite changes in technology.

- **Useful:** The technology is suited to everyday needs for communication, reference, work and learning.

- **Easy to use:** The technology is easily comprehended and navigated by people with no previous experience using it.

Kukulska-Hulme et al. noted that some of these requirements – such as technology that is fully adaptable to the context of learning and the learner's evolving skills – have yet to be fully realized, while others are now readily available through mobile technologies.

MOBILEARN

MOBIlearn was another major mobile learning initiative with funding from the European Commission. The programme ran from 2002 to 2005 and involved nine European countries as well as several countries outside of Europe, including the United States and Australia. Private-sector partners included universities and mobile phone and telecommunications companies. The programme aligned itself with key objectives for ICT in Framework Programme 5 (FP5) and, in general, aimed to support and develop learning outside of traditional schools and classrooms. To explore how mobile technologies could enhance learning, MOBIlearn launched pilot projects in three distinct areas. First, MOBIlearn worked with Master of Business Administration (MBA) programmes at partner universities to extend the reach and scope of their current blended-learning course offerings, which combined a traditional classroom approach with online and mobile components. Second, the project helped Firenze Musei, an association that manages all of the European cultural and heritage locations in Florence, Italy, to improve learning opportunities in museums and galleries through the use of mobile devices. Third, MOBIlearn worked with the European Resuscitation Council to develop a programme to deliver basic medical knowledge via mobile phones for use in emergency situations.

MOBIlearn was successful in establishing the viability of hand-held technology to enable learning in informal settings, and some of the resulting technologies and software were commercialized when the project ended. According to Kukulska-Hulme et al. (2011), a broader consequence of the MOBIlearn project was a shift in focus from learning with hand-held devices toward support for the mobility of learning in general. The project demonstrated how a mobile learner may interact with a variety of fixed and portable technologies and underscored the central challenge of connecting learning across a variety of contexts. Although mobile technologies have evolved in many ways since the MOBIlearn project, current mobile learning initiatives still grapple with the same challenge: how to create seamless and continuous educational opportunities to support lifelong learning in all contexts.

EMAPPS

The eMapps programme – which stands for Motivating Active Participation of Primary Schoolchildren in Digital Online Technologies for Creative Opportunities through Multimedia – ran from 2005 to 2008 as one of a number of medium-sized Specific Targeted Research Projects (STRePs) supported by the European Commission during the FP6 and FP7 funding periods. Targeting students ages 9 to 12, the eMapps project aimed to build communities of creative, technologically-savvy and internationally-minded children who would generate digital content about their local culture and communicate with peers in other countries through the programme's platform and network.

Another aim of the project was to develop adaptable interactive tools – primarily games played on a mobile platform – with which to deliver learning objectives and help integrate the use of ICT into education (eMapps, 2008). Game-based learning, in this case, meant learning through performance. eMapps games required students to participate in active discovery, analysis, interpretation, problem solving, memory exercises and physical activity. Players in different locations used mobile chat for real-time communication. Games were played in ten European countries, with each partner school implementing its own game. The eMapps programme supplied schools with a mobile platform and game development toolkit to design the different components of their game, which included a story, a variety of challenges, and game-play logistics. For example, a Czech school developed a one-day game that took place at the Břevnov monastery in Prague. A historic hero – a monk with a hidden identity – was introduced to the children and their task was to find out who he was. The students received a cipher that contained predictions about the unknown hero and used mobile devices to collect clues to solve the cipher and reveal the hero's name. At the end of the game, players presented their solutions to the prior of the monastery, who then spoke to them about monastic life and the history of the monastery. The pedagogical value of the eMapps game-playing experience came from the creative coupling of educational media with effective learning activities to engage students in meaningful discoveries. The games were constructed using online resources but were generally played on school grounds or, occasionally, on field trips.

M-LEARNING

Another important EU-funded mobile learning project was the UK's M-Learning programme, which was coordinated and led by the Learning and Skills Network (LSN), a now-defunct non-profit organization that was dedicated to improving education across the public and private sectors in the UK. Active from 2001 to 2004, the M-Learning project aimed to help young adults aged 16 to 24 who were disaffected learners – individuals who had not succeeded in the educational system and were considered at risk of social exclusion – by engaging them in learning outside of formal school settings. The project focused on mobile technologies not simply as a means of delivering educational content but as a tool for facilitating creativity, collaboration and communication in the learning process.

According to Kukulska-Hulme et al. (2011), the M-Learning project underscored the fact that the most effective development method is to experiment with mobile learning in practice, fine-tuning approaches and strategies through trial and error. In evaluating the project,

researchers concluded that mobile learning functioned best as part of a 'blend' of learning activities which offer a variety of ways to address learning needs, rather than a single solution. In spite of technological advances these insights are still applicable today and can be used as guiding principles for designing mobile learning programmes both in and outside of schools.

OTHER PROJECTS

Other EU-funded projects have supported the finding that mobile devices should not be used as the sole learning tool or primary method for content delivery. Two projects supported by the European Commission and led by the telecommunications provider Ericsson were dedicated to educational content delivery for mobile phones. Results were mixed in terms of learners' experiences, and the strategy of delivering content to a specific mobile device appears to have been largely unsuccessful. Kukulska-Hulme et al. (2011) conclude that:

> It now seems unlikely that most people will adopt separate 'personal learning organisers', but instead they will integrate learning activities into the flow of their daily work and leisure activities. This is already posing challenges to education institutions, as they move from centrally managed Virtual Learning Environments, to supporting a range of personal devices and tools. (Kukulska-Hulme et al., 2011, p. 157)

In other words, learners do not wish to be tied to a single device or system, preferring the flexibility to access educational opportunities from a wide variety of sources. While delivery of educational content to mobile devices may have specific uses in education, the most effective approaches to mobile learning will make use of the unique functionalities of mobile technology to support ongoing dialogue and communication and to facilitate the production and consumption of media content such as images, videos and audio files.

NATIONALLY-FUNDED PROJECTS

While the European Commission has been instrumental in establishing European research in mobile learning, some individual countries have also funded mobile learning projects as part of their national education agendas. The countries that have provided the most significant support for mobile learning in Europe are the United Kingdom, the Netherlands and Denmark.

UNITED KINGDOM

MOLENET

Compared to the projects underwritten by the EU's Framework Programmes, domestic projects are generally smaller in scale. One notable exception was the Mobile Learning Network (MoLeNET) programme in the UK. MoLeNET was the largest and most diverse mobile learning initiative in Europe and possibly the world. Implemented from 2007 to 2010, the programme involved approximately 40,000 learners and over 7,000 staff. Over 12 million British pounds of public money were invested in MoLeNET by the UK government and

participating institutions, including colleges and schools (Attewell et al., 2010). MoLeNET was coordinated by LSN, the same organization that led the EU-funded M-Learning project described above. The programme broadly defined mobile learning as the exploitation of ubiquitous hand-held technologies, together with wireless and mobile phone networks, to support and extend the reach of teaching and learning. Learning activities could take place at any location and at any time, including traditional learning environments, such as classrooms, as well as other locations, including the workplace, home, community sites, and in transit.

MoLeNET supplied funding to a wide variety of practitioner-led action research projects in mobile learning throughout the UK. LSN provided individual projects with technical and pedagogical support, educational materials, professional development for teachers, mentoring programmes, and networking and resource-sharing services. LSN also evaluated the efficacy of individual projects as well as the MoLeNET programme as a whole. Measurements of the impact of MoLeNET after two years found an improvement in learner retention and lower drop-out rates in comparison to national figures, although the researchers were not able to control for many factors (Attewell et al., 2010).

MoLeNET evaluators identified a great number of benefits to mobile learning. Researchers found that with appropriate planning in place, mobile technologies can encourage creativity, innovation and critical thinking in both learners and teachers. The portability inherent in mobile technologies allowed learning to be extended beyond school settings and sometimes into the workplace, which enabled learners to practice real-world problem solving. The flexibility to engage in learning at many different times and locations provided learners with 'choice over and ownership of their learning', while the anonymity of mobile devices provided learners with 'a safe, private and non-judgemental environment' to test ideas and make mistakes (Attewell et al., 2010). At an institutional level, benefits included improvements in learner attendance, retention, and achievement, and an increase in staff motivation and communication. Individual projects also reported closer relationships between ICT and curriculum staff and a new 'buzz of excitement and enthusiasm' within the institutions. According to MoLeNET researchers:

> Handheld technologies proved to be very useful for work-based and vocational learners, particularly in providing more convenient and timely access to learning resources and internet, and assisting with evidence-gathering and assessment. They have also helped to engage reluctant learners and those who have not previously thrived in educational environments. (Attewell et al., 2010, p. 4)

The MoLeNET programme and its government funding have now ended, though some of the programme's services continue to be offered to educational institutions in the UK. However, those services are no longer free but are provided to schools on a subscription basis.

MELAS

The UK government also financed another, smaller-scale mobile learning project called Mobiles Enhancing Learning and Support (MELaS), which was implemented by the University of Wolverhampton in 2007 and 2008. The project was funded by JISC, a government agency offering leadership and support to UK educational organizations, primarily universities and colleges. Mobile learning is part of JISC's e-learning strategy, and the organization has funded a number of similar projects in the UK.

The University of Wolverhampton was among the first institutions of higher education in the UK to experiment with Short Message Service (SMS, or text messaging) for mobile learning. The MELaS project developed an SMS network that could be used by faculty members and students to communicate without the need to exchange mobile phone numbers. In addition to increasing communication among professors and students, the software facilitated formative assessment by allowing professors to quickly solicit feedback from students during class. Students and faculty could also engage in text conferences using the SMS system. In the project's final evaluation, researchers concluded that universities and their students may benefit from the institution-wide use of communication via SMS, and that the use of SMS for teaching and learning, while in need of further refinement, held great promise for education (Brett, 2008).

THE NETHERLANDS

The Netherlands also promotes mobile learning through nationally-funded R&D projects. For mobile learning programmes aimed at tertiary education, funding is providing by the SURF Foundation, which unites Dutch research universities, universities of applied sciences, and research institutions in collaborative projects to improve the quality of higher education and research in the Netherlands. The SURF Foundation has funded two mobile learning projects in the environmental sciences: the Geo-Information for Integrating Personal Learning Environments (GIPSY) programme and the Manolo project (Wentzel et al., 2005). The SURF Foundation also worked with Kennisnet, a public Dutch foundation that supports primary, secondary and vocational schools in the use of ICT, on a mobile learning project called ARena, which focused on augmented reality.

GIPSY

The GIPSY project ran from 2002 to the end of 2003. One of its main objectives was to explore a mobile learning environment by developing two new university courses in which classroom activities were integrated with practical field work through the use of mobile devices. The first course, Introduction to Geo-Information Science, focused mainly on using mobile technologies to support individual learning activities. The second course, Integration for Environmental Policy, employed mobile technologies for group learning and practical field work. Students in the environmental policy course used mobile devices to collect geo-referenced data outdoors, discussed data in teams, processed and analysed data in the classroom using desktop computers, and returned to the field with their mobile devices to recheck the results (Alterra, 2011). The project was a good example of how mobile technologies can be used to facilitate the transition between field work and desktop work.

MANOLO

The Manolo project, which ran from 2004 to 2005, built on the results of the GIPSY project and focused on the integration of electronic, wireless and mobile learning. The project aimed to answer broad questions related to use of mobile technologies for education, such as which educational activities are best suited to mobile learning, how mobile learning affects the role of teachers, and what organizational and ICT infrastructures are necessary to support mobile learning (Alterra, 2011).

Results of the Manolo project indicated that the technological infrastructure was not yet ready for truly mobile learning. At this point the low bandwidth capacity and battery life in mobile devices still posed difficulties when the devices were used for field work. More importantly, the project's evaluators concluded that mobile learning is only effective when it provides a practical and essential service to students. This rule applies not only to mobile learning but to the integration of any technology into education. For example, researchers have found that digitizing and publishing existing, paper-based course materials on the internet has limited influence on the materials' quality or effectiveness, unless this action is linked to a redesign of the course itself. According to Wentzel et al. (2005), the GIPSY and Manolo projects demonstrated that simply offering the same web-based digital material through another modality (the mobile device) adds negligible value to students' educational experiences. On the other hand, researchers found that mobile learning can be used to enhance communication, both among students and between students and teachers, which has a positive effect on community-building and the learning environment in general. Echoing Kukulska-Hulme et al.'s conclusions about EU-funded mobile learning projects, Manolo project researchers concluded that mobile technologies seem to be most effective as tools for communication and collaboration rather than content delivery.

ARENA

In 2008, the SURF Foundation partnered with Kennisnet to support ARena, a project focused on augmented reality. Augmented reality refers to the use of mobile applications and devices to superimpose data, images and other enhancements over a real-world environment. This is usually done through the use of the camera and Global Positioning System (GPS) features available on most smartphones. In the ARena project, students used smartphone cameras to investigate their environment. However, user interaction was not yet perfected and the educational use of ARena was criticized (Ternier et al., 2010).

DENMARK

In addition to the UK and the Netherlands, Denmark is one of the few countries in Europe where the government has shown some interest in mobile learning. The Danish Ministry of Science provided 9 million Danish kroner (DKR), or approximately 1 million euros, to fund a variety of mobile learning pilot projects in 2005 and 2006 (Carvalho et al., 2008). Six out of the eleven projects funded by the Ministry targeted the education sector. These projects used media players and podcasting to: deliver educational content to students in upper-secondary schools and universities; provide visual aids to physicians-in-training; assist reading for students with dyslexia; raise health awareness and combat obesity among young people; and increase flexibility for professionals in continuing education courses by enabling them to access lectures and other course contents from their mobile devices. While Denmark seems to be relatively advanced in the use of mobile learning, there are few published evaluations describing the results of nationally-funded projects.

LOCAL AND PRIVATELY-FUNDED PROJECTS

Apart from the UK, the Netherlands and Denmark, most European countries report only scattered and small-scale activity in mobile learning. Nevertheless, a number of local or privately-funded mobile learning projects have been implemented in Europe, which were not anchored to larger government plans or educational programmes. Many of these projects demonstrate how mobile technologies can used to support interdisciplinary, student-centred, interactive and inquiry-based learning activities. The most relevant of these projects are described below.

LET'S GO

The Learning Ecology with Technologies from Science for Global Outcomes (LET'S GO) programme was an international mobile learning project supported with funds from private sources such as the Wallenberg Global Learning Network, the National Geographic Society, and universities and schools in Sweden and the USA. Active between 2008 and 2011, the project integrated geo-positional data sensing, multimedia communication, information visualization and Web 2.0 tools to facilitate science learning. Participating schools used low-cost laptop computers and mobile phones for field-based learning activities to teach students ecological science and scientific methods. In the design phase, teachers, students, developers and scientists worked together to create inquiry-based, collaborative science tasks. For example, students investigated the water quality of a local stream and recorded data with their mobile devices using mobile sensors, pen-based technologies and geo-tagged images. The data were integrated into an interactive learning environment where students could pose questions, discuss their findings and reflect on what they had learned. Several schools in Sweden and the USA collaborated using an online community platform to share research questions, data and reports.

PI

Personal Inquiry (PI) was another mobile learning project in the UK that encouraged inquiry-based learning through the use of mobile devices. The PI project, which ran from 2007 to 2010 and had a budget of £1.2 million, was led by the University of Wolverhampton together with the Open University and several colleges, secondary schools and museums. The project developed an approach to inquiry-based learning in which students aged 11 to 14 worked together to investigate a science topic by carrying out explorations in classrooms, discovery centres and at home, using computers and mobile technologies. The project aimed to help students better understand themselves and the world around them through a scientific process of gathering and assessing evidence, conducting experiments and engaging in informed debate.

The project designed a computer toolkit to enable inquiry-based learning. Computer programs served as dynamic lesson plans, guiding and supporting students through the inquiry process by providing them with a set of structured activities, data visualizations and means of communication. An authoring toolkit allowed teachers to select, write or modify the computer

scripts in order to monitor and guide student activities. To evaluate this new approach to technology and pedagogy, seven school-based trials were conducted on a variety of topics, including heart rate and fitness, healthy eating, environmental sustainability, microclimates, urban heat islands (UHIs), and the effect of noise pollution on birds.

Results from one trial that compared data with those of a control class showed a positive effect on learning outcomes and the sustained enjoyment of science lessons. Interviews with participants across the trials provided evidence of increased understanding of the inquiry-based learning process by students and teachers alike (Sharples and Scanlon, 2011). Findings from the project suggest that, among other things, teachers can be empowered to create, direct and monitor successful learning activities by providing a sustainable environment in which a sequence of lessons involving the phases of scientific inquiry may be carried out. Children can also learn how 'act like scientists' when they are equipped them with tools to help them initiate, frame and conduct personally meaningful scientific investigations. Finally, comparative studies showed that technology-supported inquiry-based learning activities can produce positive educational outcomes significantly greater than those of a control class; increase and maintain children's enjoyment of science lessons; enable fluid transitions between individual, group and whole class activities; and support learning across formal and informal settings (Sharples and Scanlon, 2011).

LEARNING2GO

A third example of an inquiry-based mobile learning project is Learning2Go, which currently claims to be the largest collaborative mobile learning project for students in the UK. The project, which began in 2003, is coordinated by a team from the Wolverhampton City Council. Learning2Go is developing new ways of delivering learning both in and outside of school. In addition to school-based projects, the programme includes a number of small case studies that aim to demonstrate the feasibility of involving students from many different schools and locations in the same project. These studies also explore methods for incorporating fieldwork and multidisciplinary activities into mobile learning projects. Finally, the case studies seek solutions to actual community problems, such as disparities between socio-economic groups in access to mobile devices and familiarity with mobile technologies (Learning2Go, n.d.). The project is still active, but an overall project evaluation is not yet available.

NINTENDOGS

Nintendogs was a small-scale game-based mobile learning project designed by teachers in two Primary 2 classes (6- to 7-year-old children) in Scotland. The project, which was implemented in 2008, used virtual pets created for Nintendo DS as the context for cross-curricular learning. The game featured a puppy (Nintendog) that players had to care for. Using the Nintendo DS device, students trained their dogs, took them to dog shows and visited the veterinarian. The students developed writing and technology skills by composing stories about their dogs that they posted on a blog, and practiced math skills by calculating how much of their budget they could spend on purchases and vet visits for their pets. Students also developed social skills by engaging in peer tutoring as part of the project.

OTHER PROJECTS

In Switzerland, all fifth-form students (ages 11 to 12) in the Projectschool Goldau primary school were given an Apple iPhone 3G for use in and outside of school as part of their personal learning environment (PLE). This school-based project, which was implemented from August 2009 to July 2011, was supervised and evaluated by the Institut für Medien und Schule (Institute for Media and School, IMS) of the Pädagogische Hochschule Zentralschweiz (PHZ) in Schwyz, a teacher education institute in central Switzerland. The project was sponsored by the telecommunications company Swisscom and did not require any additional expenditures from the school, parents or students.

Sweden has a strong research team at the School of Mathematics and Systems Engineering at Linnaeus University that has been involved in a number of theoretical and practical research projects on the educational use of mobile phones and hand-held computers, including the LET'S GO project described above. The team's main interest is in the development of mobile applications and interactive environments to support collaborative learning.

In Bergen, Norway, tablet devices and e-readers are being used to teach children to read both in and outside of school. Researchers believe that tablet devices may be particularly inspiring for boys. One expert said that she believes that technology itself can motivate boys who lack the patience to read and learn. If this proves to be the case, it may help to reduce the country's achievement gap between boys' and girls' reading skills (bt.no, 2011).

Though not a mobile learning project per se, private educational publishing companies in Denmark created a new publishing model that has had a significant impact on the spread of digital learning materials in Danish schools. It is not uncommon in European countries that schools buy at least some of their textbooks and digital content from private publishers. In Denmark, as in many other countries, the traditional practice has been for private publishers to sell textbooks to schools on an individual basis (OECD, 2009). However, publishers found it difficult to produce and sell digital learning materials in the same way. Profitable products were rare exceptions, and it was not financially feasible for companies to regularly update materials or publish them online. In 1999, a private company offered a solution to this problem by introducing the concept of school subscriptions for digital learning materials. Within a few months other companies followed suit, and the subscription model has since become a widespread practice among Danish publishers and media companies. A substantial portion of these digital learning materials are now being accessed via mobile devices. The founder of Mingoville, a successful private company that provides schools with educational applications, reported that 11% of all Danish students in compulsory schools downloaded a Mingoville mathematics application for the iPhone or iPad between August and December 2011 (S. Stephensen, personal communication, 22 December 2011). In Grade 1 the proportion was 23%. The company's applications for Android smartphones and tablets are not reflected in these statistics, which may mean that the total percentages are even higher.

Finally, scattered projects throughout Europe use mobile technologies to provide additional channels for student-teacher communication and to support or reinforce learning both in and outside of classrooms. Kukulska-Hulme et al. (2011) identified several SMS-based projects that involved the use of text messaging to facilitate both administrative communication between faculty and students – about schedule changes or deadlines – and in-class

communication, such as students using SMS to send feedback to lecturers. In higher education, SMS projects usually make use of students' own mobile phones and existing networks, although cost is often mentioned as a barrier to widespread adoption. In addition, a variety of ongoing projects use podcasts to repeat, summarize or supplement lectures in both university and primary- and secondary-school settings. Other projects have explored how to support and engage university students in off-campus learning activities, such as clinical practice for medical and veterinary students. One small project, called myPad, offers a web-based clinical activity tool accessible through mobile devices. Students use a smartphone with a specialized application to write comments and reflect on cases, capture graphical or audio data, and attach these and any other relevant resources to lecture notes.

MOBILE LEARNING POLICIES

Mobile technologies have undergone enormous changes in the past decade. Where mobile phones once simply enabled users to place voice calls, this functionality is now of almost secondary importance. Owners of smartphones can check their email, log in to social media platforms and download applications to assist them in a wide variety of tasks ranging from getting directions to learning a language or trading stocks in real time. In Europe today, it is rare to find a person without a mobile phone. In 2010 the BBC reported that in Western Europe, mobile phone penetration has reached 130%, and in rapidly developing Eastern Europe overall penetration is not far behind, at 123% (BBC News, 2010). While this data does not mean that every person in Europe has a mobile phone, as some people have more than one device while others have none, it does indicate that mobile phone use is incredibly high throughout the region. Yet despite the prevalence of mobile phones, the use of mobile technologies in education is growing slowly, and, with few exceptions, mobile learning has not yet reached the policy level in Europe.

A review of educational ICT policies in Europe confirms this observation. To date, official documents on the use ICT in education contain few if any references to mobile learning. The Institute for Prospective Technological Studies (IPTS), part of the European Commission's Joint Research Centre and an important voice on the future of ICT in Europe, has not published any reports devoted to mobile learning. In two IPTS foresight consultations in 2010 on the future of education, mobile learning and the use of mobile phones for educational purposes played a very minor role (Redecker et al., 2010; Kirsti et al., 2010). Nor is mobile learning mentioned when Ministries of Education themselves describe their priorities and initiatives. The European Schoolnet's annual series of Insight Reports, drafted on the basis of information provided by European Ministries of Education through a yearly questionnaire, have found that policy-makers are largely unaware of mobile learning activities or uninterested in the use of mobile technologies to support teaching and learning. The attempt to gather data for this paper from the Ministries of Education in the EU and other European countries also proved futile. Researchers have identified a handful of mobile learning research projects referenced in policy documents, in the context of 'key innovative trends', but for the most part mobile learning is absent from the educational agendas in the majority of European countries (Lewin et al., 2011).

Three countries – the UK, the Netherlands and Denmark – are exceptions to this trend. A review of education policies related to mobile learning in these countries may provide models for policy-makers in other countries as well as illuminate some of the challenges involved in addressing mobile learning at the national policy level.

UNITED KINGDOM

From 2000 to 2009, the UK was the most active country in Europe in the field of mobile learning. The government initiated mobile learning programmes in primary and secondary schools as well as universities, and government departments cooperated with telecommunications companies to provide mobile devices and data services to students and teachers. However, governmental interest in mobile learning has waned in recent years. This shift away from mobile learning initiatives appears to be the result of a) the economic crisis, which has forced budget cuts in all sectors, and b) a policy reorientation within the current government. In May 2010 a new UK coalition government came to power with a major programme for educational reform. Pittard and Ley (2011) described how the new policy affects ICT in education:

> The Government believes that the effective use of technology in education is important, but that schools are best placed to make decisions about how to use the resources available to them – including ICT. The Government is committed to devolving power to schools and moving away from top down intervention. Schools will be responsible for choosing and purchasing technology to meet their needs and this will be funded out of their normal budgets. (Pittard and Ley, 2011)

Due to decentralized governance in Scotland, Wales and Northern Ireland, these reforms apply only to England. It remains to be seen if mobile learning efforts can be sustained on a local level once the political support of the central government has been withdrawn, along with most of the funding. The fact that smartphones and tablet devices are becoming less expensive holds promise for the continued development of mobile learning projects in the UK. With increased access to affordable mobile technologies and the knowledge and experience gained from previous mobile learning projects, the UK could prove a fertile ground for bottom-up initiatives in the near future.

THE NETHERLANDS

Although the Netherlands has no national strategy on mobile learning, there are promising mobile learning efforts occurring at the primary, secondary and tertiary education levels throughout the country. The response from the Netherlands to the UNESCO questionnaire was delivered by Kennisnet, a semi-governmental organization dedicated to ICT innovation in education. Through Kennisnet, the Dutch government encourages mobile learning in several ways.

First, to help schools incorporate ICT, including mobile technologies, into education, Kennisnet has issued guidelines that give equal weight to pedagogical vision, teacher expertise, digital learning materials and ICT infrastructure (ten Brummelhuis and van Amerongen, 2010). Second, Kennisnet works with the SURF Foundation, a network of Dutch universities and research institutions, to stimulate the development and use of mobile applications in primary and secondary schools, vocational schools, and higher education. The two organizations implement pilot research projects whose findings are distributed to other educational institutions. Third, Kennisnet organized a contest called Make it Mobile to motivate teachers, students and scholars to develop educational applications for mobile

devices. The use of a competition to drive innovation signals a new approach to mobile learning in Europe. Finally, in 2012 Kennisnet published a report called *Learning with Your Mobile* that gives teachers and school administrators information about how mobile phones can be used to teach English in primary schools. The report advocates using mobile phones to help teachers combine images with speech and adapt their teaching to the needs and levels of their individual students.

Despite these examples, the representative from Kennisnet described the use of mobile technologies in primary and secondary education as low, and stated that the government does not expect mobile learning to become a policy priority in the near future. Since the Dutch government has decentralized control over ICT use in schools, the role of mobile devices in education is determined largely by school administrators, teachers, parents and students. The situation may differ dramatically from school to school in the Netherlands, with some schools actively promoting mobile learning and others banning mobile devices outright.

DENMARK

Denmark is one of the few, if only, countries in Europe with national policy documents that directly address mobile learning. In 2009, researchers at the government's national e-learning centre published guidelines on mobile learning, with the goal of providing educators and other interested parties with an introduction to the use of mobile technology in schools (Bjerre et al., 2009). The guidelines describe, for example, the technical capabilities of smartphones, and how podcasting can be used to distribute educational materials, facilitate group work and support student presentations. In addition to these guidelines, the Danish web portal for teachers and students (www.emu.dk) also contains a section on mobile learning where teachers can find pedagogical advice on how to use mobile devices to support learning in different subject areas.

In August 2011 the Danish government issued a new ICT strategy for the country, called the Digital Path to Future Welfare, which was revised in January 2012 by the incoming Government (Regeringen/KL/Danske Regioner, 2011; 2012). The strategy, which is part of a broader plan covering all aspects of Danish society, calls for an investment of DKR 1,500 million (around €200 million) in ICT activities in schools over the next four years, with DKR 500 million (€67 million) provided by the state and the remainder by Danish municipalities. Part of this investment will be dedicated to developing digital learning materials and creating more efficient online and mobile platforms to distribute them. The Danish government plans to work actively to ensure that market-based and user-friendly development takes place before the end of 2012. It is expected that the forthcoming platforms will function much like today's 'app store' for smartphones, allowing teachers and students to quickly and easily download applications related to specific subjects areas and learning goals (Regeringen/KL/Danske Regioner, 2012). The new strategy also dictates that all students in public schools must have access to an individual computer and wireless internet in classrooms by 2014. This target can only be reached if the majority of students bring their own laptop, tablet or smartphone to school, with schools supplying equipment for individual students who do not have their own devices. A new secretariat for the implementation of the ICT strategy has been organized within the Ministry of Education and, according to the

Education Manager at UNI-C, the Danish ICT Centre for Education and Research, government agencies are currently awaiting instructions for implementing this strategy (L. Højsholt-Poulsen, personal communication, 16 December 2011).

The new Danish ICT strategy includes two approaches to mobile learning that cannot be found elsewhere in Europe at this time. The first is the push to establish a market for digital learning materials similar to 'app stores' for smartphones and tablet devices. The second is the active encouragement of BYOT programmes, in which students bring their own mobile devices to school to help achieve a 1:1 (one device per student) learning environment. On a local level, the Danish city of Odder announced in September 2011 that the city will invest in tablet devices for all teachers and students. The city may be the first municipality in Europe to do so.

FACTORS INFLUENCING MOBILE LEARNING

DRIVERS

The primary drivers for mobile learning are the low cost of mobile devices, the increasingly diverse functionalities mobile technologies provide, and the proliferation of powerful hand-held devices such as smartphones and tablets among students in Europe.

LOW COST

As the costs of smartphones and tablets continue to drop, it is likely that schools will become more interested in using these mobile technologies to create a 1:1 learning environment for students. Already, a Google search for 'iPads in school' conducted in different languages reveals a number of small-scale projects that use this approach. Often these projects are initiated by individual teachers and comprise only one or two classes or, at most, a single school. This scenario resembles the situation in the late 1990s when the internet was first introduced into European schools, and it is possible that mobile learning will expand along similar lines as mobile devices become more affordable and accessible.

DIVERSE FUNCTIONALITIES

The growing functionalities offered by mobile devices, as well as improvements in interface design, processor speed, battery life and connectivity bandwidth, also encourage their adoption in education. Smartphone applications are already frequently used by schools to track students' schedules. A large number of schools also send text messages to parents regarding emergencies, truancy and school events, among other things. The use of mobile phones for administrative purposes is accepted as uncontroversial, which may pave the way for their acceptance in classrooms.

WIDESPREAD AVAILABILITY

Finally, the growing number of students who own an advanced mobile device may lead to more schools adopting a BYOT approach to mobile learning, in which students bring their own mobile phones, tablets or laptops to school. Denmark recently introduced BYOT as a national policy and has required schools to provide wireless internet access in all classrooms by 2014 to allow students to use their devices for learning activities throughout the day. Anecdotal evidence suggest that the BYOT approach, combined with an open Wi-Fi network, is being discussed by ICT specialists in several European schools as a practical strategy for creating a 1:1 learning environment. However, the development of any BYOT programme

must include considerations about equity, since not every student has access to a smartphone or equivalent device. It is critical that BYOT programmes not widen the digital divide between students from different socio-economic backgrounds. While schools implementing BYOT strategies pledge to provide devices to students who do not have their own, sceptics argue that there is a stigma attached to borrowing school devices. Proponents of the BYOT approach claim that the negative impact of this stigma is relatively small compared to the educational advantages of giving every student access to a powerful mobile device. As schools in Europe begin to implement BYOT programmes, the results will need to be closely monitored to ensure the initiatives are ameliorating rather than exacerbating social inequities.

BARRIERS

The two main barriers to mobile learning in Europe are a lack of policy support and governmental investment in mobile learning, and negative social attitudes among policy-makers, parents and teachers about the use of mobile phones in schools.

LACK OF POLICY SUPPORT

With the exception of the UK, the Netherlands and Denmark, few countries in Europe have included mobile learning in their national education agendas, and even these countries have not managed to sustain mobile learning efforts on a nationwide scale. Over the last decade the European Commission has taken a leadership role in stimulating R&D on mobile learning in Europe and has been successful in advancing the concept of mobile learning in general; however, none of the EU-funded projects described in this review have been scaled up to encompass an entire country, and the European Commission has not issued any guidelines for the effective use of mobile technologies in teaching and learning. While educational researchers have produced substantial evidence of the potential benefits of mobile learning, their research has not yet had an impact on policy. The Mobile Technologies in Lifelong Learning (MOTILL) initiative, an EU-funded mobile learning research project, confirmed this observation, concluding that although the scientific community has highlighted mobile learning as an effective way to promote lifelong learning, national policies have not taken any significant steps to integrate lifelong learning and mobile technologies (Arrigo et al., 2010).

It is difficult to determine exactly why there is such a lack of support for mobile learning at the policy level. It may be that most countries no longer treat ICT in education as a special policy area. In the 1990s and early 2000s, it was common for European countries to earmark money for specific ICT programmes for schools. Today, however, these programmes are often viewed as part of general education policy rather than a separate area of concern (EACEA/Eurydice, 2011). Such integration is a natural development, but it is likely to reduce the attention given to educational ICT issues at the regional and national levels. Moreover, the current economic crisis and subsequent shortfalls in public budgets may have delayed or stifled many ICT and mobile learning initiatives that might otherwise have enjoyed government support. Another reason for the absence of mobile learning on educational agendas in Europe may simply be a lack of knowledge and awareness of mobile learning among policy-makers. Although EU-

funded research projects are always expected to include a plan for disseminating their results, researchers seldom manage to capture the interest of national decision-makers or the public.

It is also possible that few teachers or school administrators have ever asked for political support to integrate mobile technology into teaching and learning. As mobile technologies and internet access become less expensive in many European countries, it is much easier for schools to initiate mobile learning projects on a local level, without support from the national government or the EU. European policy-makers might agree with the UK and Dutch governments that mobile learning efforts are best left to schools and local authorities. While it may be true that local educators are best-positioned to make decisions about mobile learning implementation at the school level, government policies are still needed to ensure the equitable development and distribution of mobile learning resources throughout a country.

NEGATIVE SOCIAL ATTITUDES

The second barrier to mobile learning is negative social attitudes held by policy-makers, parents and teachers about the use of mobile phones in schools. Mobile phones are widely considered to be disruptive to education and their use in school is restricted in many European countries. Parents and teachers see students playing games and texting on mobile phones and often assume that the devices are little more than distracting toys with limited educational value. Many parents and educators also worry that mobile phones enable inappropriate behaviours like cheating and cyber-bullying. The Eurydice network, which collects and compiles data on education and training in Europe, published a report in 2009 on the safe use of mobile phones (EACEA/Eurydice, 2010). The report stated that cyber-bullying in schools has become a topic of growing concern in the last few years.

Because of these social attitudes, policy-makers may be reluctant to enact policies that promote mobile learning, and some governments may actually oppose mobile learning efforts. According to the survey response provided by the representative from the Ministry of Education in France, the French government is actively trying to prevent the use of mobile phones in primary and secondary education. The representative cited a 2010 law that forbids the use of mobile phones in kindergarten, primary school and secondary school (French Education Code, Law no. 2010-788, Article L 511-5, 12 July 2010). MP3 players can be used for podcasting in connection with language learning only. The French respondent also stated that many parents are against the use of mobile phones in primary and secondary education because of fears about radiation from the phones. While preventative efforts in other countries are less extreme, many policy-makers throughout Europe discourage or attempt to ban the use of mobile phones in education. It is unclear to what extent positive examples of mobile learning are capable of changing negative social attitudes about mobile phones.

SUCCESS FACTORS

Two factors appear to be critical in creating an educational and social environment conducive to mobile learning in Europe: a blended approach that mixes mobile and fixed technologies, and the widespread dissemination of research and evaluative data.

BLENDED APPROACH

A review of relevant mobile learning initiatives in Europe demonstrates that none of the successful projects used mobile devices by themselves. The most effective programmes blended mobile devices with fixed technologies such as desktop computers, with the choice of which technology to use varying according to the learning context. Smartphones and other hand-held devices should be seen as complements to desktop computers or laptops, rather than replacements. Without downplaying the role of mobile technologies in making learning more accessible and flexible, it is important to note that mobile learning projects do not need to be limited solely to activities that use a mobile device in order to enhance student learning.

DISSEMINATION OF DATA

If overarching programmes and individual projects in mobile learning are to be successfully designed and implemented, research and evaluative data must be shared with as many stakeholders as possible – from regional, national and local policy-makers to school administrators, teachers, parents and students. In particular, the insight that mobile and fixed technologies are complementary needs to be disseminated on the national level, where programmes are designed, as well as on the local levels where the individual projects are carried out.

POLICY RECOMMENDATIONS

When analysing initiatives and policies on mobile learning in Europe, a distinction made by Looi et al. (2011) is useful. They characterize three levels in the education sector: macro, meso and micro. At the macro level are Ministries of Education and policy-makers, who dictate plans for nationwide implementation and devise strategies for sustainability and scalability. On the meso level are research institutions, telecommunications providers, information technology (IT) companies and non-governmental organizations (NGOs), who produce research, advise policy-makers, and provide technology and infrastructure. At the micro level are school leaders, teachers, parents and students, who enact policies and programmes in schools and classrooms.

Until recently almost all mobile learning initiatives in Europe were initiated on the meso level. These meso-level initiatives are usually R&D projects led by researchers, technology companies and to some extent NGOs. In the last two years, the meso-level projects have tended to be complemented by a number of small-scale projects developed at the micro level. However, with the exception of the MoLeNET programme in the UK, the macro level has remained mostly inactive in the field of mobile learning.

The risk of having an inactive macro level in the area of mobile learning is that growing inequalities on the micro level between regions and local actors will result. Without guidance and stimulating policies from governments or government agencies, the digital divide may widen as some schools, educators and local authorities establish productive partnerships with actors on the meso level, while others remain static. On the other hand, there is also a risk in soliciting detailed regulatory policies from the macro level. In field where technologies change rapidly and pedagogy is constantly transforming in response to new research and development, tight government guidelines may slow or stifle innovation. The challenge for policy-makers is to guide micro-level actors and ensure equity without suppressing creativity or being overly restrictive. The following recommendations may provide some guidance on navigating this difficult terrain.

1. ***Provide a macro-level framework for mobile learning on the meso and micro levels***
   There is presently a lack of interconnection between the macro level, on the one hand, and the meso and micro levels on the other. This deficiency needs to be addressed by developing a macro-level framework for fostering innovation in mobile learning on the meso and micro levels. As is the case for ICT and education in general, it may be possible to benefit from the experience of other countries and borrow successful policies. Networks like the European Schoolnet, with its thirty member countries, offer opportunities for communication and resource-sharing that may be useful in designing macro-level policies for mobile learning.

2. ***Identify innovative projects and best practices for scaling up***

Traditional approaches to ICT development have typically focused on identifying successful small projects and scaling them up to the national level. Criteria for successful projects include four elements that should be in place in balanced proportions: infrastructure, competence development for teachers, digital learning materials and a pedagogical vision (ten Brummelhuis and van Amerongen, 2010). Digital learning materials may continue to be developed on a local level: in 2012, the Center for Mobile Learning at the Massachusetts Institute of Technology (MIT) plans to make available a simple open-source programming tool for developing Android mobile applications. This free service will make it possible for teachers and students, perhaps in cooperation with technical schools, to develop educational applications for mobile devices that will meet their local needs. The other three elements, however – infrastructure, professional development and a unified pedagogical approach – should be scalable and sustainable on a national level.

3. ***Capitalize on the potential of informal learning in a formal learning environment***

Several of the mobile learning projects described in this paper have shown that mobile devices can be used for learning in everyday situations on an as-needed basis. Students may use their mobile phones outside of school to look up the definitions of words, play math games, find information about a place of interest, or listen to an audiobook or a speaker describing an object in a museum. To maximize the potential of mobile technologies to enhance education, policy-makers need to imagine how these types of informal learning activities can be used in formal learning environments like schools and universities. Mobile devices offer opportunities for new forms of learning through contextual support for field trips, location-based guides and environmental studies, among other things. The main barriers to developing these new modes of learning are not so much technical as social. According to Sharples (2009), we have 'little understanding of context and learning outside the classroom, and even less about how this can be supported through new mobile technologies'. Gathering information about learning outside of traditional classroom settings is a key step in adapting mobile technologies to school-based education.

4. ***Look to previous strategies for ICT in education***

In terms of policy, mobile learning should follow the same recommendations issued for the integration of ICT into education, namely:

- Permit the use of technology in schools – in this case, mobile phones and other hand-held devices
- Develop pedagogical guidelines for teachers
- Develop technical standards for learning materials so they can be used on several platforms, such as computers, interactive whiteboards and mobile devices
- Support the development of digital learning materials and create efficient platforms and channels for their distribution
- Evaluate programmes and disseminate information about best practices

CONCLUSION

In light of the drivers and barriers to mobile learning and the policy challenges described in the sections above, there seem to be three possible scenarios for mobile learning in Europe in the near future. First, governments and policy-makers may treat mobile technologies as disruptive devices that should be banned from schools. This is currently the case in France, and several other countries in Europe may have similarly restrictive policies. Second, policy-makers may view mobile learning as another aspect of ICT in education, considering mobile technologies as one more element in a technological toolkit that can be used to support learning both in and outside of school. This is currently the case in Denmark and the Netherlands. In this scenario, mobile learning has the potential to transform education, but it is expected to do so within limits set by policy-makers. The third option is to consider mobile learning a revolutionary practice. As Traxler (2009) wrote, 'Mobile learning is certainly not just the conjunction of "mobile" and "learning".' Rather than being another aspect of ICT in education, mobile learning might be understood to carry the potential to change learning in profound ways.

The future of mobile learning depends largely on the level of social acceptance it receives. In the worst-case scenario, policy-makers and schools will be unable or unwilling to adapt to new patterns of learning and social interaction outside the classroom, while young people see what they learn in school as increasingly irrelevant to their skills and interests. Technology will be the battleground for this conflict, with schools banning powerful tools for personal learning and social networking at the same time that they struggle to provide computers that deliver an outdated form of teaching (Sharples, 2009). Alternatively, policy-makers and schools could embrace the new opportunities that technological development opens up, making use of the numerous examples of good practice provided by researchers and pilot projects. In such a scenario mobile technologies could be used to establish continuity in learning experiences across different pedagogical contexts, helping students align the learning they engage in outside of school with the learning they do in school. Kukulska-Hulme et al. (2011) used the term 'seamless learning' to describe these new situations. Seamless learning allows students to learn whenever and whenever they are curious, in school settings and beyond, and to switch from one learning context to another easily and quickly using their personal mobile device as a mediator. These contexts include learning independently, studying with a partner, working in small groups, or being part of a large online community with the potential involvement of teachers, relatives, experts and members of other supportive groups in places such as classrooms, parks and museums. This wide spectrum of alternate modes of learning holds potentially unlimited possibilities for revitalizing education in Europe.

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APPENDIX A: EU Member States

Member State	Year of Entry
Austria	1995
Belgium	1952
Bulgaria	2007
Cyprus	2004
Czech Republic	2004
Denmark	1973
Estonia	2004
Finland	1995
France	1952
Germany	1952
Greece	1981
Hungary	2004
Ireland	1973
Italy	1952
Latvia	2004
Lithuania	2004
Luxembourg	1952
Malta	2004
Netherlands	1952
Poland	2004
Portugal	1986
Romania	2007
Slovakia	2004
Slovenia	2004
Spain	1986
Sweden	1995
United Kingdom	1973

In addition to the EU member states, Norway, Iceland and Israel are also members of the European Schoolnet and received the questionnaire.

APPENDIX B: Questionnaire

Introduction

UNESCO is committed to exploring the opportunities provided by mobile technologies, particularly mobile phones, to extend access to education and quality learning experiences, consistent with the goals of Education for All (EFA). A major agreement between Nokia and UNESCO has provided the opportunity to explore this issue in more detail, having in particular two objectives:

1. To provide national governments and education institutions with policy recommendations that can enable and support education delivery through the safe, affordable and sustainable use of mobile technologies

2. To articulate a vision for the role of mobile learning in society by 2030, setting an ambitious vision of the future to which policy-makers can aspire.

In this context, a first step consists of taking stock of how governments around the world see mobile learning in a wider policy context and how they are currently supporting its development. This stock-taking exercise takes the form of a series of regional reviews for which the current questionnaire has been developed.

UNESCO understands that mobile learning, in particular learning through mobile phones, might not be sufficiently developed everywhere as to generate a set of dedicated national, regional or local policies. Even in this scenario, the answers to this questionnaire will provide an opportunity to better understand the policy context for mobile learning.

UNESCO takes this opportunity to thank you for your time and support. Should you need additional details about how UNESCO promotes mobile learning or wish to get in touch with the unit responsible for this work, please email Francesc Pedró, chief ED/PDE/PAD, at f.pedro@unesco.org.

Instructions

1. You are invited to include in your response additional documents or links to information on the web. Please specify the questions the documents address, as well as relevant page numbers.

2. Feel free to give further explanation or comments to your replies in the area reserved for that after each question.

3. Do not hesitate to tick off multiple answers when appropriate or necessary.

Question 1

Is your government actively supporting the use of mobile phones in education?

- ☐ Yes, though initiatives by institutions and engaged individuals
- ☐ Yes, through specific projects or programmes with dedicated public funding
- ☐ Yes, through specific projects or programmes with dedicated private funding
- ☐ Yes, through government initiatives including specific measures and incentives
- ☐ Yes, otherwise. Please specify:
- ☐ No, not really
- ☐ Do not know

If you have responded YES, please provide some contact details or web pages below, or attach relevant documents that could provide additional details about the programmes or projects being carried out, what agency or organization is leading the effort, more information about the sources of funding, etc.

Are you aware of any initiatives promoted by local governments that actively support the use of mobile phones in education?

YES
NO

If YES, please identify the local government, primary contact, email address and brief description of the programme, subject area(s) and grade level(s).

Question 2

If your answer to Question 1 is YES, can you specify the level of activity for each of the following educational subsectors?

- Low: there is some activity, but it is just in an early stage of development, probably with scattered activities rarely going beyond one particular school or institution.

- High: there are programmes or activities that have reached a critical mass of schools or learners, as to become publicly noticeable.

- Very high: there are programmes or activities that can be said to be widely used by schools or learners.

	Non-existent	Low	High	Very high
Primary education (ISCED 1)	☐	☐	☐	☐
Lower secondary (ISCED 2)	☐	☐	☐	☐
Upper secondary (ISCED 3)	☐	☐	☐	☐
Postsecondary/non-tertiary (ISCED 4)	☐	☐	☐	☐
Tertiary (ISCED 5)	☐	☐	☐	☐

*ISCED = International Standard Classification of Education

Do you have any additional comments?

Question 3

If your answer to Question 1 is NO, are there indications that your country will become an active supporter of mobile learning in the near future?

- ☐ Yes, by explicitly stimulating initiatives in this field
- ☐ Yes, by introducing subsidy programmes or project funding
- ☐ Yes, by developing a dedicated governmental action plan
- ☐ Yes, otherwise
- ☐ No, not yet but it could well develop into a priority in the medium-term future
- ☐ No, we do not expect this to be or to become a priority

Do you have any additional comments?

Question 4

If your answer to Question 1 is NO, is your government actively trying to prevent the use of mobile phones in education?

No:

Yes:

Don't know:

If YES, does this policy refer to any particular (or all) of the following educational subsectors?

Primary education (ISCED 1)	☐
Lower secondary (ISCED 2)	☐
Upper secondary (ISCED 3)	☐
Postsecondary/not tertiary (ISCED 4)	☐
Tertiary (ISCED 5)	☐

*ISCED = International Standard Classification of Education

Can you please specify the nature of the policy or the action(s) that are being taken?

Question 5

Who are the main stakeholders involved in the use or prevention of the use of mobile phones in education in your country?

Stakeholder	Use	Prevention of use	Not applicable
The government			
Regional educational authorities			
Local educational authorities			
Telecom providers			
Mobile phone / hardware makers			
Teachers			
Students			
Parents			
Education specialists / scholars			
Other (please specify)			

Question 6

There are social, economic and political factors that influence public policies and social attitudes around mobile learning. Depending on the circumstances, the same factor could be seen at one point as a driver and at another point as a barrier. This could be the case, for example, regarding connectivity costs, teacher training, policy support, etc.

With reference to your country and the use of mobile phones in education, what would you consider to be the main:

Drivers:

Enablers:

Barriers:

Success factors:

Question 7

Is there reference to the use of mobile phones in education in any government or state/regional educational strategy, educational technology plan or similar documents?

No:

Yes. Please specify the title of the document and the page reference:

Policy document 1:

Policy document 2:

Policy document 3:

Please specify the nature of the reference:

Policy document 1:

Policy document 2:

Policy document 3:

Question 8

In your country, does the education ministry (or another public agency from the education sector or a different area of government) have a clear strategy or policy regarding the use of mobile phones in education?

- ☐ Yes, in operation
- ☐ Yes, in development
- ☐ Not yet, but under discussion
- ☐ No, with no preparations yet
- ☐ No, we do not anticipate this in the near future
- ☐ Don't know

Question 9

Please identify and describe any government-level policies or sample policies disseminated to the local governments or schools regarding the use of mobile phones.

Question 10

Why is learning with mobile phones a consideration or an option in your country?
And, if learning with mobile phones is not actively encouraged – if it is not an option – why not?

Question 11

Do you have any additional comments?

Today there are over 5.9 billion mobile phone subscriptions worldwide, and for every one person who accesses the internet from a computer two do so from a mobile device. Given the ubiquity and rapidly expanding functionality of mobile technologies, UNESCO would like to better understand their potential to improve and facilitate learning, particularly in communities where educational opportunities are scarce.

This paper examines illustrative mobile learning initiatives and their implications for policy in Europe. It reveals important lessons for policy-makers and other stakeholders seeking to better leverage mobile devices for education. Four additional papers review mobile learning efforts in other regions of the world: Africa and the Middle East, Asia, Latin America, and North America. A 'Global Themes' paper synthesizes findings running across the five regional papers.

Complementing the initiative and policy papers is a separate set of six papers which explore how mobile technologies can assist teachers. These papers are also organized geographically.

Two 'Issues' papers will be added to the Series later in 2012. One will anticipate the future of mobile learning, and another will articulate considerations for creating policy environments in which mobile learning can thrive.

Collectively and individually, the papers in the UNESCO Working Paper Series on Mobile Learning scan the globe to illuminate the ways in which mobile technologies can be used to support Education for All Goals; respond to the challenges of particular educational contexts; supplement and enrich formal schooling; and, in general, make learning more accessible, equitable and flexible for students everywhere.

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