MLEARN

Training teachers to use mobile (hand held) technologies within mainstream education
Project N. 539357-LLP-1-2013-1-UK-COMENIUS-CMP
Grant Agreement 2013 3306 /001-001

Lifelong Learning Programme

This project has been funded with support from the European Commission.
This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained herein.

Centre for Technology Enhanced Learning | LANCASTER UNIVERSITY

Research Report
Mobile learning and information and communication technology teacher training in MLEARN partner countries

Don Passey
Professor of Technology Enhanced Learning

Joana Zozimo
Research Associate

Centre for Technology Enhanced Learning
Department of Educational Research, Lancaster Universsity

Acknowledgements
The authors would like to thank most sincerely the partners and contacts who provided invaluable evidence for, and comments on an earlier draft version of, this final report: Fondazione Mondo Digitale (Italy); Action Synergy S.A. (Greece); Bloemcampschool (The Netherlands); Hamstead Hall Community Learning Centre (UK - England); and Kennisnet (The Netherlands). Thanks are extended also to The Titan Partnership Ltd. for their continuing support for the research through their management of the project.

Contents

1. EXECUTIVE SUMMARY

Background

- This report has been produced by the Department of Educational Research at Lancaster University for the MLEARN project, to support the development of a training programme for in-service teachers focusing on mobile learning through appropriate pedagogic uses of mobile or handheld technologies. The MLEARN project, a European Union (EU)-funded project, will explore and promote teacher development of mobile learning practices in four member states – The Netherlands, the UK (England), Greece and Italy.

Handheld devices and learning support

- A range of mobile learning projects have already been run across Europe and outside Europe, and lessons learned and limitations arising have been identified in these cases.
- A review of research literature indicates that mobile learning practices can be developed and focused to support: behaviouralist; constructivist; situated; collaborative; informal and lifelong; and learning and teaching support.
- Greater accessibility to information the provision of information in context are recognised as benefits associated with mobile learning. These contexts may be spatial/location, temporal, social, or access/technical in nature. Mobility, face-to-face social interactions, uses of authentic teaching and learning materials, constant alertness, the focus gained from mobile learning moments, and learning and time convenience are important features associated with activities in these different contexts.
- Developing practices concerned with the concept of interwoven learning interactions has been highlighted as being possible when using handheld devices in learning activities and in series of these activities. Informality and ownership are factors that influence uses of mobile technologies and the ways that activities can interweave and be interwoven.
- Benefits that can arise from uses of handheld devices include alertness, choice of student preferences, saving time, broadening assessment tasks, supporting special educational needs, language learning support, all enhancing pedagogical value.

Teacher training and the development of handheld device pedagogies

- Even so, access to and numbers of courses that focus specifically on uses of handheld devices in initial and in-service teacher training are limited, and information about these opportunities is not necessarily widely accessible in all countries. Currently, the specific mention of handheld devices in national curriculum and school guidance documents is minimal.
- Although the curriculum and its intentions in Italy support practices that lend themselves to uses of handheld devices, the penetration of ICT in schools is generally low, and teachers may not be trained in the use of these or other related ICT facilities.
- While uses of ICT are supported and encouraged in schools in Greece, the use of mobile telephones is not allowed. Devices for uses in schools in Greece, therefore, need to conform to handheld computer specifications, while facilities for the capture and editing of sounds or images may need to be disabled.
- Many teachers in schools across the Netherlands use ICT to support teaching and learning. There are agencies in place that support ICT developments and the promotion and dissemination of ICT practices, including those with handheld devices.
- In England, ICT and computing are, or soon will be, specified in curriculum documents that are statutory. Teachers are asked to adopt pedagogies to match the needs of their classes and pupils, using appropriate ICT and handheld technologies.

Developing appropriate pedagogical practices through training

- Research reviews indicate that training should provide, in as fully a contextualised and integrated way as possible, a focus on three interconnected elements: technological knowledge (what the device can do and how to use it); content knowledge (what subjects and topics can be addressed

using the devices and their applications); and pedagogical knowledge (how this is done through the development and deployment of appropriate teaching and learning activities).

- When using handheld devices there is a need to consider that the learning environment tends to be expanded beyond the classroom, due to the portability features of the devices. Similarly, features of these devices strongly support aspects of communication and their links to teaching and learning. Already, some schools and agencies have explored the ways handheld devices can support pupils with special communication needs.
- Teachers have used mobile devices in curriculum activities that involve and support practices concerned with research, capturing and using imagery and video clips, presenting to teachers and peers, discussing captured and presented work with teachers and peers, recording and sharing ideas with peers, providing anonymous feedback, pupils creating their own notes and books in multimodal formats, discussing strengths and weaknesses in presented work shared by pupils, creating videos for presentation to wider audiences, presenting perfect models or techniques, organising notes and work, and pupils recording video clips of lessons for later playback.
- Training events need to identify the many Apps that can meet specific subject and topic needs. Teachers also need to be aware of both the benefits and limitations of handheld devices for teaching and learning.
- Activities worth developing as case studies for teacher training events are:
    - "Review and reflect", where pupils capture audio, imagery and video during lessons, use these in plenary sessions to reflect on what has been covered, consider the key elements learned, how these fit into wider subject or topic pictures, and how ideas might be used or taken further outside the classroom.
    - "Think forward", where pupils access future topic material via the Internet and capture relevant thoughts or ideas to contribute to discussions or presentations in class or through on-line discussions. Pupils can be encouraged to use the handheld devices at home to research topics for themselves.
    - "Listen to my explanations", where pupils record audio when they are completing homework assignments and these verbal explanations are listened to and marked by teachers.
    - "Snap and show", where pupils capture imagery, which is downloaded to a server and accessed through a computer or interactive whiteboard screen, for wider pupil discussion, perhaps made accessible to parents so that they can see and discuss events that have happened in school.
    - "This is what I've done and how I've done it", where pupils create presentations of how they have used mobile technologies to tackle particular activities, which are recorded and made accessible on appropriate web-sites for teachers and parents to see. Observing other pupils' stories and reports, pupils can include sound recordings of their own voice as well as text and pictures to form multi-modal texts.
    - "Tell me how I could improve this", where pupils can share their work in multimedia formats with peers, mentors, teachers or trusted adults in order to seek comments, evaluative feedback, assessments of their work, and ideas to improve their work.

2. INTRODUCTION

This report has been produced for the MLEARN project, to support the development of a training programme for in-service teachers, focusing on mobile learning through appropriate pedagogic uses of mobile or handheld technologies. The MLEARN project, a European Union (EU)-funded project, will explore and promote teacher development of mobile learning practices in four member states – the Netherlands, the UK (England), Greece and Italy. The project will consider how teachers can develop and use pedagogies to support activities with learners using handheld or mobile devices in and outside classrooms. The Department of Educational Research at Lancaster University has been commissioned to undertake this background research to support the project development.

This current review seeks to better understand how relevant teaching practices, methods and pedagogy are used with handheld devices and how these can support or enhance learning. It is based on evidence gathered from partners and contacts, from country and EU sources, and from a detailed review of a specifically selected number of published papers from 2008 until 2013. As a whole, this report offers a short snapshot, to give background information for the MLEARN project, pointing out future avenues for training development and research.

The reports seeks to contextualise teacher training development of mobile learning in terms of current research and practice, considering both mobile learning and information and communication technology (ICT), particularly with regard to deployment and practices of teacher training in each partner country (Italy, Greece, the Netherlands and the United Kingdom - England).

This research report presents outcomes and recommendations, based on the specification produced for the first transnational meeting. The content considers and includes:

- A review of current initial teacher training programmes, whether these include training to use ICT in the classroom, together with indications of its overall content, with evidence gathered from:
    - Initial and email discussions and responses with partners and contacts.
    - Identification of key institutions with details gathered through a survey instrument.
- A review of current in-service training and continuing professional programmes (CPD) for teachers with regard to ICT in the classroom and what the content is, with evidence gathered from:
    - Initial and email discussions and responses with partners and contacts.
    - Identification of key institutions with details gathered through a survey instrument.
- Identification of best practice with regard to use of handheld technologies, from existing and published research, supported by knowledge from the partners, with evidence gathered from:
    - Initial and email discussions and responses with partners and contacts.
    - Identification of key institutions with details gathered through a survey instrument.
    - A selected literature review.
- Identification of key obstacles to using handheld technologies in the classroom, with evidence gathered from:
    - Initial and email discussions and responses with partners and contacts.
    - Identification of key institutions with details gathered through a survey instrument.
    - A selected literature review.
- A presentation of findings, both as an overview and in the context of each country.

3. MOBILE LEARNING AND INFORMATION AND COMMUNICATION TECHNOLOGY IN TEACHER TRAINING

Teaching practices and mobile learning

In considering teaching practices and mobile learning, Naismith et al. (2004) draw on an activity-centred perspective; they consider new practices against a number of existing educational or learning theories. Their report reviews six broad theory-based categories of activities and identifies new mobile learning practices in each one of them.

1. Behaviourist

In terms of the behaviourist paradigm, learning is thought to be best facilitated through the reinforcement of an association between a particular stimulus and a response. Applying this to educational technology, computer-aided learning can be considered as the presentation of a problem (stimulus) followed by the contribution on the part of the learner as the solution (response). This perspective supports practices that promote learning as a change in learners' observable actions. In mobile learning contexts, examples from classroom response systems include *Classtalk* (Dufresne et al., 1996 cited in Naismith et al., 2004) as well as content delivery via text messages to mobile telephones (Thornton and Houser 2004, cited in Naismith et al., 2004).

2. Constructivist

In terms of the constructivist approach, learning is considered to be an active process in which learners construct new ideas or concepts based on both their current and past knowledge. This perspective supports activities in which learners actively construct new ideas or concepts based on both their previous and current knowledge. Using this approach, learners are encouraged to be active *constructors of knowledge* (Naismith et al., 2004, p. 2) with mobile devices embedding learning practices in a realistic context at the same time as offering access to supportive tools. In the context of mobile learning, examples include learning practices termed "participatory simulations" such as *Virus Game* (Collella, 2000 cited in Naismith et al., 2004). More recently research on "interwoven learning interactions" has used the notion of constructivism to connect social interactions and mobile learning practices (Ting, 2013, p. 2).

3. Situated

Situated learning posits that learning can be enhanced by ensuring that it takes place in an authentic context. Mobile devices are especially well suited to uses of context-aware applications simply because they are available in different contexts, drawing on those contexts to enhance learning. The museum and gallery sector has been at the forefront of context-aware mobile computing by providing additional information about exhibits and displays based on the visitor's location within their buildings. In mobile learning contexts, examples include mobile systems that situate learning in authentic contexts, such as *MobLearn* (Londsale et al., 2003, 2004 cited in Naismith et al., 2004) and multimedia tours offered at the Tate Modern (Proctor and Borton, 2003 cited in Naismith et al., 2004).

4. Collaborative

Collaborative learning has been studied through research on computer-supported collaborative work and learning and focuses on the role of social interactions in the process of learning. This perspective supports activities that promote learning through social interaction. Although the concept of collaborative learning is based on the role of social interactions in the process of learning, other theories have been developed around thinking process in learning situations, such as activity theory (Engestrom, 1987 cited in Naismith et al., 2004) and conversational theory (Pask, 1976 cited in Naismith et al., 2004). The latter is particularly relevant to collaboration using mobile devices as it describes learning in terms of a conversation between different systems of knowledge, which is particularly pertinent in the context of classroom use. In mobile learning contexts, examples include mobile computer-supported collaborative learning (MCSCL) by

providing another means of coordination without attempting to replace any human-human interactions, opposed to online discussion boards where face-to-face discussion is substituted (Zurita and Nussbaum, 2004 cited in Naismith et al., 2004).

5. Informal and Lifelong

Research on informal and lifelong learning recognises that learning happens all of the time and is influenced both by our environment and the particular situations we are faced with. Informal learning may be intentional; for example, through intensive, significant and deliberate learning, or it may be accidental, by acquiring information through conversations, newspapers or observing the world. This perspective contains activities that support learning outside a dedicated learning environment and formal curriculum. Such a broad view of learning takes its focus outside the classroom and, for this reason, particular considerations need to be taken if such practices are to be developed and used with pupils.

6. Learning and teaching support

This perspective considers activities that assist in the coordination of learners and resources for learning activities. Education as a process relies on a great deal of coordination of learners and resources. Mobile devices can be used by teachers for support practices such as attendance reporting, reviewing student marks, and managing their schedules more effectively. In the mobile learning context, examples of practices include a mobile learning organiser developed and tested at the University of Birmingham (Sharples et al., 2003 cited in Naismith et al., 2004).

European projects that have used mobile learning to support instruction in and outside school

The proliferation of mobile devices in Europe presents an opportunity for those concerned with education to explore their potential for mobile learning – learning facilitated by mobile technologies – to enhance education. European governments and organisations have funded a number of mobile learning initiatives, yet very few of these projects have examined the educational use of mobile telephones specifically, tending to focus instead on larger mobile devices like laptops, netbooks, game consoles and tablet devices. This highlights a missed opportunity for educators and policymakers, as mobile telephones – especially smartphones – can be equally powerful learning tools that are significantly less expensive than other devices like laptops and tablets.

The UNESCO working paper series on mobile learning offers a useful contribution in this respect, as they identify and describe the major mobile learning initiatives that use mobile telephones to support teachers and improve teaching practices in Europe. The overwhelming majority of mobile learning projects in Europe are targeted at students (Dykes and Knight, 2012). Table 1 provides an analysis of such projects from the selected papers reviewed for this report.

Table 1: European mobile learning projects and their outcomes

Project	Partners	Aims	Lessons Learnt	Limitations
Mobile in Salford (UK)	Colleges (Eccles, Salford, Pendleton and Langdon), Salford City Learning Centre	Use of mobile devices to access closed social networks	While some students were enthusiastic about using mobile devices, others were less confident and sometimes felt overwhelmed by the tasks involved It should not be presumed that all students and teachers are comfortable with mobile technologies	Production of materials for use on mobile devices was particularly time consuming and could have a negative impact on teaching practice

Project	Partners	Aims	Lessons Learnt	Limitations
Presemo (Finland)	Helsinki Institute for Information Technology (HIIT), Aalto University and the University of Helsinki	Mobile participation platforms that teachers can use during lectures to support greater interactivity, communication and collaboration among students	The system allows the teacher to choose the most appropriate pedagogic approach for a given set of circumstances Teachers can use Presemo to ask questions and solicit feedback from large groups of students during lectures .	Because the tool is best suited to large class sizes, most of the development tests have taken place in higher education, with a few tests carried out in secondary schools
Wapeduc (France)	Philippe Steger (founder), Montpellier Local Education Authority	The mobile platform provides course materials, quizzes and tutoring for students preparing for their baccalaureate examinations	Students can build a personal mobile portfolio by uploading records of their progress Teachers can use the system to access over 110 lessons that align with the French curriculum to help students prepare for their examinations The WapEduc System also supports SMS and email to enable communication and collaboration between students and teachers outside of class	
University of Leeds Medical School	School of Medicine, University of Leeds	Students spend up to 80% of their time in clinical practice, so the project aims to support students' learning at their clinical sites	Students can now use the university-provided smartphones to access resources and assessment modules and to communicate with teachers Use led to increased access to medical information for students, and increased opportunities for students to record observations and engage in self-assessment and reflection Improved hygiene in hospital wards has also been noted as an additional benefit of the project. While notepads, loose-leaf folders and textbooks can harbor germs, the smartphones can be easily disinfected using antiseptic wipes	

Project	Partners	Aims	Lessons Learnt	Limitations
Distance Learning for Apprentices	Vocational institutions in Denmark, Germany, Portugal, Spain and Turkey	Used mobile technologies to support students engaged in distance learning as part of an apprenticeship training programme	A module called 'train-the-teacher' offered a pedagogical framework and technical advice for teachers who were incorporating mobile technologies into their instruction for the first time	
Priory School (UK)	Portsmouth Secondary School Curriculum Leader for Geography, David Rogers	His teaching methods to teach geography include asking students to match music to locations or photographs, or create a soundtrack for a walk, to explore how they feel about certain places; additionally he asks students to use the camera, audio recording and texting functions on mobile phones to capture images and sounds associated with a place, and post messages about their observations and associations	Rogers spearheaded an effort to revise the school's mobile telephone policy to allow the use of mobile devices during social time and encourage students to explore the possibilities for learning through their mobile telephones Rogers co-developed the policy with students to help increase their sense of ownership and responsibility	Benefits of mobile learning are often obscured by the behavioural issues associated with mobile telephone use in schools
Apps for Good (UK)	CDI Europe	14-25 year old young people identify a problem in their world and develop a mobile application that addresses the issue	The Apps for Good model seems to be effective in helping young people develop technical skills as well as an understanding of the potential of mobile technologies to affect change	
Blackberry Academic program	Aston University (UK), Universidad de Oviedo (Spain)	A key component of this program is teaching students to develop mobile applications to address real-world problems	BlackBerry designed a 'Mobiles Made Simple' workshop aimed at 11- to 14-year-olds, which has been made available to some schools in the UK. The workshop explores the history and science of mobile telecommunications, using the BlackBerry as an example	
REACH	Italy, Norway, Spain and Turkey	REACH is teacher-focused, involving Vocational Education and Training teachers, trainers and counsellors in developing new pedagogical approaches to learning through the use of mobile technologies		

Project	Partners	Aims	Lessons Learnt	Limitations
ENVI Game	Czech Republic	Provides mobile learning platforms to support environmental education in schools ENVI Game learning activities combine outdoor observation, facilitated by the smartphone, with classroom- based computer use	The game is intended to be played in class and during after-school programmes to supplement teachers' environmental education curricula	

According to Wu and Zang's (2010) study, mobile technologies have not been passively used for educational purposes. On the contrary, they state they have been utilised actively at all stages of students' learning. Therefore, they argue that it is imperative to address the empirical and theoretical realities of mobile technologies in schools. While many of the mobile learning projects outlined in this review have multiple educational goals, the projects' primary objectives aim to enhance instruction and encourage new pedagogical practices.

The mobile learning projects identified above in Table 1 also vary in terms of their educational level and target populations. Some projects are focused on students and teachers in primary and secondary schools, while others target higher education and lifelong learning. Only the BlackBerry Academic Program spans multiple education levels, targeting young people and their teachers in both secondary schools and universities. The majority of mobile learning projects are aimed at older learners – university students, medical students, working professionals participating in career training, and other adults engaged in lifelong learning. This may be due to the early higher penetration rate of mobile telephones among adults as well as the greater maturity level of the learners in relation to younger students at primary and secondary education levels. Key factors influencing mobile learning development in Europe have been identified from these research studies. These drivers, enablers and barriers are as follows:

- Drivers:
  - ✓ Government and EU support for lifelong learning.
  - ✓ The need for improved communication at universities and school.
  - ✓ EU and national objectives for increasing student achievement and lowering dropout rates.

- Enablers:
  - ✓ Widespread mobile telephone ownership.
  - ✓ Familiarity with mobile devices.
  - ✓ Availability of public funding.
  - ✓ National/regional leadership and guidance in implementing mobile learning projects.

- Barriers:
  - ✓ High costs associated with purchasing mobiles telephones in schools. To overcome this, institutions may try to reduce expenses associated with mobile learning by encouraging students to bring their own devices to school: however there could be issues of equity with this approach.
  - ✓ Negative social attitudes about the use of mobile telephones in schools. This is difficult to overcome as public perceptions about the disruptive nature of mobile telephones seem to be widespread in Europe (Dykes and Knight, 2012).

Non-European projects that have used mobile learning to support instruction in and outside school

Table 2 presents an analysis of the literature reviewed, which will be discussed in a later section of this report.

Table 2: Non-European mobile learning projects and their outcomes

Project	Partners	Aims	Lessons learnt	Limitations
English in Action Bangladesh (EIA)	Open University UK; DFID UK	25 million Bangladeshi school children were equipped with the skills to communicate in English to levels that would enable them to participate fully in national economic and social activities and global opportunities	EIA empowered teachers to change their classroom practice; teacher practice was enhanced by the use of handheld devices (iPods); teachers became more aware of their own practice in order to improve it	Teachers still needed ongoing peer support; some reported anxiety in dealing with handheld devices (iPods); support systems were needed

Teaching methods and their context

Naismith et al. (2004) conceptualised teaching context, focusing on the tension that may arise between a learner's wish for anonymity and privacy on the one hand, and the gathering and utilising of contextual information on the other. Others have argued that students learn best when given the opportunity to learn skills and theories in the context where the skills and theories are used. To respond to that learning need, mobile technologies allow greater accessibility to information networks and offer students context-aware information at the most appropriate teachable moments (Shohel and Power, 2010; Wu and Zhang, 2010).

According to Koshman (2011)**,** context is paramount in understanding mobile user behaviour, due to the diversity of user information environments. It is argued that context not only represents the mode of use for information retrieval but also impacts the formulation of the user's information need and motivation. In his recent study, four definitions of mobile context were analysed: spatial/location; temporal; social; and access.

Spatial/location context - spatial/location context denotes an indoor or outdoor geographic place where the user may reside or where their query may originate from. Interestingly, other study findings show that "home" was cited as a frequent Internet access point while browsing, and that users changed to several locations during a session due to the technology's portability (Cui and Roto, 2009 cited in Koshman, 2011, p. 212).This study sheds light on location coordinate information to understand the user's information activity associated with their geographical context.

Temporal context - temporal elements give rise to the notion of using the mobile Web in between planned activities. Church and Smyth (2008, cited in Koshman, 2011) analysed 405 diary entries from a diary study of 20 participants to examine mobile information needs. Their findings suggested that the majority of user diary entries occurred while users were in transit or "on-the go" and suspect that the diversity of user information needs are prevalent while away from home. They concluded that both location and time context have a significant influence on both the mobile user's information need and the expected answer.

Social context - social context may be characterised by social interaction and discussion in a defined vicinity. Church and Smyth's (2008, cited in Koshman, 2011) findings identified the social interaction/conversations in a mobile context in 25% of the diary entries as one which elicits information needs from conversations with acquaintances. The social factor is particularly interesting since this encapsulates both formal and informal reporting of user

activities stemming from a conversation, and indicates that the mobile Web may be used to enhance, start or expand verbal discourse.

Access/technical contexts - access context refers to technical usage of the Wireless Local Area Network (WLAN) or cellular network for access to the mobile Web. Technical context further takes advantage of 'push and pull' features of mobile technologies to impact the method through which the user finds and uses information. Pull technology refers to user incited activities and push technology is facilitated by an event-triggered activity. For example, a user walks down a street past a bookstore and the user is alerted to a non-fiction book sale on their handheld device (Koshman, 2011, p. 213). This works with a combination of context- and location-aware technologies since it is not information that the user deliberately sought.

In order to explore the variance in mobile context definitions, a mobile action-based framework was proposed. The author embarked on developing a mobile social visualisation for text entity retrieval that offered a micro-context for visualised information retrieval display. An *iSchool agenda* application embedded the mobile facility in several courses where technology and information behaviour were integrated for learning purposes so that more could be found out about new search behaviour (Koshman, 2011, p. 212). The main findings were the notion that contextual factors can strongly influence information behaviour and use of interactions with mobile devices. Moreover, development challenges were found to be associated with the rapid deployment of new mobile device models. Since technology is considered the driving force behind how people use information, then it is argued that detailed information usability testing should be substituted with broad contextual studies which allow researchers to extract general behavioural characteristics even though specific device models may change. Ultimately, the key consideration with regard to mobile context is to discover how the mobile devices themselves drive information behaviour in the new mobile setting and incorporate these findings from an *iSchool* information retrieval perspective (Koshman, 2011, p. 214).

Mobility

This term is interpreted here as the ability to link to activities in the outside world, which provides students with the capability to 'escape' the classroom and engage in activities that do not correspond with either the teacher's agenda or the curriculum (Naismith et al., 2004). Despite the challenge in addressing mobility in formal classroom settings, some research has attempted to do this. Some have conceptualised it as 'any educational provision where the sole or dominant technologies are handheld or palmtop devices' (Traxler, 2007), which is available 'anywhere, anytime' (Geddes, 2004 cited in Shohel and Power, 2010), whereas Shohel and Power (2010) defined the previous notion as a type of mobile learning mobility. Other studies more specifically related to handheld devices have pointed to the connection between age and mobile learning mobility. As Wu and Zang (2010) suggested, age or stage in life seemed to influence the manner in which the mobile device users balanced the expenses and convenience associated with mobility. In addition, Ting recently suggested an "interwoven learning interactions" (2013, p. 1) notion, which sheds light on a novel perspective in using handheld devices inside and outside the classroom. This notion highlights the combination of face-to-face social interaction with mobile learning moments.

Learning and time convenience

Within the context of mobile learning teaching methods, there is research suggesting the influence of time convenience on learning. Mobile technology can be used to increase access to authentic teaching and learning materials that could be used at a time convenient to teachers, such as when they are preparing lesson plans or while travelling to school. Practices such as these are said to have a great impact on teachers' own learning and their classroom practice (Shohel and Power, 2010). For Ting (2013) learning is constructed on the synthesis of both instructional and social experiences, whereas Naismith et al. (2004) focus on the time convenience dimension of learning, arguing that effective tools are needed at a time convenient for the recording, organisation and retrieval of mobile learning experiences. Furthermore, an aspect of constant alertness has been pointed out as a real challenge within mobile learning teaching methods, which can cause various stress disorders (Economides and

Nikolaou, 2008). Some others have pointed to the impact that mobile tools can have in a school environment due to time convenience use. Therefore, understanding students' learning conditions, experiences, and variety of attitudes can have a broad impact on schools' decisions to use mobile technologies (Roschelle, 2004 cited in Wu and Zhang, 2010). From a teaching method perspective, new opportunities for professional learning have been developed due to ease of access at different times or places offered by mobile handheld device use (Shohel and Power, 2010).

Interwoven learning interactions

The mobile learning literature presents various perspectives on aspects of learning. Some have focused more on the learners' needs (Seppala and Alamaki, 2003 cited in Ting, 2013), others on the mobile technologies used by learners (Price and Rogers, 2004 cited in Ting, 2013) and some others on the analysis of the mobile devices used (Roschelle, 2003 cited in Ting, 2013). Ting's (2013) study proposes a notion for helping instructors design an innovative mobile learning practice in their subject domain. The proposed design notion - interwoven learning interactions - means that the mobile technologies unobtrusively record specific types of social interactions among learners as digital information, and the digital information is synthesised with the rules and principles of subject content to represent the instructional information. When social interaction among peers enables their stimulation and exploration of subject content as well as display of students' thoughts and reasoning, learning is then constructed through the realms of both physical and social experiences linked with abstract learning content (Ting, 2013, p. 1). It has been argued that the core characteristic of mobile learning is that it enables learners to enter an information network at the precise moment when necessary, and experience the authentic joy of learning (Seppala and Alamaki, 2003 cited in Ting, 2013). The notion of interwoven learning interaction echoes the need for re-conceptualising the interaction between learning and the design of mobile technology. Therefore, during the explorative learning process, by means of computer and mobile technologies, students can synchronise their social interactions around their physical world with the instructional illustration of the subject content, thus resulting in interwoven social and instructional interactions. Students formulate the system on the basis of their social and instructional interactions. Interwoven interactions are said to be engaging to learners because they are the participants of subject presentation instead of being mere by-standers (Ting, 2013, p. 2).

Ting's (2013) research proposes a notion of interwoven interactions to provide an original view of how the mobile technology can be utilised to create a new learning process. The notion is developed on the basis of constructivism, and further developed from a social-cognitive aspect of learning. The creation of interwoven interactions are then elaborated by design principles and realised in a sample practice. The sample practice is evaluated by surveys that probe students' attitudes towards the proposed learning activity. The study provides preliminary findings that shed light on the use of mobile technology in learning. Main findings suggest that:

- ✓ Mobile technologies can distribute heterogeneous information to individuals, thus fostering their active interactions.
- ✓ Delivery of heterogeneous information to individuals in a face-to-face group activity could not be achieved without mobile technologies. Hence, mobile technologies facilitate the creation of interwoven interactions in this study through both unobtrusive recording and delivery of heterogeneous information.
- ✓ It is not the technology alone that gives rise to interwoven interactions. There should be a good match among the mobile technologies adopted, social behaviours enacted, roles assigned to each student, tasks pursued, and the rules or theories of subject content behind them.
- ✓ A learner's social interactions could be pedagogically utilised to support each student's individual social aspect of learning. This aspect of pedagogical design should shed new light on how to create new possibilities for learners to explore collaboratively a subject domain, as well as to develop new theories in order to facilitate our understanding of how learning takes place under these circumstances.

The previous findings reveal that mobile technologies indeed add a new dimension to learning activities, because of both the personal and portable nature of the devices themselves, as well as the kinds of learning interactions they can support. More specifically, mobile learning enables learners to interact and capture experiences in both physical and social realms, and makes learning more experiential and multifaceted (Ting, 2013, p. 12).

Informality

Naismith et al. (2004) remind us of the student's perspective as being important, as they may abandon their use of certain technologies if they perceive their social networks to be under attack. Alongside this, the UNESCO working paper sheds light on some barriers that could resonate with some forms of "informality abuse", such as mobile learning obscurity arising due to behavioural issues associated with mobile telephone use in schools and negative social attitudes about use of mobile telephones in schools (Dykes and Knight, 2012). It is relevant to note that both these barriers apply to a very contained environment, as is the school use setting. Other different accounts of informality were suggested in Wu and Zang's (2010) research. The students who participated in the research experiments informally helped one another in learning groups, because the handheld computers allowed the students to transfer data by using beaming functionality. Students have also reported that using handheld computers made learning more interactive and collaborative (Wu and Zhang, 2010, p. 65).

Ownership

Another student perspective to consider is their desire to own and control personal technology, but this presents a challenge when they bring it into the classroom (Naismith et al., 2004). Again, this topic deserves further exploration, considering the mobile learning barriers identified by Dykes and Knight (2012) – negative social attitude towards mobile learning and high cost of devices being overcome by encouraging students to bring their own devices to the classroom, which carries additional issues of possible equity (in)balance. More specifically, in terms of language learning setting, it has been suggested that this is one of the disciplines particularly likely to benefit from widespread ownership of mobile devices such as telephones and media players (Kukulska-Hulme and Traxler, 2005).

Benefits and challenges of using handheld devices in education

Mobile technologies with increased capabilities of networking, social interactions, and context awareness can have an obvious impact on learning (Naismith et al., 2004). More and more schools have used handheld computers as integral and regularly-used educational technology devices, as they are small, easy to move, inexpensive, and enable information to be shared quickly through wireless connections. These handheld devices, which can include mobile devices, personal digital assistants (PDA), and handheld personal computers (handheld PCs) have been introduced into many classrooms in recent years (Roschelle, 2003 cited in Wu and Zhang, 2010). The low cost, availability of software, and convenience of handheld computers have encouraged educators to develop and use handheld devices for teaching, learning, and assessment. Therefore, the study of mobile devices in a learning environment, such as a handheld PC, palmtop PC, and PDA, referred to as mobile learning, is an emerging research area (Wu and Zhang, 2010). Although various names (e.g. PDAs, Pocket PCs, palmtops, smartphones, etc.) exist to describe various types of handheld devices, Economides and Nikolaou (2008) investigated the width of handheld devices that would be appropriate for mobile learning. In their research, the term handheld device referred to a device that could be easily carried by a student and has the following multimedia functionalities: i) information and knowledge access, process and storage; ii) communication (synchronous and asynchronous); iii) entertainment and amusement (e.g. games, music, video, radio, television, etc.); and iv) organisation and management (e.g. scheduling, planning, calendar, address book, calculator, etc.) (Economides and Nikolaou, 2008, p. 2). The two previous studies (Economides and Nikolaou, 2008; Wu and Zhang, 2010) have identified a series of benefits of using handheld devices in education, including:

> **Alertness** - using handheld devices, users can confront a situation as it happens instead of postponing it until they reach their office, home, school, etc. This real-time situation confrontation allows them to solve problems as they happen. However, it also may place a

stress on them, since they may feel the need to be continually alert (Economides and Nikolaou, 2008).

Students' preferences - many pilot programmes in education investigate the educational value of handheld devices with the students preferring the use of handheld PCs over other alternatives, such as raising their hands, for example (Economides and Nikolaou, 2008).

Saving time - handheld devices appear to be very suitable for accessing information (reading e-mail, checking stock quotes and news headlines), especially when the user is seeking to fill a time slot that would otherwise be lost, for example, during a short bus ride or while waiting in a line (Economides and Nikolaou, 2008).

Advantages over PCs - handheld devices have advantages when compared to the laptop PC. Laptop PCs require a lap or surface to operate properly, they are relatively bulky and obtrusive, they take much longer to boot and consequently must be left on so that they will be ready to use, and they typically have short battery life (Economides and Nikolaou, 2008).

Assessment value - handheld PCs could broaden the range of assessment tasks and could be better aligned with inquiry-oriented instruction. These devices can create new ways for students to express themselves and expand the range of assessment methods (Wu and Zhang, 2010).

Special educational needs - handheld computers can be used to support special educational needs students to conduct spelling exercises, and have had an impact on students' performance (Hooft et al., 2004 cited in Wu and Zhang, 2010).

Language learning support - handheld PCs have been used by foreign language teachers in their learning/training (Dykes and Knight, 2012; Shohel and Power, 2010; Wu and Zhang, 2010)

Pedagogical value - inexpensive and portable handheld devices require less difficult pedagogical adjustments and can facilitate formative assessment solutions (Penuel et al., 2004 cited in Wu and Zhang, 2010)

Despite all these advantages, there are challenges and disadvantages which arise exclusively from their size:

Usability – in trying to reduce the dimensions of the handheld devices, the manufacturers have decreased their usability, for example, with a small screen size, so that writing extensively is less possible (Passey, 2013).

Availability – in reducing the size of the handheld devices, their battery lifetime is reduced as well.

Performance – in reducing the size of the handheld devices, their performance is affected. However, they are still cheaper than laptop PCs (Wu and Zhang, 2010).

Having examined the characteristics of the handheld devices and their requirements in order to support mobile learning, Economides and Nikolauo (2008) defined three evaluation areas, each one containing criteria for evaluating various handheld devices. This offers a relevant contribution to knowledge in this field in the sense that this highlights some of the characteristics that handheld devices should have in order to support or enhance learning. These criteria are shown in Table 3.

Table 3: Evaluation elements for handheld devices aiming to support/enhance learning

Evaluation elements for handheld devices	1) Usability	2) Technical	3) Functional
Criteria	User interface	Performance	Communications
	Presentation and media	Sensory system	Information and knowledge
	Navigation	Compatibility	Organisation and management
		Security	Entertainment and amusement
		Availability and reliability	

Source: (Economides and Nikolaou, 2008, p. 18)

It is possible to perform an evaluation of various handheld devices to determine the extent to which they satisfy these evaluation criteria. These can be applied in a variety of contexts and locations. A brief description of the three evaluation elements follows.

1) Usability: is related to the ease of understanding, learning, remembering and using the device and its tools. It should be easy to carry the device, to use its interface, to read and write text, to communicate with others, to record and play audio and video, to organise emails, messages, songs and photos, to navigate and orient its content.

2) Technical: is related to the device's performance, connectivity, compatibility, security and reliability. The device should have high processing power, large available memory, and ability to run various software formats. It should have long battery life and easy battery recharging facility. It should support various communication protocols and networks without serious restrictions on distance and bandwidth. It should also secure content and communications against theft or malicious attacks.

3) Functional: is related to the quantity and quality of the available features, functions and tools of the device. It should support tools for synchronous and asynchronous communication, as well as for information access, processing, storage, organisation and playing (Economides and Nikolaou, 2008, p. 3).

The authors' conclusions suggested technical specifications for handheld devices that aim to enhance and support learning (2008, p. 18). Their research recommended use of the evaluation framework, in Table 3 above, in order to make sure that handheld devices to be used for mobile learning for the next generations are adequate for their primary vocation – to enhance and support learning.

The mobile learning literature points to some relevant research on how mobile learning can enhance the process of learning languages. Two studies deserve detailed consideration on this subject. Firstly, Shohel and Power's (2010) study explored an English learning programme - English in Action (EIA) - in Bangladesh; and secondly, Wu and Zhang (2010) examined the potentialities of handheld technology on students' academic attainments.

Learning language processes enhanced through mobile learning

The English in Action (EIA) programme aims at improving the teaching of English, significantly, across all age sectors, by introducing mobile technology. The study introduced mobile technology in English language classrooms in Bangladesh, as a means of integrating information and communication technology (ICT) into different aspects of school-based support systems (Shohel and Power, 2010). There are four major strands to the EIA programme in Bangladesh:

- ✓ Primary education: engages students and teachers through innovative classroom resources.

- ✓ Secondary education: empowers teachers to change their classroom practice. These interventions are school-based, delivered through supported open and distance learning which is enhanced by mobile technologies.
- ✓ Adult learning: enables lifelong learning via interactive and digital media.
- ✓ Research, monitoring and evaluation: evaluates ongoing projects and researches the impacts of the intervention.

A mixed-methods research strategy was adopted to evaluate the impact of mobile technology for enhancing teaching and learning in the English-language classrooms in Bangladesh. The methods used included a questionnaire, classroom observation, semi-structured interviews with six school administrators and twelve teachers (Shohel and Power, 2010). The pedagogic dimension of the programme was identified through various levels of engagement, and learning expected. These levels were articulated through a variety of strands - communicate, connect, create, and community - which offered a wide range of ICT resources for the secondary teachers involved, from the simplest to the technically more demanding.

The analysis of the relevant themes was considered from pedagogically-related dimensions, as follows:

✓ **New opportunities for professional development**

Teachers explored the flexibility afforded to them by having tools and materials (both print and audio-visual) that they could access at different times or places, to create new opportunities for professional learning.

✓ **Watching and listening**

Teachers particularly emphasised the value of "watching and listening" for developing their own pedagogic knowledge (Shohel and Power, 2010, p. 206).

✓ **Ongoing peer support**

Whilst the professional development materials available through the iPod were perceived as making an important contribution to the teachers' development, teachers also recognised that these materials alone were not enough to enable or support that development. This could be seen as a limitation of the current study.

✓ **Emphasis on practice and teacher perceptions of their practice**

Teachers talked very positively about the need for, and benefit of, a strong practical focus to their professional development activities, which required them not just to discuss but to apply new ideas or techniques in the setting of their own classroom practice.

✓ **Dealing with anxiety**

When talking about their own knowledge or practice, around one-third of the teachers (3) referred to weaknesses, poor performance or mistakes. Although this was generally in the context of improvement, it raised a question as to where such a perception arose. Such comments were often in the context of when they were observed whilst carrying out classroom practice.

✓ **Support systems**

Despite the anxieties reported by some teachers, other teachers commented on their experience of training and support as 'warm' and 'friendly. It seemed to contradict the previous theme, which might represent the experience of an internal anxiety surfacing in an external environment that is perceived to be supportive (Shohel and Power, 2010, p. 209).

✓ **Determination and engagement: making changes in their practice**

There was a real sense of teachers' determination, of repeated effort and practice to master the language, the pronunciation or the classroom practices that they were being taught.

This study concluded that:

- Mobile technology has the potential to change the very nature and processes of pedagogy (McCombs et al., 2006 cited in Shohel and Power, 2010).
- Mobile technology enhances teaching and learning activities (Lacina, 2008 cited in Shohel and Power, 2010) and can offer teachers an understanding of new technological applications and professional knowledge.
- Mobile technology enables teachers to reflect on their own learning processes, both individually and collectively (Corbeil and Valdes-Corbeil, 2007 cited in Shohel and Power, 2010).

Potentialities of handheld technology on students' academic attainments

In examining the potentialities of handheld technology on students' academic attainments, Wu and Zang (2010) concluded that handheld devices could be an addition to learning technologies in elementary schools. Most research to that date had focused on handheld technology development and implementation issues; however, measuring and analysing handheld computers for testing purposes had then yet to be evaluated (Segall, Doolen and Porter, 2005 cited in Wu and Zhang, 2010). There was a minimal amount of evidence that handheld computers could be effectively used in students' assessment in the classroom and utilisation of handheld computers actually improved students' academic achievements. This study conducted two experiments with handheld computers:

(a) A comparison of the process of learning English spelling with fourth-grade students using handheld computers and fourth-grade students who did not use handheld computers.

(b) A comparison between the test results of fifth-grade students dividing fractions using handheld computers and fifth-grade students dividing fractions using paper and pencil.

This study discovered a positive potential on attainment when utilising handheld computers in elementary schools. The findings in this study supported use for both English language arts and mathematics teachers to utilise handheld computers in their classrooms. This study also showed that handheld computers have the potential to promote the students' motivation to learn and enhance their peer collaborations (Wu and Zhang, 2010). These outcomes connect also with the informality concept presented in Naismith et al. (2004), where the informal nature of devices can lead to a positive reward (2004, p. 19).

4. ITALY IN CONTEXT

The educational system

According to EACEA (2014), the education system in Italy is organised according to principles of centrality as well as supporting the autonomy of schools. The state exercises legislative rights, which are concerned with general issues of education, such as minimum standards to be guaranteed throughout the country, and regulations that regions should comply with. Schools are autonomous with regard to didactic matters, organisation, and research and development activities.

Compulsory education lasts for 10 years (from 6 to 16 years of age). It covers 5 years of primary school, 3 years of lower secondary school and the first two years of upper secondary school. Compulsory education can be completed also by attending three- and four-year courses offered through a regional vocational education and training system. The upper secondary level of education can last for 5 years and provision is offered in terms of both general and vocational pathways.

There are 15,417 primary schools in Italy. Primary schooling lasts for five years and, in general, it is available to pupils aged from 6 to 11 years. There are 7,270 lower secondary schools. Lower secondary education lasts for 3 years and is generally attended by pupils aged from 11 to 14 years. In the future, pupils aged 10 years and upwards might attend lower secondary schools. There are 5,397 upper secondary schools. General upper secondary education lasts for five years and is offered by six types of liceo specialising in the following areas: arts (*Liceo artistico*); classical studies (*Liceo classico*); sciences (*Liceo scientifico*); languages (*Liceo linguistico*); music and dance (*Liceo musicale e coreutico*); and human sciences (*Liceo delle scienze umane*). Studies at liceo are generally available to students aged from 14 to 19 years of age and are organised, for didactic purposes, into two two-year periods with a final fifth year.

The curriculum

According to EACEA (2014), at primary and lower secondary level the curriculum is defined through National Guidelines for the Curriculum of 2012[1]. This document replaces the National Guidelines for the Personalised Study Plans in Primary Schools of 2004 and the Guidelines for the Curriculum of 2007. According to the new guidelines, the general aim of the school is the harmonic and comprehensive development of the individual, in accordance with the principles of the Italian Constitution and the European cultural tradition, to be achieved through promotion of knowledge, respect of individual diversities and active involvement of students and their families. In particular, the primary level of education is tasked with ensuring pupils acquire knowledge and skills fundamental for the development of basic cultural competences. At the lower secondary level of education the specific purpose is also to ensure pupils acquire knowledge and skills fundamental for the development of basic cultural competences, but, at this level, the goal is to be reached by using subjects and disciplines as a means to know, interpret and represent the reality and the world.

At the upper secondary level (liceo), there has been a recent reform of the whole second cycle of education, so the curricula for the liceo have been revised. New curricula are now defined in the National Guidelines for the Curriculum 2012. The National Guidelines establish the specific learning objectives for each liceo, and for each subject, knowledge and skills that each student is expected to

1 http://www.indicazioninazionali.it/documenti_Indicazioni_nazionali/indicazioni_nazionali_infanzia_primo_ciclo.pdf

acquire as the basis for building her/his competences. The National Guidelines also include what the student's educative, cultural and professional profile should present, what a student should know and should be able to do after having completed a study programme at a liceo.

Digital technologies and schools

According to EACEA (2014), in general, primary schools have ICT laboratories for supporting teaching activities, and several classes may also be equipped with interactive whiteboards (IWBs). At lower secondary school, ICT is a cross-curricular subject. Generally, secondary schools are provided with a gymnasium, and a library, as well as ICT, science and multimedia laboratories. More and more classes are equipped with interactive whiteboards (IWBs). At upper secondary level (liceo), schools are usually equipped with a gymnasium, library, scientific and computer laboratories, and laboratories appropriate to the various educational offerings and to the specificities of the single school. In the last decade, special attention has been dedicated to drop-out prevention, study methods, catch-up activities as well as to increasing the use of ICT. However, at this time, it is clear that not all primary schools have ICT laboratories installed, not all facilities in primary and secondary level schools are used, and few teachers have received sufficient training to enable appropriate uses of the facilities.

General teaching methods and training

According to EACEA (2014), while not intending to prejudice any teaching freedom, the National Guidelines for the curriculum do indicate some basic methodological approaches, such as: the exploitation of pupils' experiences and knowledge; the promotion of exploration and discovery activities; the encouragement of cooperative learning; the development of the awareness of one's own learning method; and carrying out in-laboratory learning.

All teacher training courses consider the acquisition of competences in ICT, according to the acquisition of digital competences as highlighted in the Recommendation of the EU Parliament and Council of 18 December 2006. In particular, these competences refer to the capacity of using multimedia languages for representing and communicating knowledge, for using digital contents and, in general, simulated environments and virtual laboratories.

In Italy there is no national curriculum for teacher training. Indeed, in this respect with regard to ICT, OECD studies emphasise that Italian schools generally have a low ICT penetration and that only motivated teachers experiment with new technologies in classrooms.

Handheld technologies are not used widely in Italy for educational purposes. Meetings, seminars and courses about using new technologies in teaching and learning can be organised by either public or private bodies, which can involve the MIUR (Ministry of Education and Research) for dissemination of practices to schools. But participation is voluntary, and not mandatory.

In Italy research into uses of handheld technologies in secondary school classrooms occurs only at a local level, and few significant results have been identified or recognised at this time. No specific state-of-the-art research in this field has been identified. Currently there are no key institutions or individuals that have undertaken research in exploring teacher training involving handheld technologies in secondary school contexts.

.

Teacher training

In Italy those individuals who want to become primary teachers have to attend the *Scienze della Formazione Primaria* (Science for Primary Teacher Training), a university course run over 5 years that prepares for the teaching of all subjects for primary schools. To teach at secondary school, graduates in individual subjects (mathematics, literature, etc.) have to attend the Educational Active Training (TFA), a one-year course offered by universities to become qualified for teaching. The teacher training programmes are promoted by universities as well as by the MIUR (Ministry for Education and Research), which is responsible also for their dissemination.

There is currently no country list of initial teacher training programmes that involves uses of handheld technologies in teaching or learning. Similarly, there are no key institutions or individuals that undertake initial teacher training with uses of handheld technologies in secondary school classrooms in Italy. The TFA curriculum has a very limited number of hours dedicated to laboratories for interactive learning technologies. TFA is a blended course, with online activities, but there are no significant experiences integrated about uses of handheld technology in secondary education.

In Italy there are no dedicated in-service teacher training programmes. Teachers can participate in training courses, individually or involving their school, but the training programmes are not mandatory and, generally, only motivated teachers participate. Courses are organised by public or private bodies (universities, foundations, associations) and can be financed by a teacher's institution (school or the regional school offices - USR) or by teachers themselves (as is usual). In a year, every teacher has 5 days provided for attending a training programme.

There is no country list of in-service teacher training programmes that involve uses of handheld technologies in teaching or learning. Similarly, there are no key institutions or individuals that undertake in-service teacher training with uses of handheld technologies in secondary school classrooms in Italy.

Current key obstacles to using handheld technologies in the classroom

As OECD studies highlight, Italian schools have low ICT penetration and only motivated teachers experiment with new technologies in classrooms (Avvisati, Hennessy, Kozma, and Vincent-Lancrin, 2013). But, in the last few years, the MIUR has promoted three national projects: LIM (IWB) Programme, the Cl@ss 2.0, and the School 2.0 projects - with the following objectives: to introduce ICT as part of the daily tools of classroom activities; to experiment with new models of school organisation and of teaching; and to support the development of new products (resources and devices). However, the projects have limitations: there has been a very slow pace to deployment of equipment (5 to 16% of classrooms are now equipped with IWBs); there have been too few schools concerned with Cl@ss 2.0 (only 416 in total) and with School 2.0; there has not been sufficient professional development; and there have not been sufficient digital resources accessible. The Plano LIM (IWB Plan) is progressing at such a slow rate that it would take 15 years to reach the current UK level (according to Avvisati, Hennessy, Kozma, and Vincent-Lancrin, 2013). For this reason, the current key obstacles to using handheld technologies in the classroom are cultural and technological - many schools do not have Internet in the classrooms and a hardcopy book is generally preferred to an e-book.

Current key drivers to support uses of handheld technologies in the classroom

Both development and research activities can be managed by schools themselves. The curriculum promotes active involvement of students and families, discovery activities, and cooperative learning. ICT development has been instigated and encouraged in schools across Italy, although uses of ICT are clearly very variable at this stage.

5. GREECE IN CONTEXT

The educational system

The Greek education system is governed by national laws and legislative acts (decrees, and ministerial decisions), while the general responsibility for education lies with the Ministry of Education and Religious Affairs. The Greek education system was until recently predominantly centralised; however, within the framework of the country's adaptation to international standards, actions have been undertaken to shift towards decentralisation.

Primary education requires compulsory attendance of a primary school and lasts for 6 years. Secondary education requires 3 years' attendance in lower secondary education. This constitutes the last period of compulsory education and is a prerequisite for enrolling for and attending general or vocational upper secondary schools. In parallel with day schools, evening lower secondary education schools also operate, with attendance starting at the age of 14 years. The second tier of secondary education lasts also for 3 years, and constitutes non-compulsory upper secondary education, either as general secondary education or vocational secondary education. Vocational Lyceums offer two cycles of studies, constituting the formal educational system: the secondary cycle; and the (optional) post-secondary cycle of studies, the so-called "apprenticeship class". In both the General and Vocational Lyceums, students enrol at the age of 15 years. Parallel to the day schools, the Evening General Lyceums and Evening Vocational Lyceums also operate, with the minimum age for enrolment in Evening Vocational Lyceums being 16 years.

The administration of primary and secondary education is conducted at central, regional and local levels respectively by: the Ministry of Education and Religious Affairs; Regional Education Directorates; Directorates of Education (Prefectures); and School Units.

In the primary sector, for pupils aged from 6 to 12 years, there are: 4,439 Primary Schools of General Education; 19 Experimental Primary Schools; 185 Special Primary Schools; 174 Minority Primary Schools; 13 Cross-cultural Primary Schools; 172 Private Primary Schools; and 1 Primary School of European Education. In the secondary sector, for students aged from 12 to 16 years, there are: 1,602 All-Day Lower Secondary Schools of General Education; 75 Evening Lower Secondary Schools; 15 Experimental Lower Secondary Schools; 2Minority Lower Secondary Schools; 8 Cross-cultural Lower Secondary Schools; 7 Ecclesiastical Lower Secondary Schools; 42 Music-oriented Lower Secondary Schools with Upper Secondary Music Classes; 3 Art-oriented Lower Secondary Schools with Upper Secondary Art Classes; 8 Special Lower Secondary Schools; 85 Private Lower Secondary Schools; 1 Lower Secondary School of European Education; 5 Special Lower Secondary Schools of Vocational Orientation; 995 General All-day Upper Secondary Schools; 51 General Upper Secondary Evening Schools; 15 Experimental Upper Secondary Schools; 2 Minority Upper Secondary Schools; 4 Cross-cultural Upper Secondary Schools; 10 Ecclesiastical Upper Secondary Schools; 5 Special Upper Secondary Schools; 78 Private Upper Secondary Schools; 1 Upper Secondary Schools of European Education; 326 All-day Vocational Upper Secondary Schools; 62 Vocational Upper Secondary Evening Schools; 2 Special Vocational Upper Secondary Schools; and 3 Private Upper Secondary Vocational Schools.

The curriculum

At primary level, educational curricula and timetables have in the past been drawn up by the Pedagogic Institute. In 2011, the Pedagogic Institute was replaced by the Institute of Educational Policy (IEP), which is responsible for providing opinion and recommendations on issues related to

primary education programmes, school textbooks and other teaching instruments. Their recommendations are implemented in all primary education schools country-wide. Current primary education curricula fall under the integrated philosophy of the Interdisciplinary Single Curriculum Framework for Compulsory Education (DEPPS). The interdisciplinary approach defines the structure of autonomous subject teaching on the basis of a balanced horizontal and vertical distribution of teaching material and promotes cognitive subject interconnection as well as basic concepts such as global analysis. In addition, the innovative 'Flexible Zone of Interdisciplinary and Creative Activities' is also a part of the DEPPS. Curricula are compulsory for all teachers with regard to teaching material content and distribution in all six primary school grades. ICT has been added for one hour for grades A and B (between 6 and 8 years of age), and for two hours for the remainder of the grades.

At lower secondary level, the curricula are drawn up by the Pedagogical Institute and are proposed to the Ministry of Education and Religious Affairs, Culture and Sports. The Pedagogical Institute makes proposals about the textbooks for use by pupils and teachers, based on the approved curricula. The curricula serve as complete guides for teaching and include: explicitly stated purposes for each subject, in the context of the general and grade-specific aims of education; and indicative guidelines on methods and teaching media, in each subject. Curricula are drawn up, tested experimentally, and evaluated and reviewed, in line with developments in scientific knowledge about education. In addition to the curriculum, innovative actions have been introduced in secondary education, such as Health Education, Youth Entrepreneurship, Environmental Education, the Flexible Zone of Innovative Actions, Cultural programmes, and School Vocational Orientation programmes.

At upper secondary level, the curricula and timetables have been created by the Pedagogical Institute. The Pedagogical Institute was replaced in 2011 by the Institute of Educational Policy, which among other things, offers consultation and makes suggestions about issues concerning secondary education study programmes, school books and other teaching needs. The curricula serve as a complete guide for teaching and include: explicitly stated aims for each subject, in the context of the general and grade-specific aims of education; a syllabus organised in units; and indicative guidelines on the method and teaching media, in each subject.

Digital technologies and schools

At primary level, special emphasis is placed on the wider inclusion of ICT in the educational process. To this end, the Ministry of Education and Religious Affairs provides software for classroom use. There are two websites operated by the Ministry of Education and Religious Affairs, displaying ranges of teaching and educational material. It should be noted that these websites offer interactive communication and teaching support channels, given that teachers and schools can post relevant educational material on them. In parallel, primary school facilities are extended with computer laboratories.

At lower secondary level, a significant effort is invested in laboratory teaching for subjects in the natural sciences as well as supporting the teaching and the application of information and new technologies. The upgrading of teaching processes is carried out through equipment programmes concerned with the creation of portable laboratories and the supply of IWBs. Lower secondary schools are provided with: a portable laboratory including fifteen laptops along with necessary software; a storage locker with wheels for the safe keeping and charging of the computers; a WiFi Access Point along with necessary software, as well as the necessary respective services of delivery, installation, on-site training and maintenance of the equipment; and interactive systems for all grades and classes, with each one including an IWB, a laptop connected to the IWB and a digital projector, a digital projector stand, wiring and electrical material, in addition to the system training of users. Additionally, there is an educational Web portal[2] that gathers and disseminates online educational supporting material in digital form available to the entire community of educators. The portal offers specific teaching materials to interested parties, overall certified educational software that has been

[2] www.e-yliko.gr

produced over the last ten years by the Ministry of Education, together with supporting material for all lessons and levels of secondary education (lower and upper).

At upper secondary level, each school unit is equipped with a laboratory for information technology and computer applications, the basic mission of which is to teach computer science and computer applications as defined by the study programmes and according to wider educational goals. The information technology laboratory offers complementary activities to the educational process, offering contemporary and interactive ways of learning and training through the teaching of subject topics with the use of certified educational software and the Internet, the support of project-based learning in the framework of the school's activities or European cooperation actions, and the broadening of purely taught activities (enhanced teaching, additional teaching support, etc.). The school laboratory for information technology and computer applications is equipped with: computer equipment (hardware and software); peripheral devices; networking equipment (hubs, switches, modems, routers); projectors etc.; passive equipment (network and electrical installations); software in the form of CDs, DVDs, discs, software manuals, software licenses, as well as other complementary material (guides and manuals); books and publications, as well as document files relevant to laboratories for physical sciences and information technology lessons; and instructional material (stationery, projection screen material) and furniture (bookshelves, lockers, and a whiteboard). Additionally, the educational Web portal gathers in one place educational support material in digital form that is available to the entire community of educators.

However, there is no specific reference to handheld mobile devices and their use in the classroom. But there are on-going reforms and policy developments regarding ICT. It is recognised that there is a need for a new strategy regarding primary and secondary education, where the digital dimension will be integrated to modernise current educational processes and administration of education, and that this has become an urgent issue. The following actions are said to be already being implemented or scheduled: the creation and use of an educational platform and digital content; interactive media and classroom equipment; high-speed connections to the Internet for all schools; support of digital actions and infrastructure; and training in the use of digital media.

General teaching methods and training

At primary level, teachers must implement the curricula, taking into consideration any special conditions prevailing in their classes, in order to achieve the stated educational objectives. Primary Education School Advisors strongly encourage the implementation of new, more effective teaching methods. They advocate the implementation of innovations introduced in education, undertake initiatives regarding teacher training and encourage the use of modern education technology tools. At lower secondary level, all methods of modern pedagogy are applied, depending on the subject to be taught and the various teaching aids used.

At upper secondary level, the application of modern teaching methods depends on the subject, and the use of traditional as well as modern teaching materials constitute a major aim for educational practice. In the framework of the principles that serve the 'New School', starting from the school year 2012-2013, the second grade (B) of the 'General Upper Secondary School' and the second grade (B) of the 'Evening General Upper Secondary School' are introduced to research projects as a distinct section of the study programme. All research projects involve the use of technology and the Internet, and they are uploaded onto the Web after their completion, so that the education community may have access to them. At vocational upper secondary and post-secondary non-tertiary level, there is use of a school laboratory for information technology and computer applications as well as access to the educational Web portal.

Teacher training

Greece does not have an official national curriculum or guidelines regarding the use of handheld technologies for teaching and learning. It has an official curriculum regarding the teaching of ICT to

pupils in elementary (primary) schools[3]. However, this curriculum does not include the use of handheld technologies and it is concentrated almost exclusively on PCs. There are official guidelines for teachers who will teach this course, entitled "Use of ICT"[4], but again handheld technologies are not mentioned. There is an official platform called "Digital School"[5] which proposes methods to use and offers material using ICT in the classroom, and another official platform which offers suggestions and material for teaching various subjects with the use of the ICT[6]; however, no mention is made of handheld technologies.

Teachers are able to attend frequent conferences where best practices are presented (in the general field of ICT in education). Each year there is a Pan-Hellenic conference focusing on the issue of the introduction and uses of ICT in education, attended by a large number of delegates. The last conference was organised in May 2013[7]. There are other conferences organised on the topic of the uses of ICT in education. Additionally there are some specific portals that promote the use of ICT in education such as the website of the Greek Association for the Use of ICT in Education[8] and the website of TPE-Education[9], and there are some exhibitions (such as the e-learning exhibition[10]). All these initiatives are not exclusively dedicated to the issue of the use of handheld technologies but are concerned more with the broader context of the uses of ICT in education. Few best practices concerning the use of handheld technologies are presented, with most of the entries related to uses of the computer.

Research into uses of ICT in education has been undertaken by the University of Piraeus (through the Department of Technology Education and Digital Systems). There has been a postgraduate thesis[11] on the subject of uses of handheld technologies in education in general but not specifically in secondary education, written by Marinos Charchalos. Research has also been undertaken by the Ionian University (ICT Department). The Ministry of Education has established a specific organisation for research into the use of ICT in education, called ITIE Diofantos[12]. Other research includes that described in specific presentations[13]. Researchers on the subject have published on the website of the Greek Scientific Union[14]. However, most of the research concerned with the potential of the uses of handheld technologies in education is not about their actual use as the actual use of these technologies in Greek schools has been minimal.

No research has been undertaken exclusively on the issue of teacher training of handheld technologies. There has been research in the field of teacher training in the use of ICT, but no specific mention has been made to handheld technologies.

Initial teacher training programmes in Greece are announced through all university pedagogical departments as well as on the major Web portals that relate to teachers and educational issues. Teacher training programmes are not standardised, because they depend on the availability of EU funding. The use of ICT in education is a very popular issue that frequently makes up a part of initial teacher

---

3 https://www.google.gr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&ved=0CEQQFjAD&url=http%3A%2F%2Fdipe.fth.sch.gr%2Fdidaskalia_programma_spoudon_neon_didaktikon_adikeimenon__eaep.doc&ei=q-KtUvvGHYOEtAbCuoCYAw&usg=AFQjCNFa0kPp06hWmgusD-qwd2GGAY9bCw

4 http://www.oepek.gr/pdfs/tpe_eaep_800sch.pdf

5 http://dschool.edu.gr/

6 http://www.e-yliko.gr

7 http://www.ask4research.info/etpe2013/

8 http://www.e-diktyo.eu/

9 http://www.tpe-education.com

10 http://www.elearningexpo.gr

11 http://digilib.lib.unipi.gr/dspace/bitstream/unipi/1752/1/Charchalos.pdf

12 http://www.cti.gr

13 http://www.slideshare.net/nickaman/mobile-learning-8537061, http://www.slideshare.net/fotaras7/mlearning-5347198, http://www.ekped.gr/praktika10/posters/031.pdf, and http://cgi.di.uoa.gr/~grad0989/thesis.pdf

14 http://www.etpe.eu

training programmes. Handheld technologies are sometimes mentioned in these programmes, but they are never the main object of learning. The main institution that is responsible for initial teacher training in Greece is ASPETE[15], which organises classes on the use of ICT in education, where handheld technologies are mentioned. There is a specific laboratory for pedagogical applications in ASPETE, and it also organises seminars for initial teacher training on the uses of ICT. Initial teacher training is additionally provided by all Greek universities with a pedagogical department.

In terms of in-service teacher training, teachers usually get information from inside their schools, responding to calls for interest sent out by the Ministry of Education for the attention of all teachers. This information is sent out also by main organisations, supervised by the Ministry of Education, which are responsible for the in-service training of the teachers, such as the Pedagogical Institute[16] or the Institute of Educational Policy[17]. Training initiatives are also announced on important educational sites[18] or on other local media and educational websites. The main in-service teacher training programme is the "Training of teachers for the valorisation and implementation of ICT in education". This is a large-scale training programme organised by the Ministry of Education for teachers, funded and supported by the framework of the European Social Fund[19]. These training events take place according to a framework from the University Teacher Training Centres. The design of educational activities with mobile technologies is a small part of the curriculum. In total and to date, some 28,100 teachers of primary and secondary schools have been trained through this programme as well as 760 trainers. Other training seminars and training sessions are organised at a regional level, frequently in cooperation with universities. There is no specific and standard list available, because the training depends on the availability of European funds for their organisation.

The main institution that provides training on the use of ICT in education (with a small part dedicated to mobile technologies) is the Ministry of Education, through the above-mentioned programme, in co-operation with the universities. In-service seminars are also organised by educational departments of universities. Other seminars are organised by EU-funded projects (on the general issue of uses of ICT in education).

Current key obstacles to using handheld technologies in the classroom

There is a Ministerial Decision that prohibits the possession of mobile telephones (or any other device that allows the capture and editing of sounds or images) by students inside school premises, and this Decision requires teachers to have their mobile telephone turned off while on school premises. There was a national debate regarding this Decision, which has been considered as a very important obstacle to the introduction of handheld technologies in the classroom[20]. Also, teachers, on the basis of some research[21] have been found not to have the necessary skills in using (generally) ICT in education, and they do not have fundamental knowledge of pedagogical theories on how to validate ICT in education. Additionally, the necessary ICT infrastructure in schools is frequently missing. There is sufficient guidance from the Ministry of Education on uses of ICT, but not on uses of handheld technologies in the classroom. The guidance and the subsequent training that is available are almost always limited to uses of computers.

[15] www.aspete.gr
[16] http://www.pi-schools.gr/
[17] http://www.iep.edu.gr
[18] www.alfavita.gr
[19] http://b-epipedo2.cti.gr
[20] http://www.enet.gr/?i=news.el.article&id=103003
[21] https://www.google.gr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&ved=0CDkQFjAC&url=http%3A%2F%2Fwww.etpe.eu%2Fnew%2Fcustom%2Fpdf%2Fetpe280.pdf&ei=lP-tUuCGAsjVsgbW4YCABg&usg=AFQjCNFegs-YYginY1-oFpUwMNgJKfcYvQ

Current key drivers to support uses of handheld technologies in the classroom

The teaching of ICT is included in the school curriculum. Wider inclusion of ICT in education is encouraged. Teaching materials are shared by teachers through websites, including teaching materials using ICT. The adoption and use of different pedagogies to suit individual and group needs are encouraged. Research into uses of ICT in education has been undertaken in some schools in Greece.

6. THE NETHERLANDS IN CONTEXT

The educational system

The education system in the Netherlands is decentralised. Up to their fourth birthday, children can attend a day nursery or crèche. Every child must attend school full-time from the age of five years; however, nearly all children start going to school at the age of four years. Primary education lasts eight years, after which, around the age of 12 years, pupils opt for one of three types of secondary education: pre-vocational secondary education (VMBO, which takes 4 years); senior general secondary education (HAVO, 5 years); or pre-university education (VWO, 6 years). Most secondary schools are combined schools, offering several types of secondary education so that pupils can transfer easily from one type to another. Young people aged 18 years or over can take adult education courses or higher distance learning courses.

There are 6,800 primary schools in the Netherlands. This number includes non-denominational public-authority schools, privately-run, denominational schools, mainstream schools that also cater for pupils with special educational needs, and special schools for children with learning disabilities or behavioural problems. Years 1 to 4 (4- to 8-year-olds) are known as the 'juniors' and years 5 to 8 (9- to 12-year-olds) as the 'seniors'. Alternatively, the school may be divided into junior, middle and senior sections (years 1 to 3, 4 to 6, and 7 to 8 respectively).

There are 700 secondary schools in the Netherlands. There are four kinds of secondary education: practical training; pre-vocational secondary education (VMBO); senior general secondary education (HAVO); and pre-university education (VWO).

The curriculum

At primary level, the Primary Education Act 1998 and the Expertise Centres Act require schools to teach various subjects. An indication is given in each subject of what pupils must learn, defined in the form of attainment targets and benchmarks. Attainment targets indicate what schools must offer pupils in terms of teaching matter, focusing not only on cognitive and emotional development, but also on creativity and social, cultural and physical skills. The benchmarks define what pupils must have acquired by the end of mainstream primary or special education. Schools are free, within the framework set by the government, to decide how much time is spent on the various subjects and areas of the curriculum, and when this happens. The only restriction relates to the minimum number of teaching periods per year, which is laid down by law.

At secondary level, there are no detailed regulations with regard to the curriculum (content, teaching methods or materials). Some schools organise their teaching according to a particular educational theory. These include Montessori, Dalton and Jena Plan schools, which may be public-authority or private. The subject matter covered and the teaching methods used must be described in the school plan. The leaving examination regulations (syllabuses) provide guidance as to the content of the various curricula.

Digital technologies and schools

At primary level, nearly 90% of primary school teachers use computers as teaching aids. The popularity of IWBs has grown quickly, and many primary schools in the Netherlands now have at least one that is used every day. There is an average of one computer for every four to five pupils. Software makes up about 15% of teaching materials in primary schools. More than half of all teachers use subject-specific drill-and-practice software or other curriculum-related software. It is found that

educational software: makes learning more fun; enhances the children's learning environment; and offers more opportunities for customised teaching and independent learning.

At secondary level, more than half of schools have set down their views on the use of ICT in an ICT policy plan, which they are also implementing. On average, teachers use computers as teaching aids for about four hours a week, primarily for word processing or finding information on the Internet. The number of secondary school teachers using computers rose by 3% between 2009 and 2010. At this rate, it is estimated it will take another 10 to 15 years before all teachers have adopted ICT teaching aids. There is an average of one computer for every six pupils, many schools have a digital library and computer work areas for groups, and many secondary schools have IWBs.

In May 2013, a technology pact (Techniekpact 2020) was concluded, based on a partnership between businesses, unions and educational institutions. Collaboration is felt to be the key to popular and practical technical education that will dovetail with labour market requirements. The technology pact brings together the business community, employers, workers, education (both private and government-funded), pupils and students, and regional and central government authorities – all of whom have a part to play. The aim of the technology pact is to make education more relevant to the world of technology and work through better cooperation between the government, education and the business community, and thus to reduce the shortage of qualified technical personnel.

General teaching methods and training

Teaching approaches in the Netherlands are concerned with supporting a stated quality-centred agenda, focusing on language, numeracy and investment in teachers. Promoting innovation in education is a stated intention. It is felt that innovative learning models and teaching materials can safeguard the quality of education, so the government supports schools engaged in innovative activities, notably by making it easier for them to share knowledge and increasing the statutory scope for innovation. Digitalisation in education is a part of the agenda; key digital data in education includes up-to-date information about test results and individual learning gaps, information about a school's overall performance, and financial statement data. Much of this data is made available to the public through the Open Education Data portal of the Education Executive Agency (DUO). ICT agreements and knowledge centres are concerned with the agreements and standards needed for collaboration in the field of ICT, which are listed in the ROSA reference database available in wiki form. Schools and other educational institutions can turn to several knowledge centres for ICT advice and guidance, such as Kennisnet and SURF, Sambo ICT, SchoolInfo and SION (but only Dutch versions are available for access).

There is no national curriculum or guidelines in the Netherlands that indicates uses of handheld technologies for teaching and learning. Teachers get information about uses of ICT and handheld devices from the Internet[22] and ICT-coordinators share literature about good practice. Key institutions or groups that have undertaken research in the Netherlands into uses of handheld technologies in secondary school classrooms include Kennisnet and others with specific websites[23]. Kennisnet and AB-ZHW have undertaken research exploring teacher training involving handheld technologies in secondary school contexts[24].

In the past 7 years, Kennisnet has conducted a wide range of research in the area of benefits of ICT in primary and secondary education. These are undertaken through scientific research practice (evidence-based) regarding resources on teacher development of mobile learning practices. The research results have been reported to their target groups in Dutch. All reports can be found on their database of research[25]. Two studies on benefits of mobile devices are available in English[26]. Kennisnet's online

[22] www.kennisnet.nl
[23] www.kennisnet.nl; www.innofun.nl; www.abzhw.nl; www.p21.org; www.atc21.org; http://nces.ed.gov/nationsreportcard
[24] www.kennisnet.nl and www.abzhw.nl
[25] http://www.kennisnet.nl/onderzoek/alle-onderzoeken/

magazine (4W) provides teachers with discussions about general principles concerned with professional practice and benefits of ICT. The magazine is only available in Dutch[27], although one edition (October 2013) on "Know what works and why" was published in English as well as in Dutch. Kennisnet produce an annual 'Four in Balance Monitor' where the latest state of affairs and benefits in the field of ICT and education are reported. These monitors are translated into English[28].

A newly established National Transition Board for Education Research[29] (NRO) is part of the Dutch Organization for Scientific Research (NWO). Their website includes details of review studies[30].

Teachers get information about initial teacher training programmes via e-mail sent to schools. There is no known country list of initial teacher training programmes that involve uses of handheld technologies in teaching or learning. Key institutions that undertake initial teacher training with uses of handheld technologies in secondary school classrooms are Kennisnet and AB-ZHW[31]. Information is sent to schools via email about in-service teacher training programmes. There is no known country list of in-service teacher training programmes that involve uses of handheld technologies in teaching or learning. There are no known key institutions or individuals that undertake in-service teacher training with uses of handheld technologies in secondary school classrooms.

Current key obstacles to using handheld technologies in the classroom
The current key obstacles to using handheld technologies in the classroom are considered to be budget, lack of availability of educational programmes that can be used, and lack of research about improvements that handhelds bring to learning.

Current key drivers to support uses of handheld technologies in the classroom
Schools have authority to develop practices according to their identified needs. Many schools have ICT facilities and these are used by many teachers. Benefits of using ICT for teaching and learning are recognised, and promoting innovation is a stated intention of education. There are a known number of centres that support teachers in using ICT. Research into uses of ICT in teaching and learning is already undertaken in schools. There are recognised mechanisms for sharing teaching materials and practices.

[26] http://www.kennisnet.nl/onderzoek/alle-onderzoeken/mobile-learning-a-case-study-with-fifth-graders/; Sandberg, Maris and Hoogendoorn, no date
[27] http://4w.kennisnet.nl/
[28] http://www.kennisnet.nl/onderzoek/alle-onderzoeken/Four-in-balance-monitor-2012/, for the most recent publication
[29] http://www.nro.nl/
[30] http://www.nwo.nl/onderzoek-en-resultaten/programmas/programmaraad+voor+het+onderwijsonderzoek+%28proo%29/verschenen+review+studies
[31] www.kennisnet.nl and www.abzhw.nl

7. THE UNITED KINGDOM (ENGLAND) IN CONTEXT

The educational system

Central government has overall responsibility for the education system in England, but responsibility for the education service is decentralised, lying with local authorities, voluntary providers (including churches), and the governing bodies of education institutions. Overall responsibility for the education service in England lies with two departments of the UK government: the Department for Education (DfE) and the Department for Business, Innovation and Skills (BIS). DfE responsibilities include: planning and monitoring the education service in schools and early years' settings; ensuring the provision of integrated services for children; and bringing together policy relating to children and young people. BIS is responsible for: science and innovation; skills; further, adult and higher education; and enterprise.

There are 16,784 state-funded primary schools in England. These provide for pupils in Key Stage 1 (years 1-2) aged 5–7 years, and in Key Stage 2 (years 3-6) aged 7–11 years. There are 3,281 state-funded secondary schools, providing for pupils in Key Stage 3 (years 7-9) aged 11–14 years, and in Key Stage 4 (years 10–11) aged 14–16 years.

The curriculum

At primary level, the National Curriculum was first introduced in 1989.The Department for Education (DfE) has overall responsibility for the school curriculum. At Key Stages 1 and 2 (for pupils aged 5 to 11 years), the statutory subjects that all pupils must study are: English, mathematics and science (the 'core' subjects), while art and design, design and technology, geography, history, information and communication technology (ICT), music, and physical education are the 'foundation' subjects. For each compulsory subject, with the exception of ICT, and for each Key Stage, statutory programmes of study set out what pupils should be taught, and attainment targets set out the expected standards of pupils' performance. It is for schools to choose how they organise their school curriculum to include the programmes of study. When planning this, schools need to consider four stated general teaching requirements: use of language; use of ICT; health and safety; and inclusion.

At secondary level, the curriculum which pupils experience is made up of three curriculum elements. The National Curriculum – comprising statutory 'core' and 'foundation' subjects, set down by the Secretary of State in 'programmes of study' (what pupils should be taught) and 'attainment targets' (expected standards of pupil performance). The National Curriculum is currently under extensive review and a new National Curriculum will be introduced in September 2014. The Basic Curriculum – statutory curricular requirements in addition to the National Curriculum at Key Stages 3 and 4 are religious education and sex education. Except for religious education, schools determine the specific nature of provision within the 'basic curriculum'. The Local Curriculum – schools have discretion to develop curriculum provision in addition to the above, in order to reflect their particular needs and circumstances. Schools provide programmes of personal, social, health and economic education and may provide, at Key Stage 4 (for pupils aged 14–16 years), vocational-related education. For each compulsory subject, with the exception of ICT, and for each Key Stage, statutory programmes of study set out what pupils should be taught, and attainment targets set out the expected standards of pupils' performance.

Digital technologies and schools

The curriculum requirement for ICT is that pupils should be given opportunities to apply and develop their ICT capability through the use of ICT tools to support their learning in all subjects. At primary level (Key Stages 1 and 2), it is statutory to teach the use of ICT in English, mathematics and science. Teachers use their own judgment to decide where it is appropriate to teach ICT across these subjects. At secondary level (other Key Stages), there are statutory requirements to use ICT in all statutory subjects, except physical education (PE). On 11 June 2012, following a public consultation, the Secretary of State confirmed that the programmes of study and associated attainment targets for ICT would be dis-applied from September 2012. This was in response to criticisms of the inadequacy of the current ICT curriculum. However, ICT remains a compulsory National Curriculum subject at all 4 Key Stages in 2013 to 2014.

Schools are free to develop their own ICT and computer science curriculum. This is an interim arrangement until September 2014, when the new National Curriculum will be introduced. From September 2014, ICT will be replaced by computing, with new statutory programmes of study. All primary and secondary schools have a range of ICT tools available for use by teachers and pupils. These may include computers, digital cameras and handheld devices. Interactive teaching with IWBs is widespread, as is access to virtual learning environments and other digital resources. Until it closed in 2011, Becta was the Government's lead agency for ICT in education. Some of its former functions have now been transferred to the Department for Education (DfE) and the Department for Business, Innovation and Skills.

General teaching methods and training

At primary level, the teacher is responsible for ensuring that there are sufficient opportunities for differentiated work for pupils of all abilities. Differentiation is defined as providing learning with experiences that are matched to the needs, capabilities and previous learning of individual pupils. In primary education, teaching normally takes place in mixed-ability groups or classes established to cover single year groups, where possible. Primary schools may group pupils by ability in a particular subject – most commonly in English and/or mathematics. Teaching does not necessarily have to be organised and delivered within subject boundaries; schools may, if they so wish, combine one subject with another and/or teach some aspects in an integrated way, using project work, for example, as a way to teach across the curriculum.

At secondary level, teaching methods and learning materials are decided by the teacher, perhaps in consultation with the head teacher and the head of department. Each teacher is responsible for planning lessons and drawing up schemes of work to ensure that the curriculum meets statutory requirements. Rather than funding centralised programmes, the government devolves funding to schools to allow them to focus on their own priorities for improvement.

Teacher training

Currently there are no government guidelines regarding the use of handheld technology. There are forums and websites where practitioners share practice[32], but there are no set best practices. While there have been a range of smaller research studies undertaken, and some independent projects[33], there has been no comprehensive government research into uses of handheld technologies in secondary school classrooms. There are no known key institutions or groups that have undertaken research exploring teacher training involving handheld technologies in secondary school contexts.

In terms of initial teacher training, teachers get information mainly through online sources[34]. There is no known country list of initial teacher training programmes that involves uses of handheld technologies in teaching or learning. Most institutions or groups that undertake initial teacher training use some handheld technologies, but on a small scale - there are some training programmes using

[32] www.handheldlearning.co.uk
[33] www2.futurelab.org.uk
[34] www.ucas.com or via the Department of Education or other related websites

iPads for particular activities, for example, but this is not widespread. It is not clear where this information would be held centrally.

In terms of information about in-service teacher training programmes, there is no known country list of in-service teacher training programmes that involve uses of handheld technologies in teaching or learning. Any in-service training is generally shared in a school through the school's continuing professional development (CPD) coordinator, which might arise from a specific subject national body (such as the Economics, Business Studies and Enterprise Association - EBEA, the National Association for Advisors in Computer Education - NAACE, etc.) or from sharing of practice across teachers. It is the responsibility of individual schools to identify their CPD requirements. Sometimes the practises shared across local networks may be the most informative in terms of in-service training in the use of handheld technology. Key institutions or groups that undertake in-service teacher training with uses of handheld technologies in secondary school classrooms include Titan Partnership Initial Teacher Training courses, Regional Training Centre Training courses, and activities run by selected staff using handhelds in schools.

Current key obstacles to using handheld technologies in the classroom
The current key obstacles to using handheld technologies in the classroom are felt to be infrastructure (lack of WiFi connectivity), and cost.

Current key drivers to support uses of handheld technologies in the classroom
Schools are able to choose to undertake practices to support teaching and learning according to their recognised needs. The curriculum integrates ICT and computing across subject areas, and ICT is stated as a general teaching requirement that should be considered when planning activities generally. Research about uses of ICT in teaching and learning has already been undertaken in many schools.

8. IMPLICATIONS FOR THE DESIGN OF THE MLEARN TRAINING

Training focus

Mishra and Koehler (2006), from a review of teacher training needs related to digital technologies, indicate that training should provide, in as fully a contextualised and integrated way as possible, a focus on three interconnected elements: technological knowledge (what the device can do and how to use it); content knowledge (what subject and topic can be addressed using the device and applications); and pedagogical knowledge (how this is done through teaching and learning activities).

Teaching practices

In terms of teaching practices, four points to consider are:

- Mobile devices are "finding their way into classrooms in children's pockets" (Naismith et al., 2004, p. 36); educational practice needs to integrate these technologies in productive ways. From published papers reviewed, it can be concluded that teachers in general, and head teachers and senior managers in particular, have found handheld devices to be extremely efficient.
- When using handheld devices, the learning environment tends to be expanded beyond the classroom, due to the features if portability of mobile technologies.
- Some innovative researchers and educators have experimented with different ways of using mobile devices to support learning across Europe, as shown in Table 1 (see pp. 5-8). It is interesting to note that these initiatives identified very few limitations in terms of best practices achieved, so it may be worth reflecting whether mobile learning research is still facing a concern with a "boom momentum" of novelties rather than a focus on the practical challenges of the appliances.
- Mobile technologies can be utilised to create a new learning process, focusing on the notion of interwoven learning interactions. The key issue here is that the social cognitive notion is not concerned with the technology alone in giving rise to interwoven interactions. The suggestion in that there should be a good match between the mobile technologies adopted, social behaviours enacted, roles assigned to each student, tasks pursued, and the rules or theories of subject content. Therefore one can conclude that mobile technologies add a new dimension to learning activities, because of both the personal and portable nature of the devices themselves as well as the kinds of learning interactions they can support (Ting, 2013).

Teaching methods

In terms of teaching methods, three points to consider, particularly regarding challenges that teachers, educators and other actors face due to rapid growth and developments, are:

- Effective implementation of mobile learning initiatives has to be aligned with new challenges.
- It is known that current trends in mobile learning are towards handheld devices that are even more embedded and networked than those available today. The capabilities of the current handheld devices will transform everyday activities by providing the ability to capture details about the time, location and people around us. Such handheld devices can have a great impact on learning and subsequently on teaching methods applied. In this respect, teachers, apart from consulting Internet-based resources on the move, will be able to manage the administration of their own teaching workload through consultations with their diaries alongside those of their institutional-based environments. In addition, there is a role for considering new assessment practices with these new teaching methods. Handheld PCs could broaden the range of assessment tasks and could be better aligned with inquiry-oriented instruction. These devices create new ways for students to express themselves and expand the range of assessment methods, as well as opportunities for distributed collaboration and mobile team working being significantly enhanced (Naismith et al., 2004).
- The mobile learning literature offers a framework to evaluate handheld devices' characteristics. A pivotal study (Economides and Nikolaou, 2008) allows teachers, educators, policymakers, researchers and others to plan future mobile learning interventions by taking advantage of the best practices/lessons learnt in terms of handheld devices in order to support or enhance learning.

Pedagogy

In terms of pedagogy, three points to consider are:

- A learner's social interaction could be pedagogically utilised to support each student's individual social aspect of learning. This aspect of pedagogical design sheds new light on how to create new possibilities for learners to explore collaboratively a subject domain, as well as to develop new theories in order to facilitate our understanding of how learning takes place under these circumstances. With regards to learning aspects, the current literature suggests that handheld devices have the potential to promote the students' motivation to learn and enhance their peer collaborations (Wu and Zhang, 2010).
- Current research states that inexpensive and portable handheld devices require less difficult pedagogical adjustments and could facilitate formative assessment solutions (Wu and Zhang, 2010).
- Mobile technology has the potential to change the very nature and processes of pedagogy. While mobile technology can effectively support a wide range of activities for learners, it provides for each one to have a personal interaction with the technology in an authentic and appropriate context of use (Naismith et al., 2004).

Learning activities

In terms of learning activities, points to consider are (Passey, 2013, pp. 1-2):

- Features and affordances of mobile devices (and particularly iPads) are described in ways indicating they are "strongly focused on aspects of communication".
- There are a wide range of applications (Apps) that can be used on mobile devices (including the iPad), "but levels of use and forms of use to support learning are likely to depend both on the range of Apps available to support specific subject and topic needs, and teacher knowledge of how to use these, operationally and pedagogically".
- Training needs "to identify many Apps that can meet specific subject and topic needs".
- Teachers have "applied features and Apps to support a range of pedagogies, including those involving and using elements of communication and discussion. Mobile devices have been integrated into activities to support and develop co-operative working, independent learning, motor skills, and engagement".
- Teachers have indicated how "mobile devices have supported curriculum needs through appropriate applications in activities involving research, capturing and using imagery and video clips, presentations to teachers and peers, discussions of captured and presented work with teachers and peers, recording and sharing ideas with peers, providing anonymous feedback, pupils creating their own notes and books in multimodal formats, discussion of strengths and weaknesses in presented work shared by pupils, creating videos for presentation to wider audiences, presentation of perfect models or techniques, organising notes and work, and pupils recording video clips of lessons for later playback".
- It should be recognised that "some individuals have benefited greatly from uses of mobile devices, while others have not benefited to the same extents".
- The "features and Apps on mobile devices that focus on elements and aspects of communication offer particular support for pupils through enhanced communication. Pupils with special needs, in communication and motor areas, as well as pupils in hospital schools and remote locations, have been supported effectively by appropriate uses of mobile devices".
- Reports indicate that "some specific learners in hospital schools have been supported effectively with uses of iPads. Aspects of communication, uses of multi-modalities, and ease of access and handling are highlighted particularly in this respect".

Learning outcomes and impacts

Research shows that selected activities can benefit from the affordances of mobile technologies and can support higher cognitive and metacognitive levels of learning (Passey, 2010, p. 69):

- "Review and reflect", where "pupils capture audio, imagery and video during lessons, used in plenary sessions to reflect on what has been covered, the key elements learned, how these fit into wider pictures, and how ideas might be taken further outside the classroom".

- "Think forward", where "pupils access future topics via the Internet and capture relevant thoughts or ideas to contribute to these in class or through on-line discussions".
- "Listen to my explanations", where "pupils record audio to complete homework assignments and these verbal explanations are marked by teachers".
- "Snap and show", where "pupils capture imagery that is downloaded, for wider pupil discussion, made accessible to parents so that they can see and discuss events that have happened in school".
- "This is what I've done and how I've done it", where "pupils create presentations of how they have used mobile technologies to tackle particular activities, these are recorded and made accessible on appropriate web-sites for teachers and parents to see".
- "Tell me how I could improve this", where "pupils share their work in multimedia formats with peers, mentors, teachers or trusted adults in order to seek evaluative feedback, assessments of their work, and ideas for improvement on which they can act".
- It can be argued that "it is these forms of activity that need to be developed and exploited more, if mobile technologies are to feature strongly, in providing support for learning in ways that other technologies cannot provide (since mobile technologies allow ideas or examples to be captured at a point in time when and in a place where these are generated or observed, they allow conversation and discussion at times when and in places where points of interest arise, and they allow sharing of captured or saved work items in places in context".

Reading and writing

For reading and writing the size of screen needs to be considered carefully. Pilkington (2013) highlights the following with regard to reading and writing with specific mobile devices (iPads):

- In one class in one school, "the only child who did not show target progression during the year was absent from school for several weeks. The other children all improved in line with their target and teachers felt that this was a good result at a time where children are at risk of slipping behind" (p.8).
- The pilot observation showed "some children are more fluent and produce better structured writing with fewer sentences that are joined more effectively in their iBooks when compared with their pre-iPad handwritten text. Other children (and sometimes the same children) also lapse in punctuation or spelling in their iBooks" (p.8).
- Observing the children's iBook stories and reports, "children were including sound recordings of their own voice as well as text and pictures to form multi-modal texts. Children were therefore developing multi-modal literacy skills using the iPad; multi-modal literacy is the blending of sound, pictures and text in an integrated way to communicate meaning which is an essential workplace skill for the next generation" (p.8).
- The pilot showed that "children use their iPads at home to research topics for themselves and their work also evidences development of multi-modal literacy skills; mastering a sense of audience and writing creatively. Moreover, based on initial observation and feedback from parents, children are being exposed to a wide range of applications with wider potential for learning than literacy alone e.g. to develop digital artwork or to compete in online mathematical problem-solving games" (p.8).
- Perhaps importantly, "parents report that children are learning independently the skills of *how to learn* and taking a mature responsibility for their own learning. The future impact of this is as yet unknown" (p.9).

References

Avvisati, F., Hennessy, S., Kozma, R.B. and Vincent-Lancrin, S. (2013). *OECD Review of the Italian Stratgy for Digital Schools*. Accessible at: http://www.key4biz.it/files/000218/00021896.pdf

Department for Education (2013). *Primary National Curriculum until 2014*. Accessible at: http://www.education.gov.uk/schools/teachingandlearning/curriculum/primary

Department for Education (2013). *Statistical First Release 21: Schools, Pupils, and their Characteristics*. Accessible at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207670/Main_text-_SFR21_2013.pdf

Dykes, G. and Knight, R.H. (2012). *Mobile learning for teachers in Europe. Exploring the potential of mobile technologies to support teachers and improve practice (teacher focus)* (p. 38). Paris, France: UNESCO. Accessible at: http://unesdoc.unesco.org/images/0021/002161/216167E.pdf

EACEA (2014). *Eurydice*. Accessible at: http://eacea.ec.europa.eu/education/eurydice/eurypedia_en.php

Economides, A.A. and Nikolaou, N. (2008). Evaluation of handheld devices for mobile learning. *International Journal of Engineering Education, 24* (1), 3-13.

Koshman, S. (2011). iSchool agenda: mobile context research and teaching. In *Proceedings of the iConference 11*, ACM Press, pp. 211–216. Accessible at: http://portal.acm.org/citation.cfm?doid=1940761.1940790

Kukulska-Hulme, A. and Traxler, J. (2005). *Mobile Learning: A Handbook for Educators and Trainers*. London: Routledge.

Ministerio dell'Istruzione, dell'Università e della Ricerca (no date). *Ufficio di Statistica*. Accessible at: http://statistica.miur.it/normal.aspx?link=pubblicazioni

Ministry of Education and Religious Affairs, Culture and Sports (no date). *The Hellenic Ministry of Education Official Educational Portal*. Accessible at: http://www.e-yliko.gr/default_en.aspx

Ministry of Education, Culture and Science (2012). *Key Figures 2007-2011: Education, Culture and Science in Netherlands*. Accessible at: http://www.government.nl/files/documents-and-publications/reports/2012/07/24/key-figures-2007-2011/key-figures-internet-2012.pdf

Mishra, P. and Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record, 108* (6), 1017–1054.

Naismith, L., Sharples, M., Vavoula, G. and Londsale, P. (2004). *Literature Review on Mobile Technologies and Learning (Report No. 11)*. Bristol: Futurelab. Accessible at: http://telearn.archives-ouvertes.fr/docs/00/19/01/43/PDF/Naismith_2004.pdf

Passey, D. (2010). Mobile learning in school contexts: Can teachers alone make it happen? *IEEE Transactions on Learning Technologies: Special issue on mobile and ubiquitous technologies for learning, 3* (1), 68-81.

Passey, D. (2013). *Titan Partnership – iPads Study: Final Report*. Lancaster: Lancaster University.

Pilkington, R.M. (2013). *The write pad? Perceptions of the impact of the iPad on writing skills*. Birmingham: BeLF.

Sandberg, J., Maris, M. and Hoogendoorn, P. (no date). *The added value of a gaming context and intelligent adaptation to a mobile learning application*. The Netherlands: Kennisnet.

Shohel, M.M. and Power, T. (2010). Introducing mobile technology for enhancing teaching and learning in Bangladesh: teacher perspectives. *Open Learning: The Journal of Open and Distance Learning, 25* (3), 201–215.

Techniekpact 2020 (no date). Accessible at: http://www.techniekpact.nl/download/?id=1051

Ting, Y.-L. (2013). Using mobile technologies to create interwoven learning interactions: An intuitive design and its evaluation. *Computers & Education, 60* (1), 1–13.

Traxler, J. (2007). Defining, Discussing and Evaluating Mobile Learning: The moving finger writes and having writ . . . . *The International Review of Research in Open and Distance Learning, 8* (2). Accessible at: http://www.irrodl.org/index.php/irrodl/article/view/346/875

Wu, J. and Zhang, Y. (2010). Examining potentialities of handheld technology in students' academic attainments. *Educational Media International, 47* (1), 57–67.

8th February 2014

Any correspondence about this report should be addressed to the first author:

Don Passey
Professor of Technology Enhanced Learning
Centre for Technology Enhanced Learning
Department of Educational Research
Lancaster University
Lancaster, LA1 4YL

Tel: 01524 592314
Email: d.passey@lancaster.ac.uk