m-Learning support for disadvantaged young adults

- a mid-stage review -

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Abstract

m-Learning is a 3-year pan-European project that is funded by the European Commission under the Education Area of the Information Society (IST) Programme and is led by the UK's Learning and Skills Development Agency (LSDA). The project utilises mobile technologies to address the basic literacy and numeracy skills needs of young Europeans aged 16-25 who are outside of formal education, in low-skilled employment or unemployed. Many of these young adults may lack access to a computer – but do use a mobile phone.

New generation mobile phones and hybrid PDA's are turning into 'world phones' or 'microbrowsers' with multimedia functionality. Connectivity is improving and the trend is for devices to become more affordable – so where then is the digital divide? From an m-learning perspective, this paper argues that the key issues reside less in connectivity and phone quality but essentially in where you can contribute, to what extent you can exploit the nature of the Web, where a shift is perceived from supporting the individual to supporting relationships between individuals. Applications developers should accordingly design for interactivity, to promote virtual networked and collaborative learning.

Ultralab's contribution to m-learning is a prototype Internet microportal layer (m-Portal) that utilizes lower and higher level inexpensive portable technologies that are already owned by, or are likely to be readily accessible for, the majority of EU young adults. m-Portal provides access to learning opportunities created by project partners and is also a learning environment in its own right. To ensure that the protoype is need driven, not technology driven, and is attractive to target audiences, m-Portal field research engages young adults as co-researchers.

This paper discusses the iterative design and development of m-Portal in the alpha stage. It raises questions concerning emerging technologies such as WAP 2.0 'push' technology, Mobile games and MMS and their potential for delivering interactive learning opportunities and fostering a culture of learning among disaffected young adults.

Introduction

m-Learning is a pan-European project funded by the European Commission under the Education Area of the Information Society (IST) Programme. The three-year project began in October 2001 with a programme co-ordinated by the Learning and Skills Development Agency (LSDA) in London. Participant organisations include universities and commercial companies based in three European Union countries: Ultralab and CTAD (Britain), CRMPA (Italy) and Lecando (Sweden); details of the overall project and consortium are available from the *m-Learning* website.

m-Learning harnesses mobile technologies to address three social/educational problems specifically relating to many young adults aged 16-24 in the European Union:

- poor literacy/numeracy;
- non participation in conventional education;
- lack of access to web-enabled computers.

These problems may cause the young adults to be unemployed or underemployed: the Moser Report exposes that 20% of UK adults lack even the most basic of literacy and numeracy skills and finds that, particularly in the case of young adults, this may lead to social exclusion and even homelessness. The findings are backed up by 'Basic Skills and Social Exclusion in England', which reports that poor basic skills impact on life chances in relation to the labour market, personal income, social benefits, family life, health, housing, crime and community. 'Preventing and Fighting Social Exclusion' likewise associates new forms of poverty with social and educational needs and deprivations and proposes how adult education can be used as a means of addressing social exclusion.

These concerns are shared within the wider European context, for example the final report of the International Adult Literacy Survey (IALS), based on three rounds of data collection between 1994 and 1999, highlights:

> *'severe problems with literacy and numeracy amongst many countries in Europe and beyond.'*

There is nothing new in the concept that people experience literacy and numeracy problems and associated social exclusion, so if young adults are seen to underperform owing to reasons within their control, for example if they voluntarily choose to drop out of formal education, should they now receive special treatment? The answer has to be an emphatic yes, not only because it would be impossible to draw the line between deserving and undeserving cases - there are other cogent reasons for tackling literacy and numeracy skills needs on a broad front:

- In the prevailing economic situation in Europe, young adults need basic literacy and numeracy skills if they are to help to generate much-needed income and maintain the economy. On a purely pragmatic level therefore, it behoves us to consider the specific needs of educationally disadvantaged young adults.
- Even where target audiences may 'get by' in the workplace, their rate of progress may not correspond to their level of commitment and ability. 'Literacy in the

> Information Age - Tackling Social Exclusion through Improved Basic Skills' finds that action in the area of basic skills is:
>
> > *'a pre-requisite for enhanced capacity for individuals in employment, in education, in community participation and as parents.'*
>
> Educationalists have a moral obligation to strive for learning opportunities and environments conducive to all young adults' self-development and best performance.

The *m-Learning* research and development project is in accord with a general realisation within the UK and within the wider context of Europe of the inadequacies of current provision and the need to invest in research and development initiatives that can give educationally disadvantaged young adults a better future.

It is reasonable to assume that many individuals within m-Learning target audiences lack basic skills because they are disillusioned with, or just not interested in taking part in, traditional education and training. Although e-learning solutions such as Internet cafes for on-line learning may be supposed to be attractive to these audiences and may at first sight appear to offer them the flexible access they need, we know at Ultralab from our experience in working with disadvantaged young adults that sadly many are denied access to such facilities.

The solution may lie in m-learning, i.e. in accessing learning opportunities via mobile technologies. It is widely reported in the press and evidenced elsewhere in research findings (Mobile Youth 2000) that many young adults own, or will have access to, mobile phones. For example, the Foyer Federation (set up to help disadvantaged young people achieve independence by providing affordable and safe accommodation, linked to employment and training opportunities, professional and peer-group support, and a range of other services) reports that a very high proportion, perhaps as high as 80%, of young homeless people in the UK have access to a mobile phone.

There are growing expectations on the part of educationalists and the media that mobile technologies do have a significant contribution to make in education. Certainly with the increasing sophistication of mobile devices, and as applications initially sold as expensive business solutions become more affordable, their adaptation as learning tools becomes increasingly viable. Through the medium of mobile technologies therefore, the *m-Learning* project seeks to bridge 'the digital divide' and to re-engage target audiences in improving their basic skills and working towards life-long learning objectives.

Ultralab's main contribution to m-Learning is a prototype Internet microportal layer (m-Portal) that utilizes lower and higher level inexpensive portable technologies that are already owned by, or are likely to be readily accessible for, the majority of young adults in the EU and that can provide anywhere, anytime access to learning opportunities created by m-Learning partners. From a social-constructivist standpoint, we see the pedagogical value of a successful m-Portal lying in the extent to which it is easy to use, cost-effective and absorbing and can foster autonomous learning; this in turn will depend on the extent to which it can foster a culture of learning via virtual networked and collaborative learning, which is need driven, not technology driven.

Our goal is to create a user-friendly m-Portal that is powerful and empowering - and is a learning environment in its own right. We want *m-Portal* to be a 'liberating structure' (de Bono, 1992) that can promote attitudinal change and qualities such as: adaptability, self-confidence, curiosity, creativity – qualities that may be lacking owing to exposure to curriculum approach that has become 'far too mechanistic' (Barlex, 2003).

Whichever technologies are used for *m-Portal,* common sense dictates that it will need characteristics attractive to target audiences. We are therefore collaborating with lead partners LSDA in a programme of field research. LSDA initial survey findings are summarised as follows:

> *'The main use made of the mobile phones by young adults is for verbal communication, together with text messaging and the indications are that such use will not decline in the near future. Many young adults also play games on their mobile phones, with about half of them considering that mobile phones generally could be used to deliver literacy/numeracy games (even if not to them personally). It appears important to capture their imagination with such games at the outset, which also might appear especially attractive if combined with a music facility (their greatest wish as a feature for the future).'*

Our own field research engages members of the m-learning target audiences as co-researchers; our initial findings confirm those of the LSDA and afford further insights as follows:

> *'Most respondents used phone cards, and used texting, but preferred others to contact them because of cost. Individuals' interests varied but there were signs that phones should be small enough to fit into a pocket and should deliver games, video, music; not all respondents wanted a computer facility but those who did liked a keypad; stylus was used for navigation but also for drawing; interest was evinced in a spellchecker. Not many respondents had a computer with internet access at home.'*

Mid-stage review

mPortal development is currently at mid-way point. Since project inception we have seen new generation mobile phones and hybrid PDA's turning into 'world phones' or 'microbrowsers' with multimedia functionality. Connectivity is improving and the trend is for devices to become more affordable – so is indeed the stage now set for mobile technologies to bridge the digital divide that we originally set out to address? Or do they still not 'cut the mustard' for target audiences – in which case, what are the realistic prospects for m-learning?

This paper reviews current and emerging mobile technologies and usage, raising questions concerning for example WAP 2.0 'push' technology, mobile games and Multi-media Messaging Services (MMS) and their potential for delivering interactive learning opportunities and fostering a culture of learning among disaffected young adults.

The new mobile devices: advantages – and limitations

As the PDA and the cell phone merge, small high resolution, daylight viewable, tactile screens become rapidly affordable, with economies of scale impacting on costs. The hybrid PDA's and the new smart phones have more bandwidth and speed to transfer data and are capable of dealing with the Web, receiving and sending e-mail, as well as storing MP3 files and other data. High screen resolution allows viewing of documents and web pages at full page width without the necessity of horizontal scrolling. All this, together with significantly more processing power, undeniably affords interesting prospects m-learning developers. However, for the sake of inclusivity, at some stage we are going to need to address the problem of visually impaired access to these devices. The eagle-eyed young of today are the visually challenged of to-morrow!

There are still plenty more problems to overcome. We are still not able to make 'one device fit all'. Short-range radio technologies like Bluetooth may make it easier to exchange information between devices, but *en route* you are unlikely to have more than one device with you. The interim solution may lie in some "joined up" thinking where common devices allow access to mobile devices for display. For example, new televisions and new generation fridge displays need to come equipped with Bluetooth access. We also need to think more about how we use our common devices for more than one purpose but especially we need to think about how these devices can be used to capture learning opportunities wherever they arise. The generation of today aren't tied to living rooms for their entertainment - why should they be encouraged towards a 3 inch square mobile phone screen for their learning? We'll need to be sure of the added-value, when proposing m-learning solutions.

Data entry continues to pose problems, despite interesting solutions such as the integrated keyboards offered by Handspring and Blackberry and pen handwriting recognition, supported by a range of "tablet" type personal computers. In a future where the mobile is the personal computing center carried everywhere, we need to plan for bulky devices like data entry keyboards to be provided in trains and buses - built into seat backs and accessed by Bluetooth technology.

It remains to be seen whether people want their phones to be 'cut-down PCs '– the signs from our field research indicates that young adults may not be all that interested. On the other hand we are seeing that camera based phones do engage young people's interest – and what is significant - they can contribute to authentic learning by offering an environment supporting media redundancy and by providing a non notational solution to mapping individuals milestones and progress.

Meanwhile despite a very clear market push towards MMS and other image and sound based messaging and interfaces, the problem is currently that image based services are perceived as a premium rate activity; those who may benefit most immediately from their adoption are likely to be excluded by pricing in the short term.

Desktop e-learning applications are also usually unsuitable for wireless handheld devices; even smart phones can't display large colour graphics or support point-and-click navigation. In the short term, this means rewriting applications to accommodate the constraints, i.e. designing for a small, low-resolution screen with a single window if we

are to reach out to young adults who do not have the latest mobile devices – a huge challenge. Our preference is to design m-learning applications from scratch; in so doing we will be planning for MMS and also for integration of speech recognition further down the track: in Ultralab's mobile based assessment project, advanced use of speech-to-text technology allows learners to generate a full textual transcript from a lengthy spoken viva using mobile or other digital phones.

Traffic management issues

Users of mobile services not infrequently experience network-related delays; these may occur in routing data via the IP suite or where bandwidth capacity is affected by delays in processing network data. It's true that high-speed protocols GPRS and new traffic management protocol IPv6 effects improvements and reduces SMS delay (important for target audiences). However IPv6 still lacks 'killer applications' and does not yet offer the range of features that users have with IPv4. Crucially, quality of service is still hard to deliver even with IPv6, as IP is inherently a connectionless protocol not suited to real time data like video and voice. What *is* encouraging for m-learning however: Ipv6 swings the axis of control of the infrastructure towards common good and public service organisations and is a significant contributor to the EU push for open source and non proprietary software environments.

Broadband also brings big advantages: of key interest to m-learning is the significance of symmetry in bandwidth, in Ultralab experience it is a key component of a broadband learning environment as learners put in and contribute rather than simply download and interact. Although broadband still suffers from the poor investment climate, mobile professionals' need for flexible access to rich data means that change is on its way with video-on-demand and satellite.

There are other promising developments with wireless services that on the face of it could benefit ICT 'have nots': the new Internet services for wireless Web-enabled phones, laptops and PDA's enables these to act as modems. Sadly, bidding for mobile phone licences has led to spiralling costs and could ultimately make high speed access to the Internet too expensive for ordinary people, thereby widening, not narrowing, the digital divide that *m-Learning* potential users may have to bridge.

Roaming is another issue: it will be important for m-learners, not least if they want to widen their scope of peer support and mentoring, but it is still problematic. For example: a 'tri-band' phone is needed for some countries and differences in billing systems between the US and the rest of the world can lead to reluctant roamers.

3G mobile networks: faster access speeds and 'always-on'

3G networks are really, really fast, with a maximum limit of 2 mbps per second if you are stationary and 384 kbps while on the move. These speeds allow 3G mobile networks to support many more subscribers who can download data much faster. At peak times however speeds will be much slower - and more likely to be around the 56kbps that are

already possible over a fixed phone.

There are other considerations: 3G networks promise seamless mobility support, but are built on complex connection-oriented networking infrastructure. They divide each conversation into packets, coding each one to denote which dialogue it is from. Use of these technologies means that your phone effectively stays connected to the network, so that local resources and email are always accessible.

Continuous connectivity brings big changes in the way that you pay for and use your phone, as mobile operators bill you on the basis of the packets you download as opposed to the amount of time online - or they make a single monthly charge for everything. This may well not suit our target audiences, many of whom express preferences for phone cards.

i-Mode

Japan leads on 3G mobile technology with the proprietary *i-Mode* service from Japan's *NTT DoCoMo*, which launched the first full 3G service in October 2001, followed by developments in four regions - UK, Germany, Holland and Ireland. Although in Europe the number of non-voice mobile service subscribers is still less than the number of mobile phone users overall, usage is rising. However high usage predictions may be optimistic, given the following factors:

- In Japan*, i-Mode* is cheap for the consumer. In Europe however, it won't be if companies decide to recoup from the consumer the huge sums they have expended on UMTS licences.
- In Japan users have access to all kinds of email, m-commerce and entertainment services via around 1,100 official sites appearing on the I-Mode menu - and over 24,000 other sites with no official connection to DoCoMo, which can be viewed via the URL or bookmarked to the phone by e-mail; this is nowhere near the case in Europe.
- In Europe many people commute by car, whereas in Japan most users are commuters via bus and rail (where it is easy to use handhelds), also in Japan there is a lack of PC Internet access so 3G, so-called 'mobile internet', is appealing.

Using 3G services such as I-Mode your mobile phone becomes a multi-purpose device, for example holding train tickets, discount vouchers or acting as a key to unlock your house. In Europe however there have been spectrum allocation issues and technical difficulties, plus a huge network implementation effort required. While 3G implementation remains slow here, '2.5G' networks are a good short-term solution and a likely choice for cell phones for the next few years. Longer term there is the prospect of 4G, which is being designed to cater for any shortcomings of 3G. Implementation depends on a range of factors and is many years hence; eventual implementation is likely via phased migration paths, allowing managers to replace or upgrade existing technology at their own pace, for example via upgrading to Voice Over IP (VOIP) in combination with traditional phone services.

Need for open architecture standard

The need to move towards universal interoperability means on the one hand, resolution of competing paradigms: balancing diverse proprietary standards (which stimulate competition) against open standards (which offer universal access). This means merging Next Generation Internet (US federal mission agencies) and Internet 2 (university based, grant aided).

The industry needs end-to-end mobile architecture standards, hitherto, as the GSM Association concedes, competition has inhibited the bringing in of these new technologies.

Nokia's Open Mobile Architecture

According to MobilInfo, Nokia's broader 'Open Mobile Architecture' standard is a big step forward and deserves wide support; unfortunately, not least because of inter-vendor rivalry, this is not likely in the near future. Handset makers and Microsoft have placed emphasis on proprietary but allegedly 'Open' operating systems like Symbian and Windows-powered Smartphone 2002-based phones, but are still expensive. Nevertheless the next push is towards a global, unified network IP-based infrastructure, to bring increased flexibility – and open standards and support.

Programming issues: evolving protocols

With different devices running on competing operating systems and over a variety of wireless network architectures, there is a longstanding need for a common programming environment. WAP has been a standardisation effort by the Wireless Application Protocol Forum Ltd. for delivering wireless data on smart phones and other mobile devices.

Long accepted as a de facto standard, WAP was initially over-hyped: it was not really tuned for the phone and users increasingly perceived a gap between promises and delivery. This perception, together with thumb cramps and eyestrain from browsing the Web on mobile phones, made many consumers disenchanted with the so-called 'mobile Internet', *i.e.* the convergence of the Internet and the mobile phone.

User experience is changing with consumer-centric 'push' technologies, but WAP's future remains uncertain; it is now one of several competing standards that continue to evolve. XML, Java and freeware are among alternatives of strong interest to programmers.

Most wireless applications developers will be drawn from PC environments and will be unused to the new types of embedded platforms. This is an issue as designing for embedded systems means catering for different media transmission rates, limited processing power - narrow data bandwidth compared with wired networks. Developers will need to improvise, for example where possible offload to the network and return control to the OS to keep power consumption low.

3G phones will be able to receive colour video transmissions and high-quality music, however users may find large files too costly to download. A solution is to offer short video/audio clips of 10 to 15 seconds as previews, encouraging people to download the full product at home through their PC or TV.

Wireless email and groupware, identity issue and m-commerce

Wireless email and groupware

Solutions for business professionals have obvious potential for m-learning implementations. Email engines cater for popular platforms such as BlackBerry, PalmOS, smartphones and Pocket PC.

Real-time access environments allow users continuous connection to the server: data is viewed as it is entered with no local storing of data or applications. In asynchronous environments, data and applications are downloaded from the server and can be stored on the devices. Users are freed from the vagaries of network status or available bandwidth: data is updated locally and at server via synchronisation sessions. These technical benefits, plus reduced queries and 'user idle time' and controlled communication costs, make them a good choice for m-learning applications.

A groupware server should support leading backend messaging platforms such as Lotus Notes and FirstClass. However commercial interests (equity investors) may affect the levels of support given to networks: consumers need to be wary of this.

Identity issue, m-commerce and consumer email

The Internet handles identity rather poorly: a battleground in future technologies will be the struggle for control and ownership of the identity servers so crucial to social and learning interaction. At Ultralab we are clear from a broad range of on-line community projects that public resolution to this identity problem is a key requirement that is likely to be addressed by a parallel need for identity cards.

Meanwhile consumer email and consumer m-commerce have still not really taken off in Europe. Until the security issues of end-to-end encryption and authentication are seen to be resolved, m-commerce services may not attract enough users to make them profitable. Negligible revenue for most carriers is expected shorter term and e-learning companies may find that it is more difficult to make money selling products and services via mobile phones than it is via the fixed-line internet. This has obvious implications for those wishing to engage in m-learning as a business.

Moreover, although potential growth areas include location-based m-commerce and wireless advertising, target audience users may not want random advertisements popping up on their mobile phone. Wireless email and groupware will be more important for m-learning in the foreseeable future, as our research findings have shown.

Making a contribution – the real learning issue

The real issues reside less in connectivity and phone quality but essentially in where you can contribute, to what extent you can exploit the nature of the Web, 'where each of us is part consumer and part producer '(Seely-Brown, 2002) and where a shift is perceived from supporting the individual to supporting relationships between individuals*:*

> *'With that shift, we will discover new tools and social protocols for helping us help each other, which is the very essence of social learning. It is also the essence of lifelong learning …' (ibid)*

This is a social-contructivist view: social constructivism (Vygotsky, 1982) accepts plurality of meanings and promotes situated learning and the collaborative construction of knowledge. (Brown *et al*, 1989 and Lave,1990) Based on our experience with a number of major Ultralab projects (current examples are *Notschool* and *Talking Heads*), the *m-Portal* developers hold that where people are supported in becoming more autonomous learners (*i.e.* facilitated in considering their own learning goals, identifying learning needs and strategies in terms of these, exercising choice and liaising with others in putting together their own learning programme) this promotes both self esteem and intrinsic motivation, enhancing learning outcomes in the short term and encouraging an interest in life-long learning.

Ultralab's mPortal solution, designed for interactivity and incorporating asynchronous peer support and realworld mentoring, is a significant move towards implementing such a pedagogy.

Designing for interactivity – the challenges for mPortal

Within a social-constructivist framework, we are enaged in building an m-learning resource that can accommodate differing learning paradigms, while creatively exploiting what makes mobile devices unique. Learners will be able to:

- choose different modes of access to *m-Portal*;
- create their own microportals;
- choose between different learning environments;
- interact socially online, for example via chat, themed discussion and debate;
- access learning opportunities created by project partners;
- consult with others in considering their own learning goals, needs and strategies, and in creating their own learning programmes.

The undertaking is less straightforward than it may appear:

- a discursive functionality in the CRMPA Learner Management System (LMS) helps to cater for the affective components of learning online, however *m-Portal* needs to engage target audiences in taking up *m-Learning* opportunities in the first place.

We need a compelling *m-Portal* solution that can cater for different learning preferences, learning styles and learning needs. (Honey & Mumford, 1982, Kolb, 1984, Gardener,1993, Race, 1994) Here, the range of functionality offered by mobile games technologies, SMS and MMS is of obvious relevance:

- WAP 2.0 push technology is attractive, with the potential for supporting interactive learning. Youth interest in games can be supported via WAP in-built networking capability and freeware/open-source products.
- SMS is more than just a passing fad, it is a communication medium integral to young people's lives, whereby cost still remains an issue. The asynchronous nature of SMS is key to its phenomenal success.
- There is a very clear move towards MMS and other image and sound based messaging and interfaces –camera phones have real potential for annotating learning.

Hence, taking heed of the interim research findings, we are making provision for SMS solutions and at the same time researching the viability of an interface based on mobile games culture, to see in what ways this approach might engage users. Computer games engage users in spatial learning and cognitive processing and promote computer literacy (McClurg & Chaille, 1987, Pillay et al, 1999), whereby decision-complexity is more important than state-space complexity as a determining factor in solving a game (Jap van den Herik et al, 2002) – hence the viability of mobile solutions.

Social constructivism (Vygotsky, *ibid*) acknowledges the effect of tools on the user; these aspects are especially relevant to *m-Portal* development, as target audiences will not only exhibit different learning styles and preferences : their learning will also be affected by the characteristics and functionality of the learning interface and environment. Ultralab field research accordingly investigates how far the newer and more expensive Web - enabled phones, MMS and music technologies will appeal to young adult users – will they want to / be able to invest money in these devices? 'Just a phone' - that can use SMS - may still prove to be what they use most. The problem is currently that image based services are perceived as a premium rate activity; those who may benefit most immediately from their adoption are likely to be excluded by pricing in the short term. If so, we must design applications with this in mind.

We remain ambitious in seeking to engage target audiences via the new technologies – on past performance cost is likely to come down over time. We are investigating how far voice navigation and unified messaging are likely to be important, as well as the ability to create learner profiles, for example so that tutors/mentors can use them to engage with learners on a personal level.

Towards a pedagogy for m-learning – an invitation to share the debate

It has been seen that issues associated with mPortal design are wide-ranging; the associated tensions vindicate the multidisciplinary approach that we are taking in the design process. They also call for debate towards a shared pedagogy for m-learning:

- How might design ensure that m-learning is used for collaborative learning, not just one way information sharing?
- How can we harness the new mobile technologies and use them effectively to communicate with target audiences to raise their awareness of potential learning needs and opportunities?
- What specific added value/s can we identify for each intended learning situation/specific use of technology? What purpose will it really serve and how will it provide us with the information we need about what students have learned?
- Can we really use mobile technologies to promote autonomous learning and a learning culture in target audiences – or will we alienate them by 'hijacking' 'their' communication tools?

For teachers wishing to use the future m-Portal there will be all kinds of practical issues:

- What can you do about a cohort of learners where some have access to mobile technologies - and some have no access at all?
- MPortal is geared to mobile devices that have widely differing characteristics and functions – but not all m-learning applications will be available on all types of device.

If access to technology is inhibiting access to learning opportunity then we need to find ways to provide public access. If the Victorians made it their mission to provide public access libraries, is it any less important for us to provide public access information devices? Free at the point of access to everyone, with applications, community and personal files accessible from any device in any location from any country through an allocated personal identity. Finding a solution for the identity issue will be key, but this is only part of the problem: if the proliferation of different types of mobile device is widening the digital divide, there must be a coherent and determined effort to narrow the gap through public device access – and this means substantial allocation of public resources.

As we move into the final phase of mPortal development, we are keen to debate issues such as these. We invite your input to our next paper: if you are interested please contact us:

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Appendix: Glossary and Acronyms

This list offers working definitions for commonly used terms in e- & *m-learning* that may be unfamiliar to the reader. Other sources of information include Web glossaries such as those available at:

http://hotwired.lycos.com/webmonkey/glossary/api.html

http://foldoc.doc.ic.ac.uk/foldoc/index.html

http://webdesign.about.com/library/glossary/bldefdhtml.htm

http://manuel.brad.ac.uk/help/.xferfile/.glossary.html

http://cellphones.about.com/library/glossary/blglossary.htm

2G

Second generation mobile telephony protocols still in current use around the world. They include GSM and support high bit rate voice and limited data communications. Auxiliary services include data, fax and SMS.

2.5G

These extensions of 2G protocols to provide packet-switched connection (GPRS) and enhanced data rates such as EDGE.

3G

3G = third generation of wireless communication technology: a generic term covering a range of emerging wireless network technologies and claiming to support much higher data rates measured in mbits per second. 3G is intended for applications other than voice, e.g. data, motion video, video-conferencing and Internet access.

4G

A conceptual framework for a universal high speed wireless network that will seamlessly interface with wireline backbone network.

Accessibility

Provision via a universal text version without use of frames, tables, or visuals.

Active learning

A process of learning new ideas, skills and attitudes through doing, performing, and taking action. The action can be either mental (e.g. reflection) or physical (e.g. a case

study). Active learning makes use of devices such as games, simulations, introspection, role playing, etc.

AICC

Aviation Industry CBT Committee (AICC): offers certification re. compliancy with AGR 010, the AICC guideline for web-based computer-managed instruction systems.

Asynchronous learning

A learning event that is delivered after the original live event, where the interaction is delayed over time.

Authoring tool

Software application used to produce media-based content.

API

Application Programming Interface - enables programming to a pre-constructed interface (the API) rather than directlyprogramming a device or piece of software, thereby allowing for faster development without need for detailed knowledge of the device / softwares you are sending commands to.

Application Server

Supports Web-based applications which link end users to corporate databases. Acts as a go-between between web browser and database server; there is no need for high-maintenance Windows applications at user end.

Authorisation

Software tools assigning access and other privileges to designated users/groups.

Bluetooth

High-frequency radio transmission technology, allowing high-speed data transfer between Bluetooth-enabled devices - laptops, mobile phones, network access points and other devices - within a short range (10 m).

Bit

Unit of information obtained by asking a yes-or-no question.

Byte

The smallest addressable unit of storage, usually eight bits.

Convergence technologies

Technologies such as *Bluetooth* which permit convergence between devices.

Chat

Chat includes facilities like Internet Relay Chat IRC and similar text exchanges.

Cambridge Training and Development Agency (CTAD)
A project partner, CTAD is a commercial organization developling very small literacy and numeracy modules for the *m-learning* project.

Ethernet

A local area network where data is broken into packets and that is specified as IEEE 802.3, now recognised as industry standard.

Firewalls

Hardware and/or software lying between two networks, such as an internal network and an Internet service provider. The firewall protects the network, blocking unwanted access and disallowing messages to specific recipients outside the network, e.g. competitors.

GPRS

General Packet Radio Services: a packet-based wireless communication service, promising data rates from 56 to 114 Kbps plus ‘always on’ connection to the Internet.

GSM

Global System for Mobile Communications: a 2G standard widely adopted in Europe because of its international roaming capability. Sometimes known as ‘Go Slow Mode’.

Handheld

Small battery operated personal computer designed to fit in the hand; input devices: keyboard, stylus.

Hotspot

Public kiosk/display that allows users to access the Internet, for example via touchscreen.

Internet Service Providers (ISP)

ISPs link people and businesses to the Internet. Most offer the same data delivery and sending services, but services and performance vary widely. Large providers connecting to national backbones have faster network connections and deliver traffic through fewer router hops than local providers.

IMS

A global coalition with headquarters in Burlington, Massachusetts and consisting of over 250 technology vendors, developers, educational institutions, and government agencies. IMS Specifications are XML-based, open standards allowing providers to re-use education and training resources among online learning systems from different vendors. Home page at http://www.imsproject.org/

IP

Internet Protocol: a set of standards allowing 2 or more computer deviceds to share information across a network.

Java

A programming language developed by Sun Microsystems that creates code for interactive applications that is executable on web pages by web browsers. These Java applications can execute on any platform: Macintosh, PC, and so on.

'Just in Time'

A term used to describe a system or information that is available for the user at the exact time the user needs it.

Lecando AB

A Sweden commercial company, part of a group with an international reputation for expertise in advanced speech and language technologies; an *m-learning* partner.

Microportal

The standard definition of a microportal on the web is two-fold. One definition is a single page with a list of links, usually created by one person, which covers a specific purpose or area of interest. The other definition is an extension application or plugin for a web browser which adds to its navigation functionality to point to a specific type of content or features of a specific place.

Other definitions for standard portal systems include horizontal, vertical and enterprise ports:

- Horizontal portals are web portals which in some way track the preferences of the user. This can be done automatically or it can be done via some kind of preferences screen where the user can include bookmarks and enter settings.
- Vertical portals are sites which cover a specific area of interest - so you may have a portal through to lots of sites on financial information - stock markets for instance, these are sometimes in the category of downloadable plugin microportals;
- Enterprise portals are company portals - the Microsoft© web site could be described as a company portal.

Standard web portals are hierarchical sites, usually categorised by subject linking through to sites of interest. All portals have a search functionality.

MMS

Multimedia Messaging Services – the next generation of messaging. Does not utilize the SMS protocol and provides a format that can deal with complex media and is more interoperable.

m-Portal

m-learning outcome: a microportal layer which allows the participants in the m-learning system to create their own microportals with the additional benefit of having the system create the microportal for them, if desired, based upon their activity in m-learning. Other functionality of m-Portal to be iteratively developed during the project.

Multimedia

A very general term that usually refers to computer programs that use a combination of sound, video, animation, pictures, and/or text.

MVNO

A Mobile Virtual Network Operator, such as Virgin Mobile or T-Mobile, provides a mobile carrier service without actually owning or maintaining the physical network.

ODBC

Open Database Connectivity - a standard API (Application Programming Interface) for communicating with database servers. Different ODBC drivers support most major database servers, such as Oracle and Microsoft SQL Server. Programming to ODBC means being able to easily use an application on different databases without reprogramming.

Packet

A generic term used to describe a unit of data sent across a network at any layer of the OSI protocol stack, particularly application layer data units.

PDA

Personal Digital Assistant, also referred to as Palmtop or Handheld computer. Manufacturers include Palm, Handspring, Psion and Sony.

Protocol

A set of formal rules defining how to transmit data, e.g. across a network. Low level protocols define the electrical/physical standards, bit- and byte-ordering, transmission and error detection and correction of the bit stream. High level protocols define data formatting, terminal to computer dialogue, character sets, message sequencing, etc.

Proxy Servers

A server which controls client computer access to the Internet, thereby:

- controlling employees' access to Web addresses improving performance via local storing of Web pages
- protecting the internal network's identity.

RSA security

A public-key encryption system, RSA is increasingly used for document security and user authentication.

Server security

Security tools are used to prevent unauthorized access and/or modification of data. This can include a wide range of approaches and methods.

Smart phone

A wireless phone with text and Internet capabilities that can:

- handle wireless phone calls and voice mail
- send and receive E-mail and fax transmissions.
- hold addresses
- access information on the Internet

SMS

The Short Message Service enabling users to send and receive text messages from a mobile phone. Text can be words, numbers or an alphanumeric combination.

Target Audiences

Target Audiences are young adults in the age range 16-24 who are not in formal education or training environments and who have literacy or numeracy skills development needs. These young adults may be mobile, in casual/temporary employment, self-employed or in low paid/low skill employment, or unemployed.

VoiceXML

Like Extensible Markup Language (XML), but lets you convert an existing document into speech.

User

A Target Audience member; a member of a partner *m-learning* organization; a critical friend.

User testing

A phase stage whose purposes are to obtain feedback from users, to verify that requirements have been correctly implemented; to identify defects and ensure these are addressed prior to final release of the prototype.

WAP

The Wireless Application Protocol (WAP): a set of specifications, developed by the WAP Forum so that developers using Wireless Markup Language (WML) can build

networked applications designed for handheld wireless devices. WAP design works within the constraints of these devices:

- limited memory and CPU size
- small, monochrome screens
- low bandwidth
- erratic connections.
- Support from more than 200 vendors makes WAP ia de facto standard.

Web Services

The middleware between network and e-business application.

WiFi

A standard for wireless networking from the Wireless Ethernet Compatibility Alliance (WECA).

XML

A W3C method for putting structured data in a text file: produces files that are easy to generate and read by a computer, in ways which are unambiguous and avoid common pitfalls, such as lack of extensibility, lack of support for itnernationalistion/localisation and platform-dependency. The XML text format is verbose, but this is fast becoming less of a problem with cheaper disc space and improved compression programs - modern protocols can compress data on the fly - the advantages of XML easily compensate for any disadvantages. Like Html, XML makes use of tags and attributes (names) but are text files, making it easier to debug applications. However a forgotten tag or incomplete attribute makes the file unusable (in Html such errors are often tolerated).

XML is a family of technologies, which are fast developing; their development goes back to the early 80's. XML is licence-free, platform independent and well-supported.

1.1 Commonly used Acronyms

2G	2nd generation technology
2.5G	intermediate technology between 2G and 3G
3G	3rd generation technology
4G	4th generation technology (a conceptual framework)

AI	Artificial Intelligence
APDU	application protocol data unit
API	Application Program Interface
ART	Advanced Recognition Technologies
bps	bytes per second
BT	British Telecom
CCD	Charged Couple Device
CDMA	Code Division Multiple Access
CIDR	Classless Inter-Domain Routing
cHTML	Compact-HTML
CMOS	Complementary Metal Oxide Semi-Conductor
CPU	Central Processing Unit
DBMS	Database Management System
DSL	Digital Subscriber Line
EDI	Electronic Data Interface
EIP	Enterprise Information Portal
ETSI	European Telecommunications Standards Institute
FTP	File Transfer Protocol
Gb	1000 bits per second
GPRS	General Packet Radio Service
GHz	Giga Herz
GSM	Global Standard for Mobile Communication
HTML	Hypertext Mark-up Language
HDML	Handheld Device Mark-up Language
HSCSD	High Speed Circuit Switched Data
HTTP	Hypertext Transfer Protocol
KHz	Kilo Herz
ID	Identification
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IM	Instant Messaging

IP	Internet Protocol
IR	Infrared
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
J2ME	Java 2 Micro Edition
kbps	kilo bits per second
LAN	Local Area Network Access Protocol
LBS	Location-Based (or Location-Specific) Services
LDAP	Lightweight Directory Access Protocol
MB	Megabits
Mbps	Megabits per second
MHz	Mega Herz
MMAC	Multimedia Mobile Access Communication
MMS	Multimedia Messaging Services
MVNO	Mobile Virtual Network Operator
NAT	Network Address Translation
OFDM	Orthogonal Frequency-Division Multiplexing
OS	Operating System
OSI	Open Systems Interconnect
P2P	Peer-to-peer
PC	Personal Computer
PDA	Personal Digital Assistant
PIM	Personal Information Manager
PIP	Personalised Information Portal
PKI	Public Key Infrastructure
RPG	Role-Play Game
SIM	Society for Information Management
SIP	Session Initiation Protocol
SMEs	Small - Medium-sized Enterprises
SMS	Short Message Service (acronym also used by Microsoft for their Systems Management Server)
SOAP	Simple Object Access Protocol

TCP	Transmission Control Protocol
TCP/IP	General name given to the IP protocol suite
TDMA	Time Division Multiple Access
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
UWB	Ultra Wideband
VOIP	Voice Over IP
VPN	Virtual Private Network
WAN	Wide Area Network
WAP	Wireless Application Protocol
WEA	WebSphere Everyplace Access
WECA	Wireless Ethernet Compatibility Alliance
WLAN	Wireless Local Area Network
WML	Wireless Mark-up Language
WPAN	Wireless Personal Area Network
WWAN	Wireline Wide Area Network
XHTML	a hybrid of XML and html
XML	Extensible Markup Language