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## Mobile Learning in Developing Countries

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COMMONWEALTH of LEARNING



# Mobile Learning in Developing Countries

KNOWLEDGE SERIES

# knowledge series

A TOPICAL, START-UP GUIDE TO DISTANCE EDUCATION PRACTICE AND DELIVERY

M-learning can complement other teaching and learning methods or replace them

## INTRODUCTION

Mobile learning, or m-learning, is a personal, unobtrusive, spontaneous, "anytime, anywhere" way to learn and to access educational tools and material that enlarges access to education for all. It reinforces learners' sense of ownership of the learning experience, offering them flexibility in how, when and where they learn.

In developing countries, mobile technologies potentially deliver education without dependence on an extensive traditional communications infrastructure, leapfrogging some of the intervening development phases encountered in developed countries such as installing extensive electricity power grids, and building multiple computer rooms in educational institutions.

Although m-learning experience remains limited, it is becoming a credible, cost-effective component of blended open and distance learning (ODL) provisions, adaptable to an institution's needs and situation.

M-learning devices are lightweight and handheld, including:

- Personal Digital Assistants (PDAs), and palmtop or handheld computers.
- Mobile phones, also called cell phones or handphones.

Consider mobile phones, which are cheap and widely available, alongside other wireless communication devices; and handhelds, which are more expensive and scarce, alongside desktop and laptop computers. Mobile devices are educationally interesting because they offer:

- Several communications channels on one device, for example, email, voice, and text messaging.
- Cheaper, comparable functionality with desktops or laptops.
- Wireless access to educational materials, other students and Internet resources.

Handhelds are currently the dominant mobile devices, apart from basic mobile phones. These technologies are converging, creating powerful all-in-one tools such as "smartphones," mobile phones with the functionality of a handheld; and handhelds with mobile phone capability.

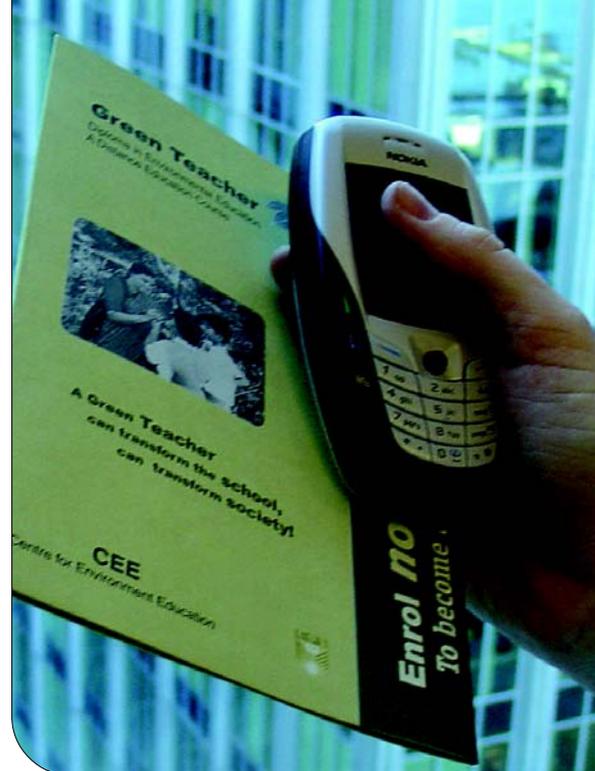
This guide focuses on the use of handheld computers or smartphones in m-learning.

## INTRODUCING M-LEARNING

### PROS AND CONS

*Learning activities:* Easily monitored and co-ordinated between various locations, but designing complex tasks and providing adequate student support is new and challenging.

*Sense of ownership:* Students can install applications suited to their specific needs, but devices can be disruptive and distracting, or be used mainly for non-educational activities.



*Security:* Devices fit into a bag or a pocket, but small size may increase vulnerability to theft.

### USABILITY AND ACCESSIBILITY

M-learning has developed mainly in Europe, the United States and in parts of East Asia, primarily in an English medium, and in environments of ongoing, rapid technology investment and advancement. M-learning has been shaped by the specific ideas of teaching and learning; specific relations between teacher, student and subject; and the specific roles for different educational institutions, found in the societies and institutions it has evolved in. M-learning can enhance education successfully, but only if its use is thoroughly analysed and modified to suit each new setting.

A "usable" device is satisfying, easy to use and improves learning effectiveness and efficiency. An "accessible" device meets the needs of users with specific learning difficulties or disabilities, such as visual, hearing, speech, mobility or manual dexterity impairment. Usable, accessible devices are key to creating an inclusive m-learning environment.

Inexperienced or older computer users, and users from diverse cultural backgrounds, may find the following challenges interacting with mobile devices:

- *Small screens:* Small images and text may lead to possible eye strain, and must be constantly scrolled down for viewing; but content providers are forced to prioritise information given to students, emphasising the most important course aspects.
- *Monochrome screens:* Poorer readability than full-colour screens and ineffective for some graphics-oriented courses, but are a cheaper alternative and are adequate for text-based subjects.
- *Small buttons, controls and keyboards:* Require good manual dexterity.
- *Context-dependent use:* Screen contents may be difficult to view in bright sunlight or in poor lighting conditions, if the screen is not internally lit.
- *Fragmented use on the move:* Writing and selecting can be difficult on a moving vehicle. Voice messaging can be difficult on public transportation, or inconvenient, if the mobile device does not have speakerphone or hands-free capability.
- *Proliferation of devices and types of connectivity:* The wide array of constantly changing user options can be confusing.
- *Dependence on batteries and recharging:* Inconvenient for users in low-tech or rural environments.
- *Highly personalised use:* Standardised technical support is difficult but students can integrate education with other personal and social activities, encouraging learning.

# M-learning is an “anytime, anywhere access to education for all

- *Transferring data.* Can be complicated, especially among multiple users.
- *Few specifically educational applications.* Most educational material must be specially adapted or designed for mobile devices.
- *Language incompatibility.* Most available programs use English, and may not be available in other languages.
- *Slow connection and information transfer.* An issue in some regions with low-bandwidth or limited wireless communications infrastructure, but wireless capability may encourage more spontaneous learner collaboration and communication.

Although the handheld's flexible access to information makes it inherently accessible, many handhelds lack specifically designed accessibility features and tools. Development of cost-effective, standardised, industry-wide accessibility solutions, such as larger, brighter screens and the ability to execute voice-only commands, remains slow.

When considering the usability of a mobile device, consider its intended use. For example, some teachers prefer delivering content, which may be easier on a larger screen; others, encouraging discussion, for which mobile phones are adequate. Some students need help with organisation, others with study. Some subjects, like geology or math, require visuals or tables; others, like literature, are more text-heavy. Some institutions have a limited ODL budget, which narrows the choice of available devices.

Adapting course content for m-learning usability can be:

- In-house using best practice examples, such as the BBC pages on the AvantGo news website. “Reversioning” software can be used to revise existing learning programmes or material for different media and computer systems.
- Contracted to external, probably expensive, consultants.

## IMPLEMENTATION STRATEGIES

- Short-term pilot projects that reward and support innovative teachers, gain and publicise valuable early insights, and give m-learning high local visibility.
- Exemplar content, lessons and courses across a range of disciplines that give teachers a sense of what they can achieve with the technology.
- Easy access to a range of mobile devices, to develop familiarity and confidence of use amongst teachers.
- Reliable and robust technical support, infrastructure and hardware, so teachers can innovate and incorporate m-learning with ample help and minimal risk.
- Sustained, timely and accessible staff development that addresses teachers' pedagogic and technical worries.
- Credible channels of feedback and communication between management and teachers, so that teachers can have significant input into the institutional m-learning strategy as it evolves.
- Institutional resources for additional non-pedagogic overheads.
- Meaningful and acceptable ways of measuring the progress and success of the strategy.

## INFRASTRUCTURE, TECHNOLOGY AND HARDWARE

Consider:

- *Existing communications infrastructure.* Internet access and a wireless network should be in place, or planned for implementation, within the institution or region.
- *Access to networked desktops or laptops.* Helpful with transferring large amounts of data, or with installing software, onto handhelds or mobile

phones. Using CD-ROMs on standalone portable computers are an alternative. After initial mobile device set up, completely isolated users can be sent memory devices with new material periodically through the mail, or users can download new information wirelessly from the Internet.

- *Available type, strength and reliability of power supply.* Some handhelds use widely available and cheap disposable batteries, others, proprietary and more expensive rechargeable batteries that must be recharged on mains electricity. Alternatives are solar panels or fuel-driven generators. Wind-up dynamo battery chargers are also available for mobile phones.

## MOBILE SYSTEMS AND TECHNOLOGIES

Handhelds and mobile phones:

- Are about the size and weight of a small personal stereo.
- Usually have a screen or “interface,” and buttons or a keypad.
- Have connecting sockets around the edges.
- Are usually used in a vertical or “portrait” position.
- Have either a monolithic tablet or a “clamshell” hinged design.
- May have protective covers or cases.

## INFORMATION STORAGE AND MEMORY

Current handhelds, particularly the most sophisticated and expensive, can run software programs comparable to those on a desktop or laptop. But because of their relatively small size, handhelds have limited internal information storage capacity or “memory,” and do not have disk drives for accessing cheap, widely available external media such as floppy disks or CD-ROMs.

Handhelds store additional information on external memory devices called memory sticks or cards that can be inserted into the handheld. These are costlier, and store less information, than CD-ROMs. It also takes slightly longer to retrieve data from external memory, compared to internal memory; this impacts on graphics-based rather than text-based learning material, for example, geography rather than literature, since graphics files tend to be large and take longer for computers to access.

## POWER SUPPLY

Current handhelds use power more efficiently than their predecessors did. However, use of cheap disposable batteries as a power supply is being discontinued in favour of more powerful proprietary rechargeable batteries, which are more expensive and must be recharged from an external electricity source.

The handheld's battery life is usually limited to a working day, and once completely drained most or all data can be lost unless it has previously been copied to an external memory device. Students quickly learn to gauge battery performance and can have the option to purchase a spare rechargeable battery, although the latter is an expensive solution.

## USER INTERFACE AND DATA ENTRY

Users tap a pen-like device or “stylus” onto the handheld's touch-sensitive display screen to access or “interface” with the contents, similar to the way mouse-clicks work on desktops or laptops. Most handhelds have the option to display an on-screen “virtual” keyboard, although this takes up valuable screen space.

More expensive handhelds have a small attached keypad, with keys similar in size to a mobile phone's buttons. Full-size folding keyboards that attach onto the base of the handheld are also available, although these require a flat surface to use. Writing on the handheld's screen, usually using a proprietary alphabet such as Palm's Graffiti, will also enter data, though this can be time-consuming.

Some handhelds, smartphones and mobile phones allow:



# e” way to learn that enlarges

- Data input with conventional handwriting, using character-recognition software.
- Operation and dictation through spoken commands using voice-recognition and dictation software, useful for hands-free situations and for people with physical disabilities.
- Display of high quality video clips and Internet streamed video and audio, useful for visually oriented teaching procedures in fields like dentistry or electronics.

## NETWORKING AND CONNECTIVITY

Handhelds can connect with desktops, laptops, printers, phones and other devices or “peripherals” using a cable, usually supplied with the handheld purchase. The cable charges the handheld, and transfers information to and from another device with a matching cable connection. The handheld end of the cable is proprietary, but the other will be a standardised connection, usually Universal Serial Bus (USB). USB cables transfer data more slowly than a wireless networking connection. Wireless data transfer times are usually only several minutes for several hours’ worth of teaching material, although an intermittent or “dropped” connection may cause slight delays.

Wireless networking connectivity is increasingly built into current handhelds, and can be added to older models with a wireless adapter card. The oldest of these technologies is infrared, now being widely replaced by Bluetooth. Although it only connects with adjacent devices, such as other handhelds or printers, Bluetooth transfers data faster than infrared. Bluetooth-enabled handhelds access the Internet by connecting to Bluetooth-enabled mobile phones, which contact an Internet Service Provider (ISP). Smartphones connect directly to an ISP without additional equipment or adapters.

Other forms of wireless networking connectivity such as Wireless Application Protocol (WAP) or wireless fidelity (Wi-Fi), each governed by international standards and each with a different range, bandwidth and level of reliability, can be used in suitably equipped classrooms, buildings and urban areas. To keep costs lower and maintenance simple, a combination of fixed location and mobile wireless access is the best option for an m-learning network in a campus or a community.

## SYNCHRONISATION AND BACK UP

Synchronisation or “synching” checks and updates data such as appointments, contact details and documents, on the handheld and another device, such as a desktop:

- If one version has not been changed since the previous “synch” and the other has, the most recent version will be written to both devices.
- If neither has been altered, no changes are needed.
- If both are changed, the necessary action is decided by the desired automatic setting, such as “handheld overwrites desktop,” or each contentious case can be flagged for individual decision.

Synching between one desktop or laptop and one handheld is straightforward. It is also easy to synch one handheld to two or more desktops or laptops. Synching a group of handhelds, such as with a class of students, to a single desktop or laptop, is problematic—for example, where some data is public and some is personal, the computers must be specifically instructed to avoid accidentally deleting or distributing the personal data. It is best to use proprietary software for synching between multiple devices.

“Back up,” or copying information to another computer or device for safe-keeping and data archiving, can be done as part of the synching process.

Although computer viruses are virtually unknown to mobile devices, synching restores infected documents, and the permanently installed operating systems in handhelds cannot be corrupted.

## OPERATING SYSTEMS

Any software program will only run on its intended operating system (OS). Unlike desktops and laptops, a handheld’s permanently installed OS cannot be changed or upgraded.

Dominant systems:

- Mobile versions of Microsoft Windows, such as Pocket PC.
- Palm, developed specifically for handhelds.

Minority systems:

- Symbian, established on smartphones.
- A compact version of Linux, the system espoused by the Open Source community.

Comparing Pocket PC and Palm:

- Similar in complexity and ease-of-use, though Pocket PC is superficially more familiar to most desktop and laptop users.
- Pocket PC consumes more memory and power than Palm, so is more expensive for comparable functionality.
- With the correct installed software, both Pocket PC and Palm exchange documents with desktops and laptops, preserving the documents’ characteristics.

## SOFTWARE PROGRAMS

Handheld and mobile phone software is generally cheaper than desktop or laptop software, is widely available, and can also be obtained free on CD-ROM from industry magazines or downloaded from dedicated websites.

Handhelds usually include a range of pre-installed software and ship with a CD-ROM of software for installation on another computer, enabling it to act as the handheld’s “host” for printing documents, synching or archiving data, and for installing new software programs.

Software programs may also be downloaded from the Internet through the host computer. Downloaded software may be free, although some time-limited versions de-activate after a trial period unless payment is made. Where no host computer is readily available, software upgrades and data can be sent in the mail on memory sticks or cards.

Educational material developed for one OS will soon be usable on many others through the ongoing introduction and acceptance of digital “learning objects” —standardised educational packets of text, graphics, video or other data, that form in effect a very short lesson. Substantial libraries or “repositories” of learning objects are increasingly available online and on other digital media, for both m-learning and e-learning.

Handheld programs with educational applications include:

- General “office” applications, especially Palm versions of word-processor, spreadsheet, email, personal information management, database and Web browser programs.
- General academic applications, such as reference material and bibliographic databases like BiblioPalm.
- Subject-specific applications intended to teach or support a particular subject.
- Document readers that enable users to read but not to alter documents, such as RepliGo or PicSel File Viewer. The most widely known document reader is Acrobat, for Portable Document File (PDF) documents. Some document readers can access published material in the growing e-book format, local documents in formats such as Microsoft Word, Excel and PowerPoint, or JPEG and GIF image files.

# I-LEARNING

## M-LEARNING APPLICATIONS

### TEACHING AND LEARNING

M-learning can complement other teaching and learning methods or replace them, and can be modelled in the same ways as other methods. It can also enhance non-academic and para-academic support, such as:

- Pastoral care, feedback and remediation.
- Motivation and guidance.
- Supporting students across the institution.
- Course administration and management.
- Institutional quality assurance.

Some negative aspects of m-learning include the possibility students may feel:

- Pressure to learn or train anywhere, at any time.
- That location-aware technology is monitoring their movements.
- That devices which hold appointments, tasks and contacts may jeopardise their privacy.
- That encapsulating their professional knowledge on a computer de-skills them.

### TRANSMITTING CONTENT

Use lectures, seminars, books and handouts, Web pages and computer-assisted learning packages from teacher to student, as a guide. M-learning offers a range of content transmittal choices, but delivered in smaller packages, such as:

- Daily or weekly study tips, reminders and alerts.
- Multiple-choice quizzes with immediate feedback.
- Browsing and searching of short texts.
- Following links to selected websites.
- Glossary and reference information.
- Concepts or definitions for revision.

An alternative to adapting existing content for use on mobile devices, or "reversioning" the content, is to develop content that complies from the outset with technical standards that make it portable across computer systems and devices. Adopting this approach does not guarantee the material is suitable, only that the content is viewable.

Quality assurance units in many institutions are struggling to develop validating procedures for technology-supported learning. This process will be less problematic if m-learning is integrated into other types of learning, rather than replacing them completely.

### SHARED DISCUSSION

Use student discussion during seminars, discussions and tutorials, perhaps facilitated by a teacher, as a guide. Although technology use, especially networked computers, easily provides increased support and richness in face-to-face discussions, mobile communication imposes some limitations such as the relatively short length of messages that can be keyed in, downloaded and read comfortably on a small screen.

Mobile communication is also "invisible" to a traditional discussion group moderator, so an electronic mediator or "e-moderator" must be

employed to develop and support interaction and discourse amongst students who may never meet each other, or their teachers, face-to-face. Experience of moderating in mobile environments is currently limited, but should move from an early model of administrative support and reacting to individual content queries, to a more mature model of pastoral support and proactively supporting new forms of learning.

### INDEPENDENT STUDY SKILLS AND INFORMATION MANAGEMENT

M-learning supports this through:

- Data collection for projects.
- Quick communication amongst students and teachers.
- Bibliographic databases created by students.
- Graphical tools that support mind-mapping.
- Tools to help students link together the different elements of a course.

### WORKPLACE EDUCATION

Students of some disciplines, such as teaching, law, medicine and nursing, spend many courses in placements gaining practical experience. Here m-learning can provide:

- Continued access to course and reference material in the workplace.
- Continued access to other students within their online community.
- Data-collection capability for completing assignments.
- Support with personal information management in a new environment.

## CASE STUDIES

### *University of Wolverhampton, United Kingdom*

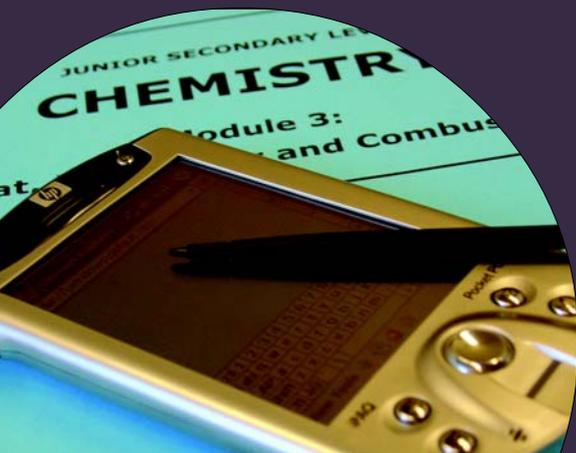
Uses mobile devices to support staff and disadvantaged students in teaching, learning and administration. It has run a pilot to help a group of students with deadlines, revisions and timetabling using Short Message Service (SMS) text messaging; and another pilot issuing a group of students with Sony Clie PDAs to help personal organisation, and mobile access to course material. These pilots have led to larger schemes in the university, and to a staff training and support scheme.

### *ZMQ project, India*

Sponsored by ZMQ Software Systems, the project uses mobile phones and focuses on Hindi-speakers. Popular regional content is converted into engaging m-learning material for under-privileged and semi-literate people. Examples are "My classroom," about an epidemic and how it spreads, and about disasters and measures to control them; "Save your village," an animated short series to prevent the spread of HIV/AIDS in villages; "Spread the red ribbon," an interactive game to spread awareness of HIV/AIDS using a popular regional character called "Babu"; and "Interactive Quiz," comprising 20 scenario-based multiple choice questions.

### *School Empowerment Programme, Kenya*

With funding from the Department for International Development (DFID), U.K. through Imfundo, the Kenyan government is starting a pilot that will use bulk SMS text messaging as in-service training to primary school teachers and local support cadres across rural and urban areas, linking into other media used in their courses. Mobile phone ownership and coverage is high across the country, except the remote north.



## FURTHER MATERIALS

### BOOKS

- Burkhardt, J., Henn, H., Hepper, S., Rintdorff, K. and Schack, T. 2002. *Pervasive Computing—Technology and Architecture of Mobile Internet Applications*. Harlow, Essex: Pearson Education.
- Gayeski, D. 2002. *Learning Unplugged—Using Mobile Technologies for Organizational Training and Performance Improvement*. New York, NY: American Management Association (AMACOM).
- Kukulska-Hulme, A. and Traxler, J. 2005. *M-learning: A Handbook for Educators and Trainers*. F. Lockwood, ed. London: Taylor and Francis.
- Kynaslahti, H. and Seppala, P., eds. 2003. *M-learning*. Helsinki, Finland: IT Press.

### WEBSITES

- Acrobat, Adobe Systems Inc.: Widespread document reader software. [www.adobe.com/products/acrobat](http://www.adobe.com/products/acrobat)
- AvantGo: Free global content and news feeds. [www.avantgo.com](http://www.avantgo.com)
- BiblioPalm, Biblioscape Research Information Manager: Reference management software. [www.biblioscape.com/bibliopalm.htm](http://www.biblioscape.com/bibliopalm.htm)
- Commonwealth of Learning (COL) Knowledge Finder: Online ODL resource base. [www.colfinder.org](http://www.colfinder.org)
- Development Gateway—E-learning: Resources for e-learning development, including m-learning. [topics.developmentgateway.org/elearning](http://topics.developmentgateway.org/elearning)
- Digital Education Enhancement Project (DEEP). [www.open.ac.uk/deep](http://www.open.ac.uk/deep)
- Documents To Go: Office programme package. [www.dataviz.com/products/documentstogo](http://www.dataviz.com/products/documentstogo)
- Handango: Commercial mobile computing software, including educational applications. [www.handango.com](http://www.handango.com)
- Hands High Software: Educational software. [www.handshigh.com](http://www.handshigh.com)
- Imfundo: Creates partnerships to deliver information technology-based projects in sub-Saharan Africa. [imfundo.digitalbrain.com](http://imfundo.digitalbrain.com)
- Institute of Electrical and Electronics Engineers, Inc. (IEEE), Learning Technology Standards Committee, Working Group 12: Project to define a global standard for learning objects. [Itsc.ieee.org/wg12](http://Itsc.ieee.org/wg12)
- M-learning Project, European Commission's Information Society Technologies (IST): Basic m-learning skills. [www.m-learning.org](http://www.m-learning.org)
- M-learning publications, University of Wolverhampton, U.K. [www.ics.ltsn.ac.uk/pub/m\\_learning](http://www.ics.ltsn.ac.uk/pub/m_learning)
- MOBlearn Project, MOBlearn Consortium: Context-aware m-learning information. [www.mobilearn.org](http://www.mobilearn.org)
- Mobipocket: E-books for reference, education and fiction. [www.mobipocket.com](http://www.mobipocket.com)
- Ninelocks: Educational software and advice. [www.ninelocks.com](http://www.ninelocks.com)
- PakXPress, 3 Way Net Inc.: Learning object creation software. [www.3waynet.com/tw/downloads/pakbuild.pdf](http://www.3waynet.com/tw/downloads/pakbuild.pdf)
- palmOne: U.S. case studies. [www.palmone.com/us/education/studies](http://www.palmone.com/us/education/studies)
- Palmtop User*: Lively, non-commercial mobile computing news magazine. [www.palmtop.co.uk](http://www.palmtop.co.uk)
- PDA Essentials*: Popular monthly U.K. magazine ships with a CD-ROM of current software. [www.paragon.co.uk/mags/pdaessentials.html](http://www.paragon.co.uk/mags/pdaessentials.html)
- PDA's in education (PDA-EDU), National Academic Mailing List Service: A subscription mailing list service from The Joint Information Systems Committee, U.K. (JISCMail), to a network of helpful, experienced users. [www.jiscmail.ac.uk/lists/PDA-EDU.html](http://www.jiscmail.ac.uk/lists/PDA-EDU.html)
- PicseL File Viewer: Multi-format document and file reader software package. [www.picseL.com/picseLtechnology.html](http://www.picseL.com/picseLtechnology.html)
- Quickoffice, Mobility Electronics, Inc.: Office programme package. [www.mobl.com/software](http://www.mobl.com/software)
- RepliGo: Multi-format document reader software. [www.cerience.com](http://www.cerience.com)
- ZMQ Software Systems: E-learning, gaming and edutainment provider. [www.zmqsoft.com/elearning/home.htm](http://www.zmqsoft.com/elearning/home.htm)

## MOBILE LEARNING IN DEVELOPING COUNTRIES

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