

## M-Learning - a New Stage of E-Learning

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**Abstract:** Distance learning, electronic learning and mobile learning offer methods, which decrease the limitations of traditional education. This paper discusses the existing devices and technologies appropriate to realise mobile learning. Mobile learning as new stage of distance and e-learning is also examined.

**Key words:** m-Learning, d-Learning, e-Learning, Education.

### INTRODUCTION

The traditional education is made in classrooms where the teacher presents the learning material to a group of students. The educational technology depends mainly of teacher and the students must physically participate in the learning process. Regardless of obvious advantages as a direct contact between a teacher and students and immediate feedback the traditional classroom education has many disadvantages. For example if the student has no ability to take part in some lesson he or she will miss the training material. These disadvantages lead to search for new and more effective educational methods.

The rapid growth of information and communication technologies and rising computer knowledge of the students make possible appearance of these new educational forms. If 15 years ago the main accent have been on Computer Based Training which used primary CD and local area networks as information medium, 5 years ago the accent is moved to use of Internet and Learning Management Systems. The e-Learning as new term is appeared.

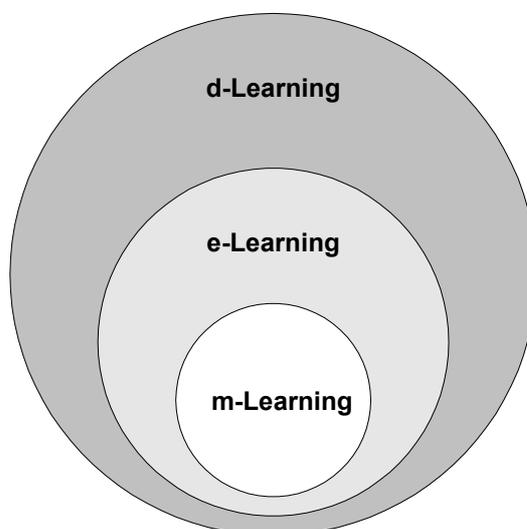
Nowadays extremely actual and perspective is mobile learning (m-Learning).

### LAYOUT

This paper discusses the existing devices and technologies to realize m-Learning as new stage of the progress of distance learning (d-Learning) and e-Learning.

By nature the m-Learning is a form of existing d-Learning and e-Learning. Historically the distance education has more than one hundred years of experience and traditions. It's main characteristic is the distance and time separation between teacher and students.

The e-Learning offers new methods for distance education based on computer and net technologies. Simultaneous to e-Learning the other forms of d-Learning still exist (for example satellite based d-Learning).



Фиг.1. The place of m-Learning as part of e-Learning and d-Learning

From the other side the m-Learning is part of e-Learning and therefore - part of d-Learning (fig.1). In the literature there are different definitions for m-Learning. Some of them consider it as only wireless or Internet based. We think that definition of m-Learning must include the ability to learn everywhere at every time without permanent physical connection to cable networks. This can be achieved by the use of mobile and portable devices such as PDA, cell phones, portable computers and Tablet PC. They must have the ability to connect to other computer devices, to present educational information and to realise bilateral information exchange between the students and the teacher.

We can consider about the potentiality of the mobile learning by following statistical information concerning the number and the growth of cell phones, PDA, smart phones and users of mobile communications:

- more than 50% working places in USA are mobile [4];
- until this moment all over the world are sold more than 500 mil. cell phones with web abilities [4];
- the number of sold cell phones in Europe has growth of 25% for the first quarter of 2004 year [6];
- the number of sold PDA and smart phones has growth more than 200% for the last year [10];
- every quarter the number of companies developing software for mobile devices increases by 1000 [7];
- up to 2005 the number of sold multifunctional mobile devices (PDA and smart phones) will exceed the number of sold personal computers [2];
- up to 2010 over 1 mlrd users will use wireless Internet [2];
- up to 2010 there will be more than 1,8 mlrd users of the mobile communications [2].

The realise of mobile learning is impossible without use of the mobile devices. They vary significantly in their abilities, sizes and prices. The common ability which united them is their mobility and possibility to make wireless connections. The main types of mobile devices used in the education process are:

- **NoteBook computers.** From one hand they have such abilities as desktop personal computer; from the other hand they have small sizes and support wireless communications. Their prices are still high.
- **Tablet PC.** These are one of the newest mobile devices. They also have full range of abilities as personal computers. Some of them haven't keyboard but have software to recognise handwritten text. It is relatively expensive.
- **Personal Digital Assistant (PDA).** They have small sizes and significant processor power. New models support more than 65000 colors, recognise handwritten text and can play different types of multimedia files. The main operating systems used are Palm and Microsoft Pocket PC.
- **Cellular phones.** The low class devices mainly can be used for voice communication and sending and receiving of text messages (SMS). Some of their disadvantages are low memory capacity and low data transfer rate. The cellular phones from the higher class can be used to Internet access via WAP or GPRS technologies. They also can be used to send and receive the multimedia messages (MMS). Their prices continuously decrease.
- **Smart Phones.** They are hybrid devices which combine the abilities of cellular phones and PDA. They have smaller sizes than PDA and bigger than cellular phones. Typically they haven't full sized keyboard and can recognise handwritten text. They use Symbian, Windows Mobile or other operating system. As they have Internet browsers they have potentiality to be successfully used in the mobile multimedia education.

The comparison between typical parameters of mobile devices used for m-Learning is given in the Table 1.

Table 1

Parameters	NoteBook	Tablet PC	PDA	Cellular phone	Smart Phone
Price	2000 €	1500 €	750 €	300 €	700 €
Weight	3 kg	1,5 kg	0,150 kg	0,100 kg	0,200 kg
Screen resolution	Over 1024x768 pixels	Over 1024x768 pixels	240x320 pixels	120x160 pixels	200x300 pixels
Memory	256 MB	256 MB	64 MB	300 memories	8 MB
Power capacity	3 h	4 h	8 h	10 h	10 h
Communication technology	IrDA, Wi-Fi, Bluetooth	IrDA, Wi-Fi, Bluetooth	IrDA, Wi-Fi, Bluetooth	WAP, GPRS, Bluetooth	GPRS, IrDA, Bluetooth

Today there are several communication technologies which are used in mobile devices. Their abilities vary vastly as well as data transmission range and range [11].

- **Global System for Mobile Communications (GSM)** is one of the leading digital cellular systems. It uses narrow band TDMA (Time Division Multiple Access). Originally a European standard for digital mobile telephony, GSM has become the world's most widely used mobile system in use in over 100 countries. GSM networks operate on the 900 MHz and 1800 MHz waveband in Europe, Asia and Australia, and on the MHz 1900 waveband in North America and in parts of Latin America and Africa. It provides integrated voice mail, high-speed data, fax, paging and short message services capabilities, as well as secure communications. It offers the best voice quality of any current digital wireless standard.
- **Wireless Application Protocol (WAP)**. This is a free, unlicensed protocol for wireless communications. It makes possible creation of advanced communications services and access to Internet pages from a cellular phone. WAP is a de facto industry standard supported by a large number of suppliers. WAP devices understand the WML language (an XML application) that is optimized for small screens and navigation without a keyboard. WAP also supports WMLScript scripting language.
- **General Packet Radio Service (GPRS)**. A packet-linked technology that enables high-speed wireless Internet and other data communications. GPRS provides about four times greater speed than conventional GSM systems. Currently 288 operators around the world have commercial GPRS services.
- **Bluetooth** wireless technology is a short-range radio technology. Bluetooth makes it possible to transmit signals over short distances between telephones, computers and other devices and thereby simplify communication and synchronization between devices.
- **IEEE 802.11** is a type of radio technology used for wireless local area networks (WLANs). It is a standard that has been developed by the IEEE (Institute of Electrical and Electronic Engineers). Wi-Fi (802.11) is composed of several standards operating in different radio frequencies: 802.11b is a standard for wireless LANs operating in the 2.4 GHz spectrum with a bandwidth of 11 Mbps; 802.11a is a different standard for wireless LANs, and pertains to systems operating in the 5 GHz frequency range with a bandwidth of 54 Mbps. Another

standard, 802.11g, is for WLANS operating in the 2.4 GHz frequency but with a bandwidth of 54 Mbps.

- **Infrared Data Association (IrDA).** This association defined a suite of protocols for infrared (IR) exchange of data between two devices, up to 1 or 2 meters apart (20 to 30 cm for low-power devices). IrDA devices typically have throughput of up to 115.2Kbps or 4Mbps. Smart phones, many PDAs, printers and laptop computers use IrDA protocols.

The comparison between parameters of existing wireless technologies is given in the Table 2 [1].

Table 2

Technology	Data Rate (Mb/s)	Range (meters)	Frequency Band
Bluetooth	1-2	100	2.4 GHz
IrDA	4	1-2	Infrared
IEEE 802.11a	54	20	5 GHz
IEEE 802.11b	11	100	2,4 GHz
IEEE 802.11g	54	50	2,4 GHz

From Table 2 we can make conclusions that these technologies can be used to provide different data transmission rates with ranges less than 100 meters in the area of the universities or so called "hot spots". To achieve higher ranges the cellular phones supporting WAP and/or GPRS technologies must be used.

The m-Learning advantages comparing to e-Learning are:

- it can be used everywhere at every time;
- most of mobile devices have lower prices than desktop PCs;
- smaller size and light weight than desktop PCs;
- ensures bigger students' engage as m-Learning is based on modern technologies, which students use in everyday life;
- using GPS technology the m-Learning can provide location dependent education.

The current problems of using portable devices for m-Learning are shown in the table 3. Potential technological solutions which have the abilities to solve these problems are also given in table 3.

Table 3

Problem	Potential solutions
Small PDA and cellular phone screen sizes limit the abilities to display information.	There are two potential solutions to this problem: to use projection technology to project the information from the screen into the air [12]; the other solution is to use wireless technologies to transmit video data to the computer or TV monitors supporting these technologies.
The small keyboards of PDA and cellular phones make the input of the information difficult.	The solution of this problem is technology called "virtual keyboard" which is already used in mobile phone Siemens SX1[5].
Today PDA and mobile phones have limited memory size.	The solutions of this problem are to use flash memory cards or developed by Toshiba micro HDDs with capacity up to 4,0 GB [8].
There is necessary to regularly charge the mobile devices' battery.	The potential solution of this task is to use a technology of methanol fuel cell, developed by Toshiba. There are announces that this technology will be included in notebook computers this year [9].
Until now it is impossible to use applications developed for desktop PC in mobile devices.	The solution of this problem is universal operating system for mobile devices - Motion eXperience Interface (MXI) created by RADIXS company [13].

There are difficulties to use multimedia elements (especially video) in cellular phones.	This problem will be solved with the use of 3G and next generation communications.
The prices for wireless communications are still high.	The growth of the number of mobile operators and services will lower the prices.

The change from e-Learning to m-Learning will excite the change in the educational paradigm [3]. This will require the pedagogical methods change and communication changes between teacher and students from one hand, and among students from the other hand.

### **CONCLUSIONS AND FUTURE WORK**

Regardless of existing till now disadvantages the m-Learning will become more and more popular with the progress of information and communication technologies. Its common use with the traditional education will correspond to the needs of educational quality improve. The educational process will become more flexible and will fulfill to the needs of life long learning. M-Learning also can assure good educational opportunities for disabled people.

The future work of the authors will be to analyse the existing mobile multimedia education systems and to develop adequate to the Bulgarian conditions one.

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