Mobilizing e-learning

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***Abstract*— Our experience in distance learning shows that successful solutions carefully select pedagogical methodologies and apply the most widely accessible technologies. Mobile computer devices of the last few years are comfortable to use, "powerful enough" and provide access to a large number of applications. The market penetration of smartphones is high; people who want to buy a phone will almost certainly choose a smartphone in the price range appropriate for them. Besides traditional access to the internet, broadband mobile internet access is also available all over the world and we have a wide range of subscriptions in Hungary, too. The members of Generation Z, i.e. those born after 1995 have had computers since their childhood. They carry their smartphones, tablets and phablets with them everywhere and constantly use them.**

High levels of mobile penetration are proved by a number of other statistics as well, resulting in presumptions that mobile devices will take the lead in e-learning; electronic teaching and learning will be replaced by mobile teaching and learning, and e-learning will eventually become m-learning. In order to have a clearer picture, this paper gives an overview of the history of e-learning up to our days. It showcases a few m-learning models and summarises the main aspects of their introduction and operation and the leading research areas now in the focus of attention.

We have mainly examined the application of mobile devices in higher education but this type of learning could supplement any type of education. It could play a major role in life-long learning, as well as in training the socially disadvantaged or the elderly. Because of the limitations to the length of this document, we cannot provide a detailed discussion of shaping the institutional strategy of mobile learning, the steps and aspects of its introduction or methodological issues.

***Key words*—mobile learning, ubiquitous learning, smartphone, hardware–software–human components of learning, mobile learning models**

I. INTRODUCTION

A. The definition of mobile learning

When looking for the definition of mobile learning (m-learning) we can see that earlier attempts to determine it focused on technology and were inaccurate. Mar Gutiérrez-Colón Plana (2013) [18] mentioned the following definitions in his talk:

- "any educational provision where the sole or dominant technologies are handheld or palmtop devices" (Traxler 2005).
- "Mobile learning should be restricted to learning on devices which a lady can carry in her handbag or a gentleman can carry in his pocket". (Keegan, 2005).
- "exploitation of ubiquitous handheld hardware, wireless networking and mobile telephony to enhance and extend the reach of teaching and learning" (MoLeNET, 2007).

Further research in this field has resulted in definitions in various categories in the last few years [Ibid.]: technology-driven mobile learning, miniature but portable e-learning, connected classroom learning.

Schofield et al. (2011) [25] offer the following definition of mobile learning in the UNESCO study on mobile education: "handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning".

Benedek, on the one hand, sees it as the accomplishment of e-learning, and, on the other as a supplement or at times an alternative to formal, school-system learning, as well as an ideal tool for life-long learning. [4]

Nyíri (2002) mentions two well-known mobile learning approaches [22]. In the first one e-learning simply becomes m-learning without significant changes to its content while internet access is provided by wireless devices. The second approach emphasizes that mobile learning will typically target ubiquitous and situation-dependent knowledge. According to Nyíri's own, third approach mobile learning is learning conducted through mobile communication between people. Mobile learning targets situation-dependent knowledge, it crosses fields of science, and, being an organizer of basic principles, it stands out from practical tasks. It has multisensory content.

Many researchers think that content development is of ever growing importance and is part of, if not a criterion for, learning with mobile devices. This is discussed especially in the field of informal learning.

Describing the features of mobile learning, Schofield et al. (2011) [25] quote Naismith et al. (2004) [19]: Mobile learning is "highly situated, personal, collaborative and long term; in other words, truly learner-centred learning", which involves portability (small devices that can be used anywhere), interconnectivity (with other people, devices and networks), interactivity (portable devices potentially contribute to a cooperative learning environment), context sensitivity (the student's environment can be used during learning to a greater extent), life-long learning and individuality (based on previously acquired knowledge, learning can be tailored to the user's needs). We agree that these features/ facilities are appropriate to describe mobile learning.

We should also highlight the definition of Vágvölgyi et al. (2011), which casts light on the essence of the problem at a higher level, because it considers access to content and activity as major factors: "Any content or activity

available on a mobile device and related to learning" [29] – although attaining information is only access to it and not learning.

The figure below represents mobile learning within distance learning as it is generally accepted, within the concept of e-learning and close to online learning.

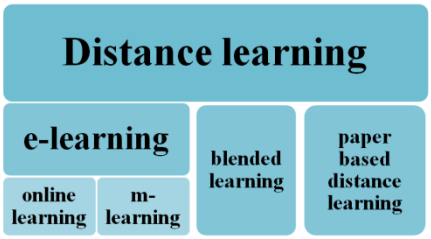

Figure 1. The place of m-learning within distance learning

One might have the idea that mobile learning has always been present, even during organized, teacher-controlled learning that ended with an assessment; For example, when doing home assignments or when you can study books or notes, independently of location. Today, however, we apply the term *mobile learning* to tuition/ learning assisted by portable, personal electronic devices that have internet access, which also provides as many opportunities as possible for students to manage the learning activities they can control in a dynamic and personalised way. These would include carrying out interactions, managing their own learning in order to access new, relevant sources of information, even those that are confined to locations or situations, contacting the teacher and the fellow students anywhere, any time, online (chat) or offline (forum), getting instant feedback about their achievements in the electronic system, creating new elements of content they can publish for the other trainees.

B. Mobile devices

We will now review the widely spread electronic devices that can be used in mobile learning. According to the definitions in the previous section, not all of them are regarded by many authors as tools for mobile learning, as those who consider content development and the contact between participants (students, teachers support staff) as a key element and who wish to realise it and all the other learning activities with the help of mobile devices, will not include e.g. walkmans, MP3 players or digital cameras. However, if we want to see which electronic devices can at certain points be included in a course within organised education, we will have quite a wide palette. We have thought of the devices below and have indicated examples or areas of application:

- mobile phones: limited web content, optimised content;
- smartphones: more complex web content, courseware;
- tablets: e.g. iPad, Playbook, Galaxy Tab; web content according to choice, full-scale multimedia;
- phablets: a hybrid of tablets and smartphones, e. g. Samsung Galaxy Note;
- PDA: Personal Digital Assistants, e.g. Palm;
- eBook readers: e.g. Kindle; electronic books;
- notebook, netbooks: laptop-like functionality;
- laptop: PC-like functionality;
- MP3 players: e.g. iPod; talking book, language learning, voice recording, audio instructions or content;
- walkmans: talking book, language learning;
- digital cameras: for content, embedded media.

In the above cases both the device, its user and very often the internet connection, the experience and the options are mobile. Today the learning we outlined in the previous section can easily be independent of location and time. Logically, many would name learning with a PC, where the place is fixed (personal/ one's own/ family/ school computer) as a contrast to these devices. Experts usually underline that smartphones, tablets and other handheld devices are personal; we always have them on our person, we access information with their help, interact with them and they are used to manage our activities. It has been revealed several times that top quality smartphones and phablets providing multiple services and suitable for installing a lot of applications are liked by their owners "for their own sake" and they would never exchange them for any other products, even if they fitted their needs more.

Many of the above devices are not listed by Naismith et al. (2004) [19] in their classification but a few others are included and the reasons for that are explained. They are placed along the personal – shared and portable – static scales:

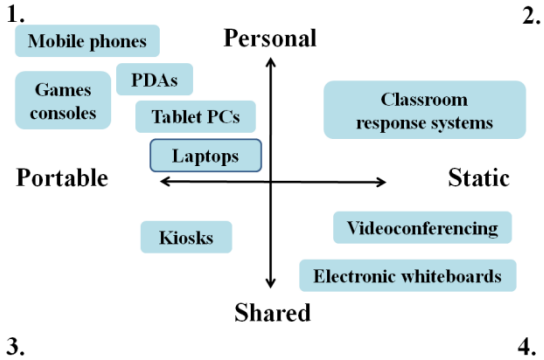

Figure 2. The classification of mobile technologies [19]

The 1st, top left quadrant includes portable and personal devices. Most of them are generally considered to belong to mobile technology: mobile phones, PDAs, tablets, laptops. Naismith et al. think games consoles also belong here. They are portable personal devices, too, and, because they can be connected to networks, they can ensure communication and information sharing. They are also applied in education.

The 2nd, top right quadrant has technologies with personal and static devices. They still offer personal interaction in learning and are small and portable within a certain space, e.g. a classroom. Classroom response systems are also listed here. These devices can be used by students anonymously to answer multiple choice questions, while the teacher manages administration on a central server.

We can find portable, shared devices in the 3rd, bottom left quadrant. It includes kiosks (in streets, institutions, e.g. interactive museum kiosks), which, although static, provide learning opportunities for a wide, mobile circle of users. They might seem less personal, large and not portable at first sight.

The 4th, bottom right quadrant includes static, shared technology (that can be used linked to one place) with interactive white boards and video conferences. Although quadrants 1-3 have technologies that are obviously mobile, devices in the 4th one are not exactly static, either. For example, if they have an appropriate brand width and financial framework, students can join a video conference from any place.

II. PHASES IN THE HISTORY OF E-LEARNING

Several experts have given an overview of the phases of the evolution of e-learning in terms of devices and technologies. In his talk, Mar Gutiérrez-Colón Plana (2012) outlines 5 waves of teaching with electronic devices. The first four were defined by Pownell and Bailey (2001) and the fifth began after that. [18]

1st wave: started before 1970 (record players, audio cassettes). Mar Gutiérrez-Colón Plana, a language teacher adds here that it was the Linguaphone language school that first produced wax cylinders in 1902. Phonograph records emerged in 1920 to be replaced by magnetic tapes in 1960, before digital technology launched in 1980.

2nd wave: started in 1970 with PCs.

3rd wave: from 1990, when the Internet and the World Wide Web appeared.

4th wave: started in 2000, as laptops and mobile phones began to spread. Today handheld computers are at the cutting edge of educational technology.

5th wave: probably started with the appearance of iPods and MP3 players, widely applied in learning. (Handheld devices, e.g. PDAs, available before that were meant for business, they were not used in education.)

Taylor (2001), examining the impact of the evolution of distance learning in higher education, defined five generations as follows: [28]

1st generation: Correspondence model, based on printing technology.

2nd generation: Multimedia model, based on printing, audio and video technology.

3rd generation: Telelearning model, based on telecommunication technologies, providing opportunities for simultaneous communication.

4th generation: Flexible learning model, based on online information sharing via the internet.

5th generation: Can be derived from the 4th one, it uses the features of the internet and the web.

Other attempts to divide this history into phases also looked into the technological changes in e-learning from the aspect of hardware, probably of software. We think we get a more detailed picture if we interpret software in a broad sense and include the key aspects of human resources during these periods. Therefore we suggest that the opportunities and limitations in the various phases of e-learning should be analysed from three aspects, from that of hardware, software and human resources. Hardware is the range of electronic devices applied in teaching and learning. By software we mean, apart from programmes, courseware and framework run on hardware, the methodology of e-education and e-learning. By human resources we mean those taking part in the teaching and learning process, i.e. the teacher and the students, as well as tutors, mentors, training organisers, organizational controls and frames, within which e-learning operates (see figure below).

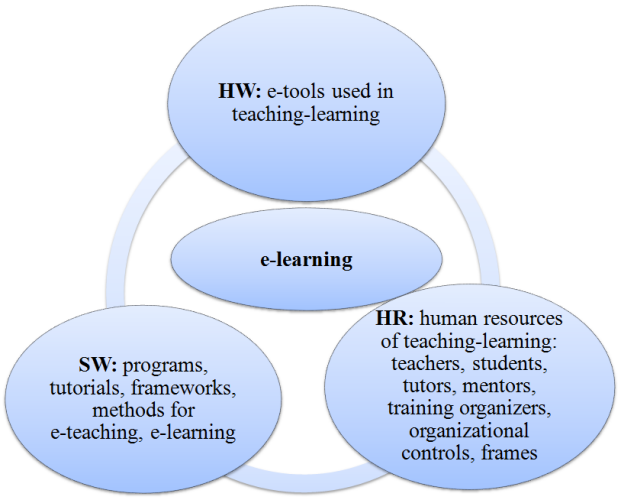

Figure 3. Components of e-learning: hardware, software and HR

We will examine e-learning according to these three aspects in four phases from 1920 to our times (see next figure). The boundaries of phases 1-3 were defined by Seres et al. (2010) [26]. Although we focus on opportunities available in Hungary, we also indicate events in the world by providing years in brackets with the help of Ferriman (2013) [9].

Phase 1 lasted from the 1920s to the end of the 1950s. In terms of hardware, the 1920s saw the spreading of public radio broadcast. (In the USA, Pennsylvania State College was the first higher education institution to broadcast courses via the radio in 1922.) Public television broadcast started in the 1930s, with the University of Iowa as the first university to apply television as an educational tool in 1934. At that time, electronics was a significant, new subject only in education. The first tools of e-learning were radio schools in the 1940s and educational television in the 50s and 60s, also in Hungary, where, by that time, we had had sufficient coverage and numbers of receiving sets.

In terms of software, radio schools and especially educational television were able to operate only with significant background support (directing, editing, etc.), therefore they were applied at national or large community levels.

Considering human resources, there was great interest on the learning side; a lot of people listened to the radio and watched television. However, the number of topics fit for teaching and of communities that could be reached was limited. There were few channels and short air-time and on the teaching side there was small variety; few people were suitable to give lectures that would be of interest for a wide audience. Hungarian scientists-teachers like physics professor Öveges, children's psychologist Jenő Ranschburg or genetic researcher Endre Czeizel were rare and pleasant exceptions.

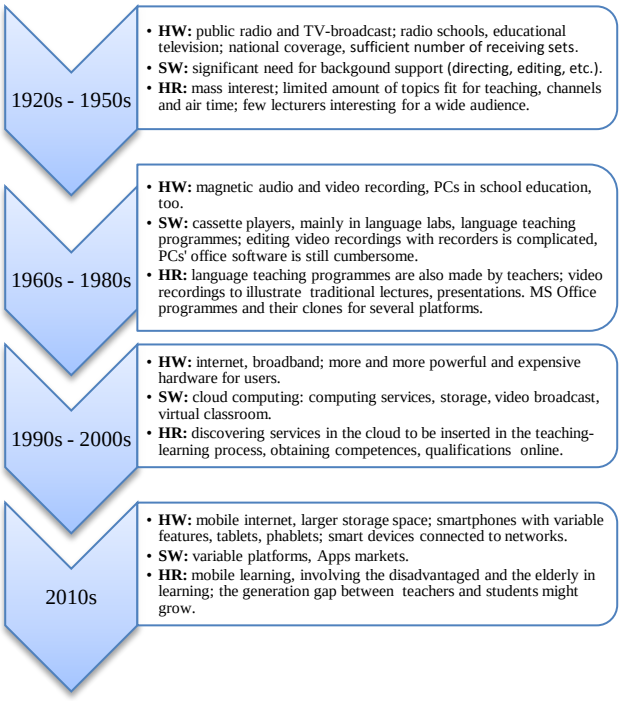

Figure 4. Phases of e-learning in Hungary with regard to key hardware, software and human resources features

Phase 2 lasted from the 1960s to the early 1990s. As regards hardware, with the appearance of magnetic audio recording in the 60s and 70s, and of video recorders and personal computers in the 80s, the tools of e-learning were already present in school education, too.

(In 1969 the first version of internet, APRHANET was created in the USA. In Vienna in 1971 philosopher Ivan Illich's book "Deschooling Society" gave an impetus to computer-based education. The first virtual college was founded at the University of Phoenix, Arizona in 1976. In 1980 in Alaska the first state satellite education system provided daily education television programmes for 100 villages. The Computer Assisted Learning Center for adults was founded in Rindge, New Hampshire in 1982.

As for software, tape recorders/ cassette players were mainly used in language laboratories, for which teachers themselves already made programmes but professional language teaching programmes were also published. Cutting and editing video recordings, on the other hand, was quite complicated. Using the programmes of the first computers for word processing, table management or making presentations was not easy, either.

Looking at the aspect of human resources, both students and teachers like using language teaching programmes, even today. Video recording is still mainly used to record traditional lectures, although students like lectures illustrated with video. Nowadays recordings of lessons made by students and uploaded to community websites are more frequent than educational films. Computer-based word processing, table management and creating presentations have been more widely used in e-learning since the appearance of MS Office. Now its clones exist for almost every platform.

In Phase 3, the great breakthrough was brought about by the wide-scale application of the internet in the 1990s and the spreading of broadband, resulting in fast internet-access in the first decade of the 2000s. With the help of digital data, audio and video recording and broadband, any kind of teaching material can be made available on the internet for anybody, any time, anywhere, in a realistic period of time. Running more and more complicated users' programmes, storing and moving larger and larger data files and reaching an ever growing speed for data processing and transfer set users' requirements for more and more powerful and expensive hardware and software.

(The Electronic University Network assisted with the development of virtual university campuses via AOL[1] from 1992. CALcampus created the first wide-scale, "online-only" learning material in 1994. The Regent University, Virginia Beach has been providing online PhD training in the area of telecommunication since 1995. WebCT 1.0 and LMS that could be considered as the predecessors to BlackBoard were launched in 1997. Blackboard Course Systems were introduced in Washington in 1999. In 2002 the virtual learning environment Moodle 1.0 was launched in Australia. In 2004 they started the SAKAI Project, the scalable software for virtual learning environments developed by cooperation between higher education institutions and organisations.)

On the software side, the service called cloud computing became widespread among users in the first decade of the 21st century. Modern, cost-effective, interactive transfer of knowledge is not feasible today if we only use our own resources. Services in cloud computing are available in the area of e-learning, too, which has resulted in cloud-learning (c-learning). Solutions offered by c-learning are widening every day; not only are traditional e-learning functionalities being moved to the clouds but we can also use services in the teaching-learning process we have never dreamt of. For example, classes can be made accessible with the help of live video broadcast, virtual classrooms or made more colourful with presentations shared by the teacher and the students. Our own reference would be an IBM Power Systems course conducted with Norbert Sepp at the Dennis Gabor College, Budapest in 2012, where we also used a virtual classroom and live video broadcast.

The human factor has an ever growing role; who will be able to detect more services in the cloud that are fit to be inserted in the teaching-learning process? And this is where roles start to be reversed, as in many cases students know cyberspace in this field better than their teachers do. Also, a wide range of competences and even qualifications can be obtained by completing self-access, online training programmes/ courses on the internet without physically entering an educational institution.

(By 2005 almost 3.2 million students in the USA had enrolled in at least one online university course. By 2009 53% of students in secondary state education had enrolled in distance learning courses. YouTube EDU has presented thousands of free lessons. Between 1998 and 2008 the number of students who chose distance learning courses as part of the traditional training programmes grew by 150%.)

Phase 4 unfolded in the second decade of the new century and brought the rapid expansion of mobile internet. Hardware conditions for mobile learning are

[1] AOL: Originally America Online, today AOL Inc. The most successful company network and internet service provider. In the early days of the internet AOL was the internet itself for many Americans.

getting better; a new smartphone or tablet seems to appear on the market every day and they have innovative features and offers. For example, typing on tablets can be facilitated by docks or sliding keyboards. Service providers offer their devices and services (internet subscription, storage space, etc.) with more and more favourable conditions; smartphones come in packages with tablets. Mobile devices and smart television sets with larger and larger screens can easily be connected through home and school WIFI networks and thus be integrated in the m-learning process. Certain educational institutions lure new students by giving them free tablets upon registration.

As for software, similarly to computers, the manufacturers of mobile devices apply various operation systems. The dominance of platforms changes faster in this market. Each platform has a "programme store" but their applications are usually not compatible with each other. The "look" of learning material and presentations is different on the screens of different sizes. C-learning applications are not yet accessible from every mobile platform. These applications and the size of the screens and storage space of mobile devices create a large diversity, which makes it difficult to develop learning material for a wide student audience.

Looking at the human resources aspect, mobile learning applications make learning possible in situations not exploited before, e.g. during travelling or while waiting for the doctor, so learning may really become ubiquitous, provided there is full internet coverage and the service is available at a reasonable price or for free. We should not forget about the fact, though, that learning is an activity one is engrossed in, requiring suitable external and internal circumstances, which are not ideal in crowded means of transport or when waiting for our turn.

Mobile phones provide opportunities for the disadvantaged to join learning and for all those who wish to learn to be involved in life long learning. Simple operation of tablets may help draw in the elderly generations. However, during the teaching-learning process the generation gap between teachers and students may grow, simply because while the teacher teaches, acts as a tutor, does further training or creates learning material, the learner will find even more novelties when working with a well-structured learning material.

(In the USA, 60% of four-year private universities/ colleges offer online classes in 2013.)

III. THE PENETRATION OF THE INTERNET AND OF MOBILE PHONES IN THE WORLD AND IN HUNGARY

Let us review the penetration of the internet and the use of mobile phones in the world and in Hungary. If we set up the system of mobile learning with involving the students' own devices (Bring Your Own Device, BYOD), then one of the preparatory tasks is making a survey of these facilities.

Steve Jobs said in 2010: "PCs are going to be like trucks. They are still going to be around. However, only one out of x people will need them. The move will make many PC veterans uneasy because the PC has taken us a long way."[2]

[2] Kara Swisher: Full D8 Interview Video: Apple CEO Steve Jobs, June 7, 2010, http://allthingsd.com/20100607/full-d8-video-apple-ceo-steve-jobs/.

PC sales have been stagnant since 2005, and this has several reasons. Although in Western Europe fewer desktop computers are sold, there was a growth in developing countries, e.g. in India in 2011–12. PCs that are only a few years old can easily be upgraded (with video cards, larger monitors, SSDs). Tablets that emerged in 2010 are mainly used for entertainment but some people would use them to replace their PCs. Smart phones are used in many developing countries instead of computers. Monitors, keyboards, mouses can be attached to them and this way they can practically be used as office computers. All-in-One PCs are as powerful as notebook configurations with integrated video cards.

The statistics published by Forbes in mid-2011 [6] compare the tendencies of desktop computer and notebook sales with those of smartphones and tablets between 2005 and 2013. Desktop computer sales have basically remained on the same level and those of notebooks have been slowly growing, whereas the sales of smartphones have been growing steadily, so that in the fourth quarter of 2011 they alone superseded the total number of desktop computers and notebooks sold. After their appearance in 2010, the sales of tablets doubled every year. According to forecasts, by the end of 2013 the ratio of computer and notebook sales as compared to smartphone and tablet sales will be 4:7.

According to the survey conducted by Ericsson [27] in the third quarter of 2012 worldwide mobile penetration was 91% (with about one third of subscriptions belonging to the same user). In this quarter, the sales of smartphones accounted for approximately 40% of mobile phone sales, which is 10% higher than their total 2011 sales. Thus, the ratio of smartphone subscriptions within mobile subscriptions in this quarter was 15%.

According to the survey conducted by NRC market research in Hungary in March 2011 [15], more than 90% of people aged 15-24 and those with university or college degrees, 80% of people in their 30s and medium qualified citizens, 43% of people in their 50s, 35% of adults with only primary education, 25% of those in their 60s and 5% of those older than 70 (according to 2008 data [12], they account for 15% of the Hungarian population) use the internet.

According to Kurucz [ibid.], if in the near future people were only able to buy smartphones and even the cheapest package included internet access, penetration in Hungary would grow to some extent. This way it would also be used by those who so far have had access through PCs or notebooks, those with a low educational level and the elderly.

Among those under 30, nine out of ten use the internet actively; what is more, they spend most of their time using it [ibid.]. Half of the people, including those in their 60s, use several screens at the same time (use the internet while watching television) [24].

One quarter of children in Hungary say mobile phones are "vital" for them; they cannot imagine life without them [20].

We conducted an anonymous survey at the Dennis Gabor College, Budapest in the ILIAS e-learning framework in April 2013. 32% of students with an "active" status answered the questionnaire. 82% of these have smartphones. 61% have internet accounts, out of which 19% with packages larger than 1GB. Significantly

larger numbers use their phones frequently: 55.4% several times or continuously during the day, and the majority of them have mobile subscriptions.

IV. MOBILE LEARNING MODELS

A. Models set up according to aspects of ICT and educational technologies

Several mobile learning models have been created based on one or two aspects of information, communication or educational technologies, e.g. according to supported mobile devices, the type of wireless communication, supporting synchronous and/ or asynchronous communication, the facility of permanent internet connection between the mobile learning system and the user, the geographical position of the user, or the access to learning material and/ or administrative services.

Georgieva et al. (2005) [10] generalised the aspects previously mentioned in the literature and added two more: support for e-learning standards and communication between teachers and students. They also provided the 3D model of their categorisation, with axes of online-offline contact, service provision within or outside campus and access to material for learning and administration. In the 3D rectangular coordinate system formed by these three axes, mobile learning systems (mLSs) can be placed according to nine different features. Those considered as best at present are at the origin of the sphere.

In the following sections we will use a new approach to examine mobile learning and will discuss one of the Technology Acceptance Models (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), its further development and a paradigm shift in this field.

B. UTAUT models upgraded for mobile learning

The foundations of the Technology Acceptance Model were laid down by Davis (1989) [7], based on the book by Ajzen and Fishbein (1975) [1]. The investigation of technology acceptance studies people's psychological attitude to the use of a certain technology, in voluntary and mandatory settings. The area of study is IT and information systems (use of computers, software and their acceptance in a working environment). It has been further developed several times and has been applied to other areas as well.

The Unified Theory of Acceptance and Use of Technology (UTAUT) was published by Venkatesh et al. (2003) [30]. Its validation found it to account for 70% of the variance in BI. It has been widely used with success and it has been upgraded, also in the area of mobile learning by many [17] [31] [8], who expanded the model.

The TAM was widely criticised, for example, Nyirő (2011) [21] in his summary. One of the critics of the UTAUT and its extensions was Bagozzi (2007) [2], who was involved in creating the TAM model. He thinks that, although UTAUT is well-meaning and thoughtful, it presents a model with too many independent variables. He proposes instead a unified theory that coheres the "many splinters of knowledge" to explain decision making. His suggested model consists first of a decision making core (goal desire → goal intention → action desire → action intention) that is grounded in basic decision-making variables/processes of a universal nature. The decision core also contains a mechanism for self-regulation that moderates the effects of desires on intentions. Second, added to the decision making core, are a number of causes and effects of decisions and self-regulatory reasoning, with the aim of introducing potential contingent, contextual nuances for understanding decision making. Many of the causal variables here are contained within TAM or its extensions; also considered are new variables grounded in emotional, group/social/cultural, and goal-directed behaviour research.

C. The model for the effective use of technology

Bates and Poole's model (2003) [3] is based on key criteria to be used in determining the choice of technology for teaching in higher education. The eight criteria are the appropriateness of the technology for students, ease of use and reliability, cost, teaching and learning approaches, interactivity, organisational issues, novelty and speed (e.g. how quickly materials can be developed).

They also provide guidance on how to develop and deliver a course using electronic technology and discuss the organizational and technical support structures that are needed to back up instructors using technology. They provide a comprehensive theoretical and pedagogical foundation to help instructors make critical decisions about the use of technology within the college curriculum. The book discusses the relationship between knowledge, learning, teaching, and the nature of media, and shows how this information should inform the use of technology in a teaching environment.

D. The holistic approach to learning

We agree with Gosper (2011) [11], saying "The curriculum does not work in isolation of the environment in which it is delivered, hence necessitating a holistic or ecological approach to the development of learning environments." Based on an extensive review of the literature, she identified four areas for consideration, all with an underlying emphasis on the pedagogic factor:

"1. Institutional success factors: Recognition of multiple models, rather than a generic approach. A scholarly transformational approach that takes a whole of course approach rather than simply adding on the technology. Commitment to regular evaluations with publication of the results. Institutional building blocks in place including organisational readiness, sufficient technical resources, motivated faculty, good communication and feedback channels with students.

2. Teaching factors: Continuing professional development with sufficient time allowed for development. Ongoing pedagogical and technical support and the development of communities of practice. Consideration of teachers' fears of loss of control, lower student feedback grades and the impact of online learning on classroom relationships. Consideration of the impact on workloads.

3. Students: Consider students' learning maturity and readiness for blending learning with its demands for independent study. Take account of student expectations on face-to-face attendance, workload and the need to develop responsibility for their learning and time management skills. Provide consistent and transparent communication around the new expectations.

4. Pedagogic considerations: Choices on the combination of virtual and physical environments should be based on the strengths and weaknesses of each

environment and appropriateness to the learners involved. Use of literature and examples of good practice should be used to help inform decisions about the use of technologies and the design of courses and activities. Recognition of the importance of a strong integration between the two environments, face-to-face and technology-mediated. Consideration of the role of the teacher, particularly in providing feedback when students were present and in preparing students for online activities."

Apart from these factors, we think that our findings, related to distant learning and e-learning, listed below, should also be highlighted: [5]

- Learning is done through management.
- The material adapted to or developed for the chosen media also has a managing function.
- Human beings will always need the direct student-teacher and student-student relationship.
- The e-toolkit needs to be integrated at every level and integrated use follows from the institutional strategy.
- It is the environment – with its main areas such as family, society and knowledge – that defines knowledge and the requirements and conditions of the teaching-learning system.

V. MOBILE LEARNING IN THE WORLD AND IN HUNGARY

This chapter will give an overview of mobile learning in the world and in Hungary, categorised according to several aspects.

Kismihok establishes [14] that "Japan, Taiwan and South Africa are world leaders in mobile learning but South Korea and China can also prospectively get to the leading group. We can also see considerable activity in this area in Australia, Canada, India and the USA."

Kismihok sorts European distance learning institutions into four categories, according to their types: consortiums, distance learning universities, distance learning institutions and distance learning units at universities, training companies and schools. European countries can be placed on four levels according to their achievements in mobile learning.

In the United Kingdom (Level 1) there are at least four areas of mobile learning: primary and secondary education, universities, government organisations and companies.

There are 16 countries at Level 2, which mainly run projects funded by the European Commission (Austria, Plovdiv University, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, Corvinus University of Budapest, Hungary, Ericsson Education Ireland, several projects for university and government research centres in Italy, the Netherlands, NKI in Norway, Portugal, Slovakia, Slovenia, Spain and Sweden.).

The 7 EU countries of Level 3 are making their first steps in this field (Estonia, France, Greece, Latvia, Lithuania, Malta and Poland).

There are 3 EU countries at Level 4, where there have been no or hardly any m-learning activities (Belgium, Luxemburg, Romania).

We have seen a large number of papers and reports about the use of mobile devices in teaching/ learning and good practices since these tools appeared. A lot of summaries publish case studies, categorised according to certain aspects about good solutions in the field of mobile learning. Schofield et al. (2011) [25] published the documentation of semi-structured interviews with nine universities; leading, innovative educational institutions that have outstanding results in mobile learning and their achievements represent great diversity. The authors summarised the lessons learnt from the key aspects that were highlighted in the interviews as follows:

- "Uses: Several of the examples utilised the opportunity that mobile devices gave them to have people together in classrooms to extend collaborative learning; for others mobile technology provided opportunities for innovation which engage participants in and out of the classroom.
- Learning: Mobile devices have allowed individuals to connect to executive education at a time that suits them and in a way that can support current business challenges. Less dependent on the classroom, they can connect in times of reflection. Also, mobile devices are currently being used in a range of different types of learning activities for which there is potential in executive education (for example, behaviourist, constructivist and situated, collaborative, informal and in support).
- Evaluation: Many institutions have not evaluated learning beyond initial and ongoing reactions of students. A few hubs of expertise have measured learning, behaviour and results. These institutions have taken an action learning approach that regularly evaluates actions, experience and outcomes in order to improve performance.
- Technology: The current focus amongst executive education providers is predominantly technology driven rather than user driven."

Naismith et al. (2004) [19] list a large number of examples from six categories of mobile learning that could be found up to 2003. The examples were selected to illustrate one or more features of the following: "broad impact, mainly inferred from the number of learners supported, strong theoretical basis, support of an interesting or novel activity and inclusion of both qualitative and quantitative evaluation results." The six main bases and the typical activities are:

- Behaviourist: practice and feedback with classroom response systems.
- Constructivist: engaging in simulations.
- Situated: problem and case-based learning context awareness.
- Collaborative: mobile computer assisted learning.
- Informal and life-long: supporting deliberate and accidental learning episodes.
- Learning and teaching support: supporting individuals with administrative tasks.

Among Hungarian publications, e.g. Kis [13] mentions a number of good examples used to support the various phases of learning. The Scoolers product family, for example, to learn arithmetic, the "Crib store" of the Hungarian National Textbook Publisher can assist secondary school pupils with the database of historical events and the personal note taking function. Kis presents

a project on making interviews related to local history at history lessons, illustrated with lesson plans. They describe the activities of the pupils before and after the recording made by mobile phones (planning, preparation, relevant ethical norms, looking at examples, practice, written summary, etc.).

Kismihok presents an example from the Corvinus University of Budapest [14], which, according to the four-level approach of the EU mobile learning programme regarding mobile adoption is at level 3. (Level 1: Administration (SMS notification about assessment deadlines). Level 2: Study help (as compared to level 1, 4 or 5 more video phone sessions from and with institution, e.g. consolidation, mock exam, forum, downloading material, access to registration system). Level 3: Course modules (m-learning in mainstream education: accreditation of mobile learning modules, curriculum, formal assessment, payment of fees). Level 4: Location and context-sensitive education and training (supplementing mobile learning modules with location-based and context-sensitive features).)

You can join a number of professional groups on the internet to get ideas and help. There is a great variety of both free and pay applications for mobile platforms, related to learning.

VI. PROBLEMS TO BE TACKLED, RESEARCH AREAS

A large number of publications is also available about the stages and aspects of introducing mobile learning. Based on their secondary research and semi-structured interviews, Schofield et al. (2011) [25] give the following suggestions about problems yet to be solved in order to launch mobile learning. (Their approach is undoubtedly holistic; this advice responds to the four areas to be considered, earlier mentioned in section III.):

- We should take into consideration *facilities already existing* in the learning space and introduce mobile technology on that basis.
- *Participants* (educators, staff) should be involved in order to mitigate resistance to change. Successful solutions of teachers should be acknowledged. It should be emphasized why the adoption of mobile technology is useful. Unsuccessful initiatives should be accepted to provide greater freedom for creativity.
- Choosing *technology* is a complex issue, as there is no single device any better than the other. The suitability of the device depends on our choice and the needs. Further aspects could be the ownership of the technology and students' lifestyle.
- *Costs* will largely depend on the chosen approach (initial costs, ongoing costs of infrastructure and technical support, designing and implementing new concepts, etc.).
- It is important to know the *prospective learners*, their preferences, behaviour, attitudes towards, phone usage and learning. We should have reliable assessment of background information.
- The adopted *pedagogy* should be placed first as part of a wider strategy with support elements as it cannot be expected that industry will settle long enough to provide *standards* as a template.
- It is important to think about *content format* and its *distribution* with respect to what mobile devices the users have. Content should be created so that it will be accepted by users.
- *Communication* should be appropriate. The management should inform the staff about mobile learning facilities. There also needs to be pedagogical support for educators. Support services need to be available for the management of equipment during installation and operation.
- *Evaluation* of the mobile strategy, apart from the participants' response, should involve assessment of both learning and behaviour. Participants' results should be compared to those achieved outside mobile learning.

Some of the key pieces of advice noted down during interviews were: "Start slowly – but start;" "Be experimental – don't call it an initiative"; "Be prepared for more work – not less"; "Don't wait for the industry to settle – you'll be waiting a long time"; "Be open to feedback – from participants, faculty and staff"; "Adopt a 'freedom to fail' approach".

According to a frequent opinion, the challenge set by the adoption of mobile learning in education is the portability of the devices and developing formats for them. However, as we have seen before, this is only part of all the tasks to be considered when introducing or operating mobile learning. The following need to be noted, too, (and, of course, several more items could be added to the list):

Web pages designed for desktop computer monitors are too difficult to manage on small displays. With mobile devices we need to use automatically selected, optimised style sheets and content building (one-column text, few and low-resolution images, simplified navigation, functions designed for mobile devices). (Moodle and ILIAS, for example, have these styles now. Our own embarrassing experience is that this paper, for example, cannot be easily read in docx format on every mobile device, because of the two-column arrangement, and the SmartArt diagrams cannot be displayed.) We need to look into ways of creating a course that can be used in a printed form, on PCs, mobile devices, also by disabled people. Progressive web pages are promising, as well as standards like html5/css and W3C recommendations. Because of the versatile platforms of mobile devices, sometimes we need to make several different versions of software.

Data can be entered into mobile devices in various ways (traditional mobile phone keypad, QUWERTY keyboard, touch screen, pen) but it is considerably slower than PC or laptop keyboards.

Today it is still very expensive to buy a suitable set, an internet package, perhaps the necessary applications and updates. Also, in the case of organised training, a help desk should be taken into account to answer users' queries.

The running time of batteries is still very short and they will wear off in a few years.

Coverage for mobile internet is very often insufficient or absent; it depends on service providers and the institution where the student is located. Download speed is very often unsatisfactory, signal strength is unstable, the internet connection keeps breaking. Speed should be appropriate even during concurrent downloads. Content should be accessible offline, too.

Finally, let us look at the mobile learning technologies being researched:

- location and context-based learning;
- context-aware, ubiquitous learning;
- 'point-and-shoot' learning with camera phones and 2D code;
- close proximity, fast and secure data transfer (Near Field Communications, NFC);
- sensors and accelerometer in mobile devices for behaviour-based learning;
- games and simulations on mobile devices for learning;
- Augmented Reality (AR);
- learning performance support;
- the development of mobile content (including user-generated content);
- tests, surveys, J.I.T. learning;
- social network-based mobile learning;
- mobile learning carried out through SMS and voice-based CellCasting[3];
- storing files in clouds.

VII. Summary

In this paper we first examined mobile learning from the aspect of the devices, reviewing the literature and our own opinion; we defined mobile learning, using several approaches, the types of mobile devices and the phases of the history of e-learning. Subsequently, from the aspect of hardware, we highlighted the penetration of the internet and mobile phones and gave its overview in Hungary and in the world. After that we looked at several models related to mobile learning, arranging them in a kind of evolutionary order (from models defined in terms of educational ICT to the holistic approach). Then, providing categorisation from several aspects, we looked at the ongoing progress of mobile learning in the world. Finally, we gave an overview of tasks to be fulfilled when introducing and operating mobile learning, first holistically, then underlining the equipment side. This last section was concluded by the study of forward-looking technologies used in the field of mobile learning that are being researched.

We wish to underline that we made suggestions regarding the analysis of opportunities and limitations of e-learning according to three aspects: hardware, software and human resources. We defined the four phases of the development of e-learning: At present, after the first decade of the 21st century the use of mobile technologies and cloud learning seem to be outstanding. There is a great diversity of hardware and software and teachers and students have a wide range of choices in terms of human resources.

In education, including distance learning, successful technologies and electronic devices are the ones that are generally accessible, easy to use and whose overall technology is commonly accepted. We agree with Oblinger (2005) [11] saying "It is not the technology that is most important but the activity it enables: the activity, not the technology, is what advances learning".

[3] CellCasting: podcasting for phone with interactive evaluation.

Mobile devices can by no means replace the "traditional" tools and solutions of distance and e-learning. Mobile learning should be examined, operated and introduced in a holistic way. All participants/ stakeholders should be considered and it should fit in the strategy of the organisation. In order to integrate the technologies into the curriculum, the numerous models created to suit the various contexts (distance, intramural, blended and flexible learning, etc.) will only be effective if tailored according to the institutions' needs. Success also depends on the structure of leadership/ management, which ensures that the developed models are efficient and sustainable.

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