

WE NEED AN EDUCATIONALLY RELEVANT DEFINITION OF MOBILE LEARNING

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Abstract

In this paper we challenge current definitions of mobile learning and suggest that the direction of progress, both in theoretical/applied research as well as its role as a tool that serves social transformation and development, will be determined and even dictated by the availability of an adequate definition. A new framework for the definition of mobile learning is proposed, one that considers a repertoire of domains, and which embraces not only technical, methodological and educational aspects, but also considers social and philosophical dimensions.

Keywords: mobile learning, definition, theory, philosophy, pedagogy, mental development, social responsibility, literacy divide, digital divide.

Introduction

Why has the term “mobile learning” suddenly become so fashionable? Sometimes, we become witnesses of re-organized scientific communities appealing for a niche role in mainstream science with catchy terminology in an attempt to attract interest and funds. Usually such attempts turn out to be nothing more than a re-packaging of existing concepts that do not add to our scientific understanding. Is mobile learning such an example of science trying to sell us a new discipline? Doesn't mobile learning simply mean “learning on the move”? In other words, doesn't the new term simply attempt to differentiate between learning that takes place in a formal context, such as a classroom, from learning that takes place anytime, anywhere while we are moving in our environment? If this is the case, then what is the nuance? Haven't we invented audiotapes with pre-recorded language lessons to carry with us while driving or jogging several decades ago? Hasn't learning always been mobile since the “creation” of man (or even before), thanks to the fact that we (as well as other animals) carry in our skulls a supercomputer we call brain? Don't we really learn at all times, wherever we are, whatever we do, simply because the learning machine is always “on”, even during sleep when we re-organize and sort out experiences and knowledge acquired during the day? If mobile learning is not really a new concept, why then bother with a new definition?

We ran a Google search in January 2005 using [+"mobile learning" +definition] and received 1,240 items. We ran the same search at end of June 2005 and it resulted to 22,700 items. Running it on scholar.google.com we received 231 items. A quick consideration revealed that depending on who is asking, and what the context is, different people mean different things when they use the term mobile learning. In the mean time, the interest in mobile learning is growing exponentially. A search with [+"mobile learning" + conference] gave us 45,100! Traxler (2005) has provided an excellent documentation not only of the most important international conferences, but also of the most influential projects of the past couple of years. We suggest taking a helicopter view of the

various definitions of mobile learning proposed so far and check whether we have a consensus, a redundancy and/or an overlap. Most researchers and educators probably view mobile learning as the immediate descendant of e-learning. Pinkwart, et al. (2003) for example, defines e-learning as ‘learning supported by digital “electronic” tools and media’, and by analogy, mobile learning as ‘e-learning that uses mobile devices and wireless transmission’. Quinn (2000) defined it earlier, as simply learning that takes place with the help of mobile devices. In line with this definition, several authors (e.g., Turunen, *et al.* 2003) view mobile devices as a pervasive medium that may assist us in combining work, study and leisure time in meaningful ways. Polsani (2003) considered these definitions “restrictive” and proposed instead the term ‘network learning’ (or ‘nlearning’). He therefore defines mobile learning as ‘a form of education whose site of production, circulation, and consumption is the network’. More recently, Traxler (2005) defined it as “any educational provision where the sole or dominant technologies are handheld or palmtop devices”, but a few paragraphs later he admitted that this definition might be rather technocentric and argues that we might need to look at mobile learning from the learner’s and user’s perspective. Sharples (2005) took a different approach. He described learning “as a process of *coming to know*, by which learners in cooperation with their peers and teachers, construct transiently stable interpretations of their world.” This definition gives mobile technologies a special role, because they dramatically increase our possibilities of communication and *conversation*. According to him, this radical constructivism (von Glaserfeld, 1984) extends the notion of learning as a constructive process beyond the individual to describe how organizations, communities and cultures learn and develop. All these definitions highlight differences in both perceptions and expectations. We cannot claim a consensus, but we can concede these noticeable differences call for a new definition. The way we define mobile learning inevitably emphasizes certain aspects and favors certain perceptions about it. Where there seems to be some consensus, however, is that mobile learning is something that needs to be re-considered in the context of the appearance of electronic mobile devices. Yet, even if we decide to define mobile learning in this context, we still have to consider two issues. First, the term mobile learning is composed of two words; the word “learning” demands at least as equal attention as the word “mobile”. In other words, defining mobile learning only in the context of mobile phones leaves out half of the story. The second issue is that the mere appearance of mobile devices, calls for the re-definition of many other terms and concepts as well. For example, concepts like “space” and “being-there” or the “learning environment” need to be revisited. Even more general concepts such as that of the digital divide (see Discussion section for an analysis of Nyiri’s 2005 thesis), our understanding of religion (see Laouris argumentation in Laouris 2006; draft available at request), or philosophy might need to be revised. In conclusion, the situation is in fact much more complicated than a superficial, helicopter-view consideration reveals. We therefore need to approach the issue of defining mobile learning in both a *systematic* and a *systemic* way. The requirement “systematic” will translate into considering each term (“mobile”, “learning”) in isolation as well as in concert (i.e., “mobile learning”). The requirement “systemic” will translate into considering the whole environment in which mobile learning unfolds, i.e., the inter-relations and interactions between technology, the learning environment, the philosophy, the pedagogy, etc. In the following sections, we will attempt to develop a comprehensive framework to embrace definition of the term “mobile learning” by considering its various facets and aspects both in isolation and in concert.

Preliminary considerations

The term “mobile”

Many authors use the term mobile as synonym to mobile phone. This amounts to an over simplification that misses the whole concept, because viewing a telephone as a device which operates wirelessly reveals only a very thin aspect of what today’s mobile technologies can offer. Indeed, the authors proposed the thesis that the appearance of the mobile phone has signaled the

launching of a major revolution in human evolution. While the computer constitutes the first human construction that aspired to amplify mental rather than physical human powers (in contrast to all previous human constructs; for an elaboration of this argument see Laouris 1998, 2004, 2005c), the mobile phone goes one step further. It marks the appearance of a new “organ” in the evolutionary time line; one that extends the human language system, both on the receiving (i.e., hearing) and the sending (i.e., speech) end (we refer to this as the third hear-and-talk organ). It can claim the role of an “organ”, because it indeed “integrates” directly with the brain (for a thesis on how innovations in technology may serve human evolution see Laouris 1996, 2005c). It thus demolishes distance, it demolishes boundaries (private or public), it will soon even demolish the very concept of what it means to be here or there. For the physically disadvantaged, the mobile phone (and more generally, the virtual identity that may accompany it) makes their *problem* disappear (no one can tell on the phone how you look, i.e., if you are paralyzed or if you are ugly) by lending them an “invisible” body. According to Nyiri (2002, 2005) the “... mobile phone is evolving towards the dominant medium. It is becoming the natural interface through which people conduct their shopping, banking, booking of flights, etc. Moreover, it is turning into the single unique instrument of mediating communication not just between people, but also between people and institutions or more generally between people and the world of inanimate objects”. The mobile phone is also joining the sphere of mass media. In the next few years the mobile phone will be the primary source for radio and television signals, as well as the link to up-to-the-minute information. We conclude this section by underscoring that not only the concept of mobility, but also that the concept of the *third hear-and-talk organ* triggers changes far beyond those imagined by its two billion users.

From e-learning to m-learning; Learning in focus

Many authors (e.g., Mostakhdemin-Hosseini and Tuimala, 2005) view mobile learning simply as the natural evolution of e-learning, which completes a missing component of the solution (i.e. adding the wireless feature), or as a new stage of distance and e-learning (e.g., Georgiev, et al. 2004), one that describes it as occupying a sub-space within the e-learning space (which in its turn occupies a sub-space within the d-learning space). The transition from the e-learning to the m-learning revolution is characterized also by a change of terminology. For example, the dominant terms in the e-learning era were: multimedia, interactive, hyperlinked, media-rich environment, etc. In the m-learning era terms like spontaneous, intimate, situated, connected, informal, lightweight, private, personal etc. are used to characterize the context. Table 1 contrasts the choice of terminology with underlying characteristics of the two types of learning environments, while Table 2 illustrates their differences in the context of pedagogy and environment. While e-learning was still compatible with the classroom paradigm, m-learning calls for environment- and time independent pedagogy.

Table 1. Terminology comparisons between e- and m-learning

e-learning	m-learning
Computer	Mobile
Bandwidth	GPRS, G3, Bluetooth
Multimedia	Objects
Interactive	Spontaneous
Hyperlinked	Connected
Collaborative	Networked
Media-rich	Lightweight
Distance learning	Situated learning
More formal	Informal
Simulated situation	Realistic situation
Hyperlearning	Constructivism, situationism, collaborative

Table 2: Pedagogical differences between e- and m-Learning environments
(Modified from Sharma & Kitchens 2004)

Pedagogical Changes	More text- and graphics based instructions	More voice, graphics and animation based instructions
	Lecture in classroom or in internet labs	Learning occurring in the field or while mobile

The mere use of terms like *when I want*, *wherever I want*, and *however I want*, indeed impose new requirements not only to the technological and educational frameworks, but also to the way in which all actors interact and communicate. Table 3 summarizes differences in these communication pathways. Finally our possibilities for assessment and evaluation are different for the two paradigms (Table 4).

Table 3: Differences between e- and m-Learning environments with respect to modes of communication between actors (Modified from Sharma & Kitchens 2004)

Instructor to Student Communication	Time-delayed (students need to check e-mails or web sites)	Instant delivery of e-mail or SMS
	Passive communication	Instant communication
	Asynchronous	Synchronous
	Scheduled	Spontaneous
Student to Student Communication	Face-to-Face	Flexible
	Audio-teleconference common	Audio- and video-teleconference possible
	e-mail-to-e-mail	24/7 instantaneous
	Private Location	No geographic boundaries
	Travel time to reach to internet site	No travel time since wireless connectivity
	Dedicated time for group meetings	Flexible timings on 24/7 basis
Poor communication due to group consciousness	Rich communication due to one-to-one communication, reduced inhibitions	

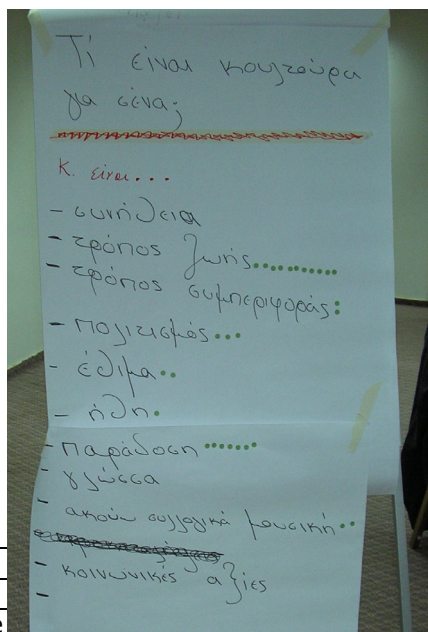
Table 4: Differences between e- and m-Learning environments with respect to methods of evaluation (Modified from Sharma & Kitchens 2004)

Feedback to Students	1-to-1 basis possible	1-to-1 basis possible
	Asynchronous and at times delayed	Both asynchronous and synchronous
	Mass/standardized instruction	Customized instruction
	Benchmark-based grading	Performance & improvement-based grading
	Simulations & lab-based experiments	Real-life cases and on the site experiments
	Paper based	Less paper, less printing, lower cost

The above tables may guide us to define mobile learning in ways, which not only take into account the various aspects that change, but also take advantage of the emerging possibilities.

Mobile learning and the universality of culture

What is culture? In a series of four youth (ages 12-16 years) workshops we proposed this as our triggering question for a brainstorming session among 20 individuals (in each workshop). Not surprisingly, all groups came up with more or less the same definitions (confirming the correctness of the “collective wisdom” concept), an example from one case shown in Fig. 1.



Assignments & Tests

In-class or on computer	
Dedicated time	
Restricted amount of time	able
Standard test	Individualized tests
Usually delayed feedback	Instant feedback possible
Fixed-length tests	Flexible-length/number of questions

Presentations, Exams & Assignments

Theoretical and text based	Practical oriented exams direct on site, hands-on based
Observe and monitoring in lab	Observe in the field and monitoring from remote location
Class-based presentations	1-to-1 presentations with much richer communication
Usually use of one language	Automatic translation for delivery of instructions in many languages (possible)
Mostly individualized, component-based group work	Simultaneous collaborative group work
Paper-based assignment delivery	Electronic-based assignment delivery
Hand-delivery of assignments at a particular place and time	E-delivery of assignments at any place and time
Instructor's time used to deliver lectures	Instructor's time used to offer individualized instructions and help

Fig. 1 Pictures of wall charts taken during the workshop (for details refer to text)

A careful look at the various facets of the definition of culture and civilization reveals that “things we learn” are in the basis of most of them. As “learning” becomes more standardized (technology imposes this requirement), and more accessible to all (and thus more global) the shared knowledge

base (i.e., the overlap of knowledge across people who are geographically or nationally divided) expands. But if we accept that aspects of our culture and our civilization (and by extrapolation our learning base) contribute towards distinguishing countries and nations, aren't we then moving towards a global culture?

These thoughts illustrate how the wide penetration of mobile learning might even affect our very concepts of culture and civilization, thus contributing towards the emergence of a universal culture. The notion of the universality of culture is not new. Indeed, more than 23 centuries ago after leaping from Greece to conquer most of the known world, Alexander the Great envisioned such a world and attempted to create it by founding more than 70 cities all called "Alexandria". Before Alexander, there was little contact between different cultures (for example there is only indirect mentioning of the existence of Jews in Greek literature). Along with the characteristics of an emperor and dictator, he also promoted cultural diversity, openness and integration. Today, the unprecedented rate of globalization makes the mixing of civilisations, without the need for forced reinforcement, a reality. This mixing is supported by virtual (i.e., through mobile devices and internet) and physical (i.e., through traveling) communication, as well as by decreasing variability in what people "learn" and experience". In all these aspects, the mobile phone (with its various appendices such as video cameras) and the revisited concept of (mobile) learning, plays a prevailing role. But, what happens if the current status quo and power-relations among the nations and cultures is added to the picture? Will advances in telecommunications and wonderful opportunities such as of mobile learning simply become the tools in the hands of imperialist attitudes to impose and reinforce their own beliefs, stereotypes and educational models on the rest of the world? Therefore, we may conclude by saying that the mobile phone, and the concept of engaging in learning with it, does not come or exist or in a vacuum. On the contrary, it is part of a gigantic picture that extends to all angles of life and calls for careful and comprehensive examination. The way we define it will disclose the depth of our understanding of the magnitude and importance of all inter-relationships, as well as our commitment to apply it in the service of all humanity.

The discussion in the previous paragraphs illustrates how the definition of mobile learning might change as a function of time, but also as a function of our (biased) perspective. From the point of view that learning takes place in our heads, it has always been *mobile*. Yet, in the era of e-learning, a definition would focus on issues of accessibility to knowledge through (portable) computers and the internet, while a contemporary definition would have to take into account the various liberalizing- and concept-transforming attitudes of modern telecommunications. In the next sections we attempt to elaborate on how considering the various facets of mobile learning not only affects the definition, but moreover, it affects our assumptions, our expectations, and even our world-views.

Defining mobile learning in the context of devices

Both Quinn (2000) and Pinkwart, et al. (2003) defined m-learning as "e-learning that uses mobile devices". Also, the majority of authors, actively or passively, apply a definition that views mobile learning as learning connected to a mobile device (and most of them imply a regular mobile phone or in the best case a PDA). Is it necessary to make the definition of mobile learning dependent on mobile devices (i.e., mobile phones), or can we envision a device-independent definition? Indeed, we would like to propose the thesis that not only should we not constrain our definition of mobile learning to *learning through mobiles*, but we must shift focus from device to human. We suggest taking a broader view that accounts for a learner freely moving in his physical (and virtual) environment. Tomorrow's learners will have access to a dynamically changing repertoire of devices and services that will differ in speed, processing power, monitor (and other output) characteristics, etc. As our engagement with technology changes with time, mobile learning

becomes a function not only of time, but also of the momentarily available and dynamically changing technology. The various mobile devices, embedded in our virtual environment, need to be considered not only in concert and in context with their inter-relationships and inter-dependencies to different types of content and content delivery. They must also be considered as functions to time-varying levels of attention, interest, preferences and motivation of the learner. The momentary access to the learner's private learning environment (which is constrained by the mobile device at hand) imposes requirements as to what type of learning might be advisable, possible or appropriate. We thus deduct that a socially and educationally responsible definition must view the learner as the one being mobile and not his/her devices! What needs to move with the learner is not the device, but his/her whole learning environment.

In closing this discussion about devices, we would like to point out that our approach, of shifting attention away from the device, also has political and philosophical implications. It is for example to the interest of the industrialized world to promote definitions that emphasize on devices, rather than on complex interactions and theory, because they maintain absolute superiority in the design and mass production of such electronic devices. Such a focus facilitates the opening of new markets to distribute their products, and at the same time serves to maintain the economic and digital divide.

Defining mobile learning in the context of the learning environment and learning experiences

Learners do not learn in a vacuum. They learn together with their peers and their teachers, they learn while competing and collaborating, they learn by example, they learn by doing and they learn by correcting misconceptions they have from previous "learning activities". Furthermore, they learn within a well-defined learning environment. In the past, this was constrained within walls and the teacher was the main source of knowledge. With the advent of computers, the teacher was put in a position in which the information within the walls was competing with information outside the classroom and beyond his/her control, thus calling for changes (Koschmann, 2001, Bransford, et al. 1999). The concept of mobility (as we understand it in the context of mobile phones) invites us to revisit what learning actually means and what are its ingredients (graphical summary in Fig. 2).

Table 5: Components of the learning environment

1	Learner with paper and pen.
2	Teacher or other facilitator/coach.
3	Access to knowledge and books.
4	Structured curriculum with pre-defined tasks and targets as well as methods of interaction.
5	Learner is member of a learning community within which s/he competes in tests, cooperates in logistics and learning and

For example, to what extent is learning restricted to acquisition of new knowledge and to what extent does it encompasses the logistics related to the process of learning. What are the minimal ingredients of the learning environment. We propose these to be those summarized in Table 5.



Fig 2. The mobile learning environment.

The learner may have access to a multitude of different hand devices. S/he is also embedded within a physical and digital medium in which antennas, repeaters, servers and other technical equipment may continuously change. A multitude of managing-, negotiation-, monitoring-, and maintenance processes run in parallel. Much of

these logistics directly affect the quality and efficiency of learning. They must, therefore, be treated as an integral part of the learning process. What moves with the student must no longer be the device, but the learning environment. What remains distributed will be the various knowledge applications and of course the raw data.

Mobility is about increasing a learner's capability to physically move their own learning environment as they move (Barbosa and Geyer, 2005). The mobile context permits not only constructivist approaches to be employed, but also contextual learning. Indeed, it is now possible to take the learning process out of the classroom into authentic environments (Michie, et al., 1998). Learning while interacting with many peers has the potential to develop collective cognitive responsibility (Dolan 2005; see also Bransford, et al. 1999; Churchill, et al., 2001; Dillenbourg, 1999; Zurita, et al. 2003; Zurita & Nussbaum, 2004), because it offers possibilities for immediate and radical conceptual changes and correction of misconceptions. Activity theory and Vygotsky might need to be revisited in many ways, not only from the point of view of mobility, but also in view of the era of globalization and our changing concepts about cognitive neuroscience. Engstroem (2000) for example has added social context and cultural aspects.

Defining mobile learning as a function of its facets

From the analysis of the proceeding sections, it becomes obvious that a systematically correct and systemically complete definition of mobile learning must take into account many parameters and also ways in which they interact and influence each other. In order to be able to visualize, conceptualize, and hopefully later, study in greater detail such parameters and their inter-relations, we propose the following abstract formulation for the definition.

$$(1) \quad \text{MLearn} = f \{ t, s, \text{LE}, c, \text{IT}, \text{MM}, m \}$$

t = time	Whereas t was discontinuous and discrete for previous paradigms of learning (e.g. mainly whenever in classroom), for m-learning time during which mobile learning can take place may be continuous.
s = space	In the classroom paradigm, space was simply defined as the classroom and to some extent the learners' home. Now space is not constrained at all and it may even incorporate virtual spaces.
LE = l-environm	The learning environemnt consists of at least those elements summarized in Table 5.
c = content	The curriculum, the specific educational themes and chosen topics covered are now structured in a completely different fashion and follow different rules and priorities. The learner usually shifts from topic to topic and from discipline to discipline, in what might appear as a chaotic pattern.
IT = technology	This parameter is quite complex. It encompasses all technological aspects and momentary characteristics of both the hand-held device and the surrounding environment (i.e., services available, antennas, repeaters, external devices within reach etc.).
MM = mental	This parameter contains as a conglomerate of the learner's mental abilities, prior knowledge, preferences, motivation, momentary attention etc.
m = method	The "method" is a conglomerate of all parameters related to delivery of and interaction with content. These may include pedagogy, philosophy as well as technical and logistical aspects such as method of presentation (or assessment).

(2) $s = f \{ MM \}$ The spaces which the learner may wish to visit or wander (theoretically) depend on his/her free will and preferences, and to some extent to time (i.e., during the night, mobile learning activities might not be possible).

(3) $c = f \{ MM, soc, edu \}$

- edu = educationally relevant
- soc = socially responsible

The chosen educational themes must be the result of a *negotiation* between the learner's agent (in which his/her MM is coded) and what we as society wisely have decided that it is socially responsible.

(4) $LE = f \{ IT, S, C \}$

- S = available services (agents, facilitators, access to knowledge)
- C = learning community

The learning environment is not only defined by the available technology but also by the presence of and access to available services such as agents, facilitators/coach, knowledge bases, tracking systems as well as other learners who are part of a learning community.

(5.1) $IT = f \{ s \}$ The IT available depends on the technologies that are available in the concrete space (physical or virtual in which the learner is working).

(5.2) $IT = f \{ s, m \}$ We propose IT to also be a function of m; this imposes new requirements for design because it implies that if the interaction with a specific type of knowledge requires some m that is currently not available, IT must be in a position to ubiquitously negotiate the addition of the necessary service.

(6) $MM = f \{ MA, k, p, \alpha \}$

- MA = mental attributes
- k = prior knowledge
- p = preferences
- α = attention

We suggest that m is a function of the learner's mental abilities, prior knowledge, preferences, motivation, momentary attention etc. This imposes new requirements for the design of educational environments and choice of pedagogy, because it requires knowledge of these parameters. The authors have a parallel project in which they attempt to model MA. Parameter k, can theoretically be available (in the future) if we assume that all learning activities of the individual are negotiated by his/her (permanently available and accessible) agent. Parameter p can be dynamically modified by the learner. The inclusion of the parameter α opens up a whole new area for research, because it will require real-time methods of monitoring and keeping track of the learner's changing attention.

(7) $m = f \{ PM, Ph \}$

- PM = Pedagogical Model
- Ph = Philosophical paradigm

The choice of the methods to be applied during the learning interactions is a function of a pedagogical model (or sub-unit of it) appropriate for the type of learning experiences at hand, as well as a philosophical approach suited for the particular moment (i.e., location, learner's preferences, etc.). Research in the design, standardization, delivery, etc. of learning objects, as well as research related to modeling and managing user preferences, is of great importance for the concretization of these relations.

This is probably the first attempt to develop a model of mobile learning that inspires to include the full spectrum of actors in both a systematically correct and systemically complete way. As such it probably contains inaccuracies and inconsistencies. The author will be thankful to contributions and criticism. The original ideas for this approach stem from the KnowledgePacket[®] concept which the authors have applied while developing in the early 1990's, a 6-year long curriculum (referred to as Cyber Kids Method) used in the Cyber Kids experiment to introduce IT in the lives of young children (see Laouris 2005 paper presented in the same conference).

Conclusions and Discussion

In an epoch where humanistic values are decrementing and vision towards social progress is disintegrating, our need to promote responsible education and learning is more crucial than ever. Within this context we suggest that sensitive definitions as those related to learning must take into account the role that learning (and education in general) must have within the framework of socially responsible education (Laouris 2003).

Most definitions focus on the devices. The most elaborate one added “.. learning supported by mobile devices, ubiquitous communications and intelligent user interfaces” (Sharma & Kitchens, 2004). The only definition that views mobile learning from a more general perspective is the one proposed by Nyiri (2002). He defined it “as learning that arises in the course of person-to-person mobile communication.” This definition stimulates a philosophical consideration of the role of mobile phones, because as he pointed out, “mobile communication is enhanced everyday communication; and just as our everyday conversation is indifferent towards disciplinary boundaries, so, too, is m-learning. Situation-dependent knowledge, the knowledge at which m-learning aims, by its nature transcends disciplines; its organizing principles arise from practical tasks; its contents are multisensorial; its elements are linked to each other not just by texts, but also by diagrams, pictures, and maps.” However, this definition leaves out our responsibility to define revolutionary concepts and devices in ways that best serve our humanistic values.

The analysis in this paper has hopefully convinced, for the multi-dimensional and extensive effects that mobile phones increasingly exert influence not only on learning paradigms, but also on a repertoire of actors and parameters related to learning as well as to the spheres of philosophy, politics and even religion. The advent of mobile phones presents a great opportunity and offers a timely challenge to re-define and transform our educational paradigms. As wine fans claim “we cannot pour fresh wine in old bottles”, likewise, mobile learning too requires a new philosophical framework and new educational paradigms if it is to flourish. Only then will it become ubiquitous. Learning will occur not only with less effort, but also without us being conscious that we are learning (as indeed is the case for most of the knowledge we acquire in life!). To achieve this goal we will need to turn to the science of bionics and mimic processes evolution has optimized over millions of years like, for example, in our hypothalamus (which acts like our private secretary and librarian and is active even when we sleep, sorting out and “filing” information). Recent research with “virtual agents,” user preferences management and definitions of mental attributes is relevant in this line of thought (for example see Barbosa and Geyer 2005). We may envision an m-learning environment in which agents take over most of the logistics. Some may argue that logistics are not part of the learning process. When we sleep and our hypothalamus organizes our knowledge, is that part of learning or not? I maintain the thesis that it is. It is not surprising that ISTAG priorities include memory enhancer tools to help us access to our own knowledge (like an artificial hypothalamus?). Access to intelligent parts of our mind that help us remember where to find knowledge we acquired, review and re-visit it, share it with others, re-use it, adapt it and restructure it for a new situation. Within this context we might need to open up our definition of our learning mind to include the *third hear-and-talk organ* and also all external in agreement with the recently proposed extended mind theory (Clark and Chalmers 1998).

In conclusion, and in appreciation to the theme of the conference, we must ask ourselves whether and to what extents mobile learning is a potential actor in the digital divide debate. The author has dedicated another paper to this issue as he and his colleagues have accumulated ten years of experience on how technology can not only contribute toward bridging the digital divide, but also towards accelerating economic and social development in less developed countries. Nyiri insists that the digital divide is a myth. He claimed “ ... give a kid a keyboard and a screen, and illiteracy becomes a thing of the past. Provide a disadvantaged, barely literate person, with access to the Internet, and soon s/he will run a small virtual business enterprise.” With all the respect we have to this great man who has and is contributing enormously to the establishment and development of the field, we feel that such over-enthusiastic statements must not be read literally, but in merit of their constructive intentions. It’s a bit like arguing about the potential of a specific genetic code saying, “ ... give this sperm an egg to penetrate and the great man who is coded in its DNA will change the world.” Unfortunately, we all know that there is considerable distance between a “potential” and its “materialization.” Our ten-year-long experiments in social intervention and change have scientifically documented that technology alone cannot serve our purpose. It needs to be accompanied by vision, strategy, scientific theory and methodology, and a great deal of commitment.

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