Mobile Learning: From single project status into the mainstream?

Dr. Olaf Zawacki-Richter [olaf.zawacki-richter@fernuni-hagen.de] (corresponding author)
Professor of Educational Technology,
Fern Universität in Hagen (Germany)
Adjunct Associate Professor,
University of Maryland University College (USA)

Dr. Tom Brown [tom.brown@mgi.ac.za]
Principal and General Manager,
Midrand Graduate Institute (South Africa)

Dr. Rhena Delport [rhena.delport@up.ac.za]
Associate Professor,
University of Pretoria,
Faculty of Health Sciences (South Africa)

Abstract

During recent years, many distance teaching as well as residential institutions have started to experiment with mobile learning through pilot projects as part of their e-learning and technology enhanced learning environments. The practical experience gained with the employment of strategies and approaches within distance education can assist with the conceptualisation of mobile learning as well as the development of applications for this new learning medium. Information and communication technologies (ICTs) – especially mobile devices – open up new paths for learning support and opportunities to reach a wider audience for (higher) education. However, will mobile learning bring about a paradigm shift in distance education? Or is it perhaps a new generation of distance education? Does it afford new opportunities for teaching and learning in terms of access and flexibility? This paper reports on an international survey that was conducted amongst distance educators in order to explore these questions.

Keywords

Mobile learning, mobile devices, education innovation, generations of distance education

List of topics

1 Introduction: From print to wireless

Mobile learning is in many ways a new phenomenon and its theoretical, pedagogical, organizational and technical structure is currently still developing (Brown, 2004). Many distance teaching as well as residential institutions have already started to experiment with mobile learning through pilot projects as part of their e-learning and information and communication technology (ICT) enhanced learning environments (cf. Kukulska-Hulme & Traxler, 2005). Because of the similarities between distance education, online and mobile learning, the established field of distance education can assist with the conceptualisation of mobile learning as well as the development of applications for this new learning medium. Distance education can review over 150 years of experience with media-based instruction (Gladieux & Swail, 1999): "Today's virtual instruction has its roots in correspondence schools" (p. 9). Distance teaching institutions are therefore at a clear advantage in the development and application of new ICTs for teaching and learning. However, it can be observed that many speakers at conferences or vendors of cutting-edge technologies often neglect the link between new ICT tools or devices and the lessons learnt

in distance education, which have to be considered in order to avoid mistakes from the past.

The experience of distance education shows that learning support for students is of decisive importance for successful distance study (Brindley & Paul, 1996; Zawacki-Richter, 2004). Student support systems in various forms have existed in traditional distance education for decades. ICTs – especially mobile devices – open up new paths for learning support and opportunities to reach a wider audience for (higher) education.

In the light of the above pattern of thought, does the emergence of mobile learning imply a new generation in distance education or even an educational paradigm shift? Does it afford new opportunities for teaching and learning in terms of access and flexibility? The aim of this paper is to explore mobile learning as a new field of pedagogical activity.

1.1 The emerging concept of mobile learning

Landline telephones and wired computers are beginning to be replaced by wireless technologies. Desmond Keegan emphasized in his keynote address at the World Conference on Mobile Learning 2005 in Cape Town that "The future is wireless. [...] Never in the history of the use of technology in education has there been a technology that was as available to citizens as mobile telephony. The statistics are stunning: Ericsson and Nokia tell us there are 1.5 billion of them in the world today for a world population of just over 6 billion. Nokia forecasts further sales of 700 million in 2005. In China alone there are 358 million mobile subscriptions and these are reported to grow by 160.000 a day" (p. 3). Seventy-seven percent of the world's population is within reach of a mobile phone network (Kukulska-Hulme & Traxler, 2005).

Educators started experimenting with wireless and mobile technologies from the turn of the millennium and the concept of mobile learning began to emerge. There is currently globally a rapid rate of development and application of wireless and mobile technologies in contemporary learning environments and learning paradigms. Apart from mobile phones, other wireless and mobile computational devices such as laptops, palmtops, PDAs (Personal Digital Assistants) and tablets also rapidly entered the market – some devices, of course, have exhibited more success than others for particular markets. Kukulska-Hulme & Traxler (2005) provide a dozen detailed case studies that report on the experiences of pioneer educators who have experimented with mobile technologies in universities and colleges and in commercial training. They explore user experience with mobile devices, accessibility, pedagogical and institutional change, and current technology. With regard to the potential of mobile learning in developing countries, Brown (2004) argues that Africa is leapfrogging from an unwired, (almost) non-existent e-learning infrastructure, to a wireless e-learning infrastructure. There are already many mobile learning activities and projects in Africa – from the use of PDAs in assessment strategies (e.g. the clinical assessment of medical students) and PDAs in wireless learning environments (e.g. engineering students for collaboration and coursework) to the use of the most basic mobile texting functionality (SMS) for learning support (Brown, 2006). Given the lack of technical infrastructure for e-learning in developing countries, there is a huge demand for mobile learning. Brown reports on a pilot project in a teacher training programme that was launched already in 2002 with 1,725 students of the University of Pretoria in South Africa (Brown, 2004). The profile of these students was as follows:

- 100 % full-time employees (teaching),
- 83,8 % between the ages of 31 and 50,
- 66,4 % female,
- 97,3 % non-white,
- 0,4 % with access to e-mail, and
- 99,4 % with a mobile phone.

The majority of these students lived in deep rural areas with little or no landline telecom and internet infrastructure. This example shows that two-way academic and administrative support via mobile devices was the only way to reach this remote student population.

Over the past decade we have become familiar with the term 'e-learning' and now the concept of 'mobile learning' is emerging. What then, is the relation between the two notions? The all-inclusive umbrella term for media-based learning and teaching is distance education or distance learning, which is characterized by "the quasi-permanent separation of teacher and learner throughout the length of the learning process" (Keegan, 1986, p. 49). The central concern of distance teaching pedagogy is to bridge the distance: "Because the distance to students was regarded as a deficit, and proximity as desirable and necessary, the first pedagogic approaches specific to distance education aimed immediately at finding ways by which the spatial distance could be bridged, reduced or even eliminated" (Peters, 2001, p. 18).

E- and mobile learning provide enormous opportunities for closing the gap between learners and teachers or the teaching institution, to overcome the misconception of distance learning as an isolated form of learning.

Mobile learning can be viewed as a subset of e-learning. E-learning is the macro concept that includes online and mobile learning environments. In this regard the following simple definition by Quin (2000) is useful: "M-learning is e-learning through mobile computational devices" (p. 1). Mobile learning devices are defined as handheld devices and can take the form of personal digital assistants, mobile phones, smartphones, audio players (such as the Apple iPod), video and multimedia players, handheld computers and even wearable devices. They should be connected wirelessly, thus ensuring mobility and flexibility. They can be stand-alone and possibly synchronized periodically, intermittently connected to a network, or always connected.

1.2 Mobile learning in the context of distance education

To further explore opportunities that mobile learning affords, we have to build upon previous generations of technological innovations, in order to benefit from the lessons learnt in distance education. The term 'paradigm shift' in education refers to the changes in teaching and learning as a consequence of the tremendous impact of technological advances (Peters, 2004): "A paradigm shift in education might mean that in education certain models or patterns no longer exist, because new models and patterns which differ from the old ones in a marked way have substituted them. This means that, very often, we are not dealing with a transitory process in the field of education under investigation but with a sudden, if not with an abrupt change" (p. 25).

Media are described by Garrison (1985) as a function of interaction and independence. He identifies three

milestones of technological innovations, namely print media (correspondence generation), telecommunication technologies (telecommunications generation) and the personal computer (computer generation). Other media that are not considered to have significantly altered the delivery of distance education are so-called ancillary media, e.g. radio and television broadcasts, audio or video cassettes. Such media are not capable of providing two-way communication, which is widely accepted as a constituent element of distance education (cf. Keegan, 1986). Garrison's generations are an established concept that has been further developed with the emergence of new media, especially the Internet, since the 1980s by other authors such as Nipper (1989), Taylor (2001) or Srivastava and Reddy (2002). The term 'generation' has been criticized since it implies the end of one phase and the beginning of another. However, an 'old' generation does not fade out, but technological advancements build upon each other to open new channels of learner support and two-way communication.

Access, flexibility and costs have been described by Daniel (1998) as major attributes of distance education. Distance education is capable of offering access to education for high numbers of students, independent of time and space, at low costs through economies of scale (mass higher education)

1.3 Mobile learning: the next generation?

Soloway (2003) remarked that: "For the first time in ICT history, we have the right time, the right place and the right idea to have a huge impact on education: handheld computing" (p. 2). The increased access to mobile technological devices, the availability of support systems and the need for communication paved the way for learning to be available anytime, everywhere.

Kukulska-Hulme and Traxler (2005) summarize the affordances of mobile technologies for learning and teaching as follows: They "[...] open up new opportunities for independent investigations, practical fieldwork, professional updating and on-the-spot access to knowledge. They can also provide the mechanism for improved individual learner support and guidance, and for more efficient course administration and management" (p. 26).

But do mobile technologies lead to a new quality of teaching and learning in terms of interaction and independence, access, flexibility and costs so that it might be appropriate to speak of a new generation of distance education or an 'educational paradigm shift' in the sense of Peters (2004)?

2 Survey on mobile learning

In order to address this open question and to explore mobile learning as a new field of pedagogical activity, the authors conducted an international survey amongst distance educators. The questionnaire was distributed by Carl von Ossietzky University of Oldenburg (Germany) in cooperation and the University of Pretoria – Department for Education Innovation (South Africa). The following themes were investigated:
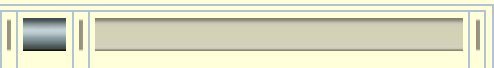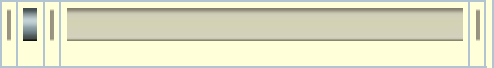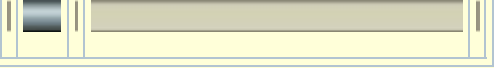
- mobile learning and teaching experience of distance educators,

- the development and growth of mobile learning,

- the impact of mobile technologies on teaching and learning,

- mobile learning applications and mobile learning activities,

- mobile learning and access to (higher) education, and
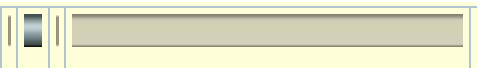
- the future development of mobile learning.

The survey was distributed via professional distance education networks like the European Distance Learning and E-Learning Network (EDEN), the South African Institute for Distance Education (SAIDE), and the Canadian Association for Distance Education (CADE). The data was collected between November 2006 and February 2007.

2.1 Who responded?

The authors received 88 responses from 27 countries, the majority from South Africa, Germany, Canada and Great Britain. The highest percentage of respondents (59.1%) were from institutions that offer both face-to-face (contact-based) and distance learning programmes (mixed-mode/hybrid). 10.2% came from traditional distance teaching institutions and 9.1% from campus-based institutions (single-mode). Further 3.4% of respondents came from purely online teaching institutions or virtual universities and 4.5% from private training institutions or corporate universities. Other institutions such as community colleges or e-learning service providers and vendors accounted for 12.5% of all respondents.

The highest percentage of respondents (59,1%) were from institutions that offer both face-to-face (contact-based) and distance learning programmes (mixed-mode/hybrid). Figure 1 depicts the distribution of respondents amongst defined higher education institution types.

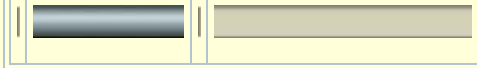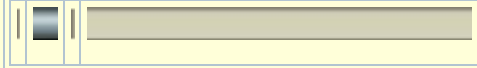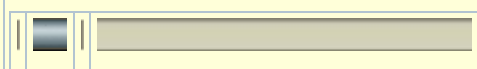| Is your organisation/institution...			
a traditional distance teaching institution (single-mode)?		10.2%	9
a purely online teaching institution or virtual university?		3.4%	3
an institution offering both, face-to-face (contact-based) and distance learning programmes (mixed-mode/hybrid)?		59.1%	52
a traditional face-to-face or contact-based teaching institution (single-mode)?		9.1%	8

a corporate university or training institution?		4.5%	4
other, please specify:		12.5%	11

Number of responses: 87

Figure 1. Frequency distribution of responses amongst institution types

The institutions that were referred to as 'other' included a community college, an e-learning service provider, a telecom vendor and a research centre.

Figure 2 represents findings on whether the respondents' institutions have plans for developing course materials for use on mobile devices. Approximately 50% of the participating institutions do not have such plans, while 37% of institutions have envisaged developing course materials but have not as yet done so. 14% of respondents reported that their institutions indeed have developed such materials for use on mobile devices. Of these more than half reported that they had developed such materials for use on mobile devices in a standard format for output on a variety of mobile and stationary devices.

Is your institution planning on or presently developing course materials for use on mobile devices?			
No, there are no institutional plans for developing course materials for use on mobile devices.		48.8%	41
Yes there are institutional plans for developing course materials for use on mobile devices, but there has been little done.		36.9%	31
Yes our institution is now developing course materials for use on mobile devices. These are developed specifically for mobile devices.		6%	5
Yes our institution is now developing course materials for use on mobile devices in a standard format for output on a variety of mobile and stationary devices.		8.3%	7
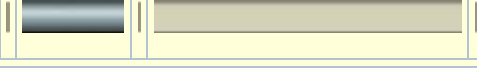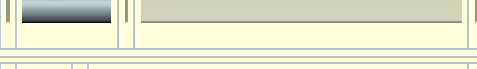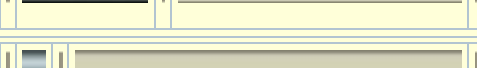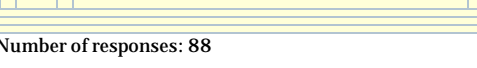
Number of responses: 84

Figure 2. Frequency distribution of responses concerning the development of mobile learning course materials

Of the nine traditional distance teaching institutions being represented in the survey 55% reported having institutional plans for, or are presently developing course materials for use on mobile devices. Respective percentages for the other institutions were 33%, 48% and 75% for the 3 purely online teaching institutions or virtual universities, 52 mixed-mode, and 8 traditional face-to-face or contact-based teaching institutions.

2.2 Mobile learning experience

Respondents were requested to report on the extent to which they are knowledgeable about and have experience in mobile learning. These findings are represented in Figures 3 and 4. Approximately 62% of respondents reported being personally involved or have read publications on the subject, while approximately 71% reported being either actively involved, or being informed on mobile learning projects in their own or other institutions.

Are you knowledgeable about mobile learning?			
Yes, I am personally doing research on mobile learning.		25%	22
Yes, but I am not personally doing research on mobile learning.		21.6%	19
Yes, I am involved in mobile learning projects.		10.2%	9
I have read a number of articles and papers on mobile learning.		30.7%	27
No, but other persons in my institution are knowledgeable.		5.7%	5
No, I have not heard about mobile learning.		6.8%	6

Number of responses: 88

Figure 3. Frequency distribution of responses with respect to being knowledgeable about mobile learning

Do you have experience in mobile learning?			
Yes, I have personally been involved in mobile learning projects in my institution.		26.4%	23
Yes, but the mobile learning project(s) are not within my own institution.		13.8%	12
I know about mobile learning projects in my institution or elsewhere.		31%	27
No, but other persons in my institution have been involved in mobile learning projects.		9.2%	8
No, I have not had any exposure to mobile learning projects before.		19.5%	17

Number of responses: 87

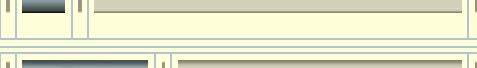**Figure 4.** Frequency distribution of responses with respect to having experience in mobile learning

2.3 Development and growth of mobile learning

Of the 86 respondents who reported on the implementation of mobile learning within their institution, 41% reported that it does not exist, while only about 5% reported mobile learning to be either spread amongst several projects across the entire institution (2.3%) or integrated as part of their institution's mainstream activities (2.3%). The remainder had instituted mobile learning as pilot projects in one or two departments (44.2%) or had already implemented mobile learning in various departments to a limited extent (10.5%).

Mobile learning at my organisation/institution is...			
not-existent.		40.7%	35
limited to some pilot projects in one or two departments.		44.2%	38
limited but already implemented in various departments.		10.5%	9
spread amongst several projects across the entire institution.		2.3%	2
integrated as part of our institution's mainstream activities.		2.3%	2

Number of responses: 86

Figure 5. Frequency distribution of responses with respect to the implementation of mobile learning within the organisation/institution

As was to be expected, non-existence or existence in some or other form of mobile learning and being knowledgeable about mobile learning were significantly associated, as was the case for non-existence or existence and having experience in mobile learning (respective Chi-square, p-values: 22.7, $p<0.0001$ and 32.9, $p<0.0001$). A significant association was, however, observed between non-existence or existence in some or other form of mobile learning at an institution and the absence or presence of some or other form of institutional support (Chi-square 9.9, $p=0.002$). This may imply that institutional support is essential for the implementation of mobile learning. Figure 6 depicts a variety of possibilities within an organisation/institution that offer support with the technical as well as pedagogical aspects of setting up and running e-learning/mobile learning programmes.

Are there any units in your organisation/institution that offer support with the technical as well as pedagogical aspects of setting up and running e-learning/mobile learning programmes?			
No, there is no institutional support.		**38.4%**	33
Yes, a new unit at the organisation/institution has been created for this purpose.		**18.6%**	16
Yes, an internal, coordinated institutional network has been created (decentralisation).		**14%**	12
Yes, there are two or more central units that work together to help us in this matter.		**9.3%**	8

Yes, there has been a merging of existing units offering media services into a central academic support unit.		3.5%	3
Yes, we outsource for this purpose.		1.2%	1
Yes, other. Please specify:		14%	12

Number of responses: 85

Figure 6. Frequency distribution of responses with respect to technical as well as pedagogical support within an organisation/institution

Surprisingly, 36.4% of respondents stated that there is no support available from the teaching institution to offer e-learning or mobile learning courses, although some respondents mentioned that there are plans to set up a support unit in the near future. Mobile learning was, however, expected by the majority of respondents (78.4%) to become an integral part of mainstream higher education and training within three to five years (Figure 7).

When – do you believe – mobile learning will become an integral part of mainstream higher education and training?			
In 1 years time.		9.1%	8
In 3 years time.		37.5%	33
In 5 years time.		40.9%	36
In 10 years time.		9.1%	8
Never.		3.4%	3

Number of responses: 88

Figure 7. Frequency distribution of responses with respect to expected duration of time during which mobile learning will become an integral part of mainstream higher education and training

The findings depicted in Figure 8 suggest that online and distance teaching institutions are spearheading the development of mobile learning. Sixty seven percent of online teaching and 56% of distance teaching institutions plan on, or are presently developing learning material for mobile devices, in contrast to only 24% of traditional contact-based teaching institutions.
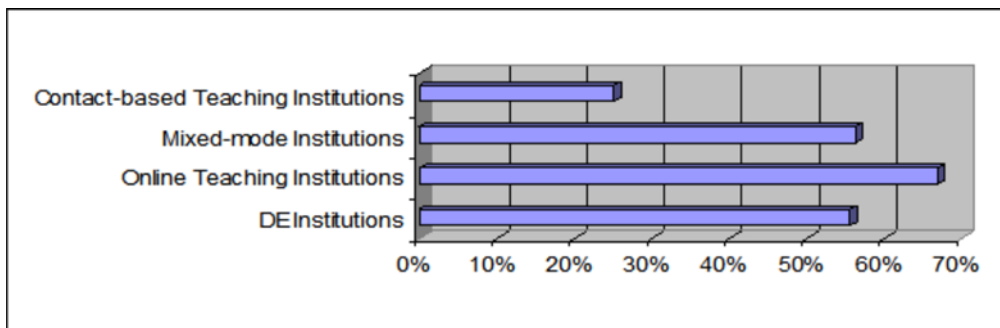
Figure 8. Institutions that plan on, or are presently developing learning material for mobile devices

2.4 Impact of mobile technologies on teaching and learning

Figures 9 and 10 depict reflections and expectations concerning changes in teaching and learning practice as well as learning theories. Figure 13 reports on expectations concerning new strategies and methodologies being facilitated by mobile learning. The main findings are that 61% of respondents expected that teaching and learning strategies and methodologies would adapt continuously due to new affordances that technology provides (Figure 9) and 56% expected learning theories to remain the same in essence, but that new learning paradigms and learning strategies would emerge because of technological developments (Figure 10). The majority of respondents (77%) thought that mobile learning would be very helpful in enhancing teaching and learning independent of time and space (Figure 11).

My views about the latest trends and developments in teaching and learning are that...			
technology changes should not have an impact on our teaching and learning strategies and methodologies.		0%	0
technology changes should have an impact on our teaching and learning strategies and methodologies, but this is currently not the case at present.		25.3%	22

teaching and learning strategies and methodologies adapt continuously due to new affordances that technology provides.		60.9%	53
technology changes brings about radical changes to our teaching and learning strategies and methodologies.		13.8%	12

Number of responses: 87

Figure 9. Frequency distribution of responses with respect to views on trends in teaching and learning

Teaching and learning theories in 20 years time...			
remain unchanged no matter what technological changes will come our way.		0%	0
in essence remain the same, but will be adapted somewhat and enriched due to affordances of future technologies.		12.6%	11
in essence remain the same, but new learning paradigms and learning strategies will emerge because of technological developments.		56.3%	49
change completely with new learning theories replacing behaviourism and constructivism due to the radical impact of future technologies.		28.7%	25
Other, please specify:		2.3%	2

Number of responses: 87

Figure 10. Frequency distribution of responses with respect to anticipated learning theories in 20 years time

The attributes and opportunities that mobile technologies afford will...			
have no impact on teaching and learning.		1.1%	1
be widely applied mainly for administrative services and/or assessment purposes.		8%	7
be very helpful in enhancing teaching and learning independent of time and space.		77%	67
completely change the way we teach and learn.		11.5%	10
Other, please specify:		2.3%	2

Number of responses: 87

Figure 11. Frequency distribution of responses with respect to the expected impact of the attributes and opportunities that mobile technologies afford

One respondent remarked that "mobile devices will make learning even more flexible and spontaneous than 'traditional' e-learning". Most respondents (72%) believed in principle that mobile learning would afford new opportunities for learner support and content development and delivery (Figure 12).

Do you agree with the following statement? Mobile learning will facilitate new strategies and methodologies for learner support and content development and delivery in distance education.			
Yes, mobile learning affords new opportunities for learner support and content development and delivery.		72.4%	63
No, mobile learning will not lead to anything entirely new. It's just another medium or channel for learner support and content delivery among others.		27.6%	24

Number of responses: 87

Figure 12. Frequency distribution of responses with respect to new strategies and methodologies being facilitated by mobile learning

Strategies and methodologies that may be afforded by mobile technology were proposed by respondents. These suggestions are grouped and categorized in the following table.

Table 1. Strategies and methodologies as proposed by respondents

Category	#*	Typical examples
Learning activities	19	(Inter)active learning, authentic learning, explorative learning, project orientated learning, situated and informal learning, Qs and As.
Assessment	3	Security for testing andevaluation procedures, assessment to determine students' knowledge a day or two before a lecture/discussion to determine which topics need more attention.
Resources	9	Generation of information, sharing resources, data sourcing, access to information, navigation, m-library.
Interaction	6	More support for collaboration, more support for bottom-up content creation, enhanced social support, consulting peers and experts. Distance Educators will teach again instead of providing teaching material only.
Personalisation and individualisation	12	New strategies might emerge from better knowledge of learner behaviours and study patterns with technology, which were never examined that closely before, just-in-time learning, addressing learner styles or needs, keeping it simple, focus on small 'chunks' of learning, just-in-time support/job aids.

* Number of times suggested by respondents

The relation between anticipated affordances of mobile learning and being knowledgeable about and have experience in mobile learning was evaluated. A positive response on whether mobile learning will facilitate new strategies and methodologies for learner support and content development and delivery in distance education was reported by 88% of individuals (15/17) who said that they were knowledgeable on mobile learning as they were personally doing research on mobile learning, 61% of individuals (11/18) who reported "Yes, but I am not personally doing research on mobile learning", 100% of individuals (7/7) who reported "Yes, I am involved in mobile learning projects", 57% who had read a number of articles and papers on mobile learning (13/23), 67% who reported "No, but other persons in my institution are knowledgeable" (2/3), and 75% who reported "No, I have not heard about mobile learning" (3/4). Concerning experience in mobile learning and a positive response on whether mobile learning will facilitate new strategies and methodologies for learner support and content development and delivery in distance education, the following percentages were observed for the items tabled:

Table 2. Experience in mobile learning and anticipated affordances of mobile learning

Experience in mobile learning...	Positive response	(n)
Yes, I have personally been involved in mobile learning projects in my institution.	88 %	15/17
Yes, but the mobile learning project(s) are not within my own institution.	67 %	6/9
I know about mobile learning projects in my institution or elsewhere.	54 %	14/26
No, but other persons in my institution have been involved in mobile learning projects.	100 %	6/6
No, I have not had any exposure to mobile learning projects before.	69 %	9/13

From these findings it is thus concluded that the expectations concerning the affordances of mobile learning are based on knowledge and experience of mobile learning.

2.5 Mobile learning applications and mobile learning activities

Respondents were requested to rate the importance of learning 'tools' for students on mobile phones or smartphones (Table 2), the importance of learning activities which are appropriate for mobile devices (Table 3) (with suggestions for additional learning activities), and the importance of applications (software) on mobile devices (Table 4). Respondents were also asked to rate the usefulness of mobile learning 'tools' for students on PDAs or smartphones (Table 5).

Table 3. Rating of importance of learning 'tools' for students on mobile phones or smartphones

	Importance ratings				
	1	2	3	4	5
Text messaging (SMS) for communication and interaction. (Number of responses: 86)	27.9% 24	18.6% 16	25.6% 22	18.6% 16	9.3% 8
Voice calls for communication and interaction. (Number of responses: 87)	12.6% 11	27.6% 24	29.9% 26	16.1% 14	13.8% 12
Text messaging to e-mail and vice versa. (Number of responses: 86)	18.6% 16	27.9% 24	19.8% 17	20.9% 18	12.8% 11
Sharing texts, notes and documents. (Number of responses: 86)	14% 12	17.4% 15	20.9% 18	22.1% 19	25.6% 22
Being connected anywhere, anytime. (Number of responses: 86)	55.8% 48	12.8% 11	4.7% 4	8.1% 7	18.6% 16

	1	2	3	4	5
Totals for rating columns	25.8% 111	20.9% 90	20.2% 87	17.2% 74	16% 69

Rating from 1-5 where 1 is the most important
Total number of ratings: 431

Table 4. Rating of importance of learning activities which are appropriate for mobile devices

	Importance ratings				
	1	**2**	**3**	**4**	**5**
Coursework (accessing and reading learning materials) (Number of responses: 85)	10.6% 9	10.6% 9	22.4% 19	29.4% 25	27.1% 23
Assessment (quizzes, tests, questions-and-answers, etc) (Number of responses: 85)	17.6% 15	16.5% 14	23.5% 20	18.8% 16	23.5% 20
Collaborative learning (interaction with tutor, discussion with other students, group work) (Number of responses: 85)	31.8% 27	22.4% 19	25.9% 22	10.6% 9	9.4% 8
Field work (location-based learning: gathering and sharing on the site information) (Number of responses: 84)	39.3% 33	19% 16	14.3% 12	14.3% 12	13.1% 11
Information retrieval (search in databases and encyclopaedias) (Number of responses: 85)	23.5% 20	21.2% 18	24.7% 21	20% 17	10.6% 9
Totals for rating columns	24.5% 104	17.9% 76	22.2% 94	18.6% 79	16.7% 71

Rating from 1-5 where 1 is the most important

Total number of ratings: 424

The following additional learning activities and applications to be employed in mobile learning might include as suggested by respondents: authentic explorative learning, reflective diaries, Pre-programmed simulations and scenarios for onsite (field) applications, sharing pictures and video, podcasting, tracing and tracking students locations, data collection in applied settings for personal or group projects, daily new vocabulary, exam reminders, mobile gaming and quizzes, location based services (e.g. http://semapedia.org) andquick reference systems.

Table 5. Rating of importance of applications (software) on mobile devices

	Importance ratings				
	1	**2**	**3**	**4**	**5**
Mobile Office (Word, Excel, Powerpoint, etc). (Number of responses: 85)	16.5% 14	31.8% 27	20% 17	10.6% 9	21.2% 18
Diary and scheduling. (Number of responses: 77)	28.6% 22	20.8% 16	20.8% 16	22.1% 17	7.8% 6
Audio and video applications. (Number of responses: 84)	22.6% 19	20.2% 17	21.4% 18	19% 16	16.7% 14
Imaging. (Number of responses: 75)	4% 3	29.3% 22	17.3% 13	32% 24	17.3% 13
Additional accessories (notes, calculator, etc.). (Number of responses: 78)	14.1% 11	16.7% 13	26.9% 21	17.9% 14	24.4% 19
Browser for internet connection/online data services. (Number of responses: 85)	37.6% 32	23.5% 20	10.6% 9	16.5% 14	11.8% 10
Totals for rating columns	20.9% 101	23.8% 115	19.4% 94	19.4% 94	16.5% 80

Rating from 1-5 where 1 is the most important

Total number of ratings: 484

Table 6. Rating of usefulness of the mobile learning 'tool' that were perceived as being most useful

|	Importance ratings				
	1	**2**	**3**	**4**	**5**
Sharing texts, notes and documents via bluetooth or wireless connections. (Number of responses: 82)	15.9% 13	25.6% 21	22% 18	22% 18	14.6% 12

Accessing class notes, schedules, documents, websites, etc via wireless connections. (Number of responses: 82)	23.2% 19	26.8% 22	25.6% 21	14.6% 12	9.8% 8
Using the scheduling and diary applications for organising their learning environments. (Number of responses: 81)	14.8% 12	29.6% 24	19.8% 16	16% 13	19.8% 16
Using mobile Office or the like applications for their normal learning activities. (Number of responses: 82)	11% 9	19.5% 16	22% 18	25.6% 21	22% 18
Being connected anywhere, anytime. (Number of responses: 82)	52.4% 43	9.8% 8	9.8% 8	7.3% 6	20.7% 17
Totals for rating columns	23.5% 96	22.2% 91	19.8% 81	17.1% 70	17.4% 71

Rating from 1-5 where 1 is the most important

Total number of ratings: 409
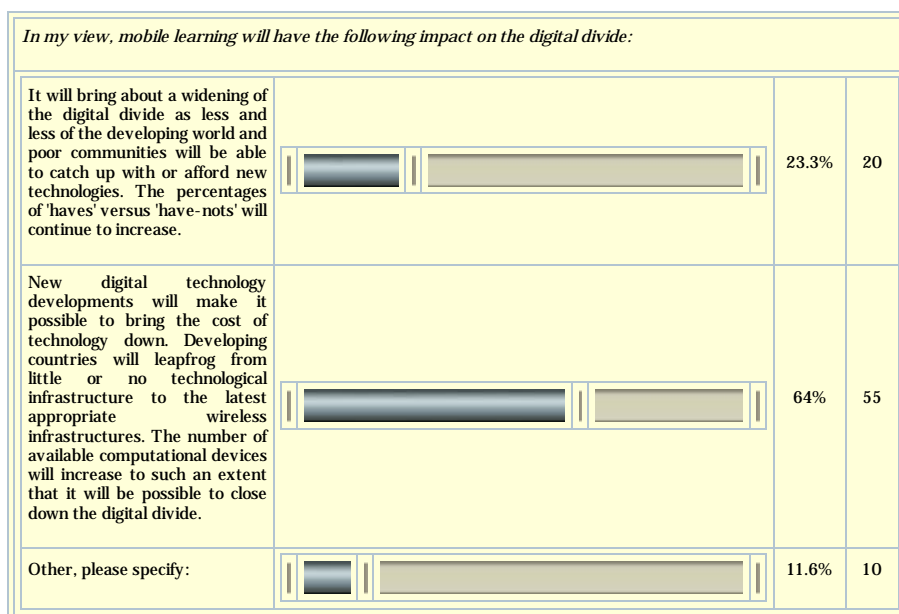
2.6 Mobile learning and access to (higher) education

Reponses were elicited on expectations concerning the impact of mobile learning on access to (higher) education. The findings are depicted in Figure 13. The general expectation (54%) was that it would widen access to (higher) education, because of the proliferation of mobile phones and wireless infrastructure – especially in developing countries.

The development of mobile learning will have the following impact on access to (higher) education:		
It will exclude parts of the population who have no access to mobile devices.	20.7%	18
It will not further increase access to (higher) education, because of the high density of networked computers already available.	21.8%	19
It will widen access to (higher) education, because of the proliferation of mobile phones and wireless infrastructure – especially in developing countries.	54%	47
Other, please specify:	2.3%	2
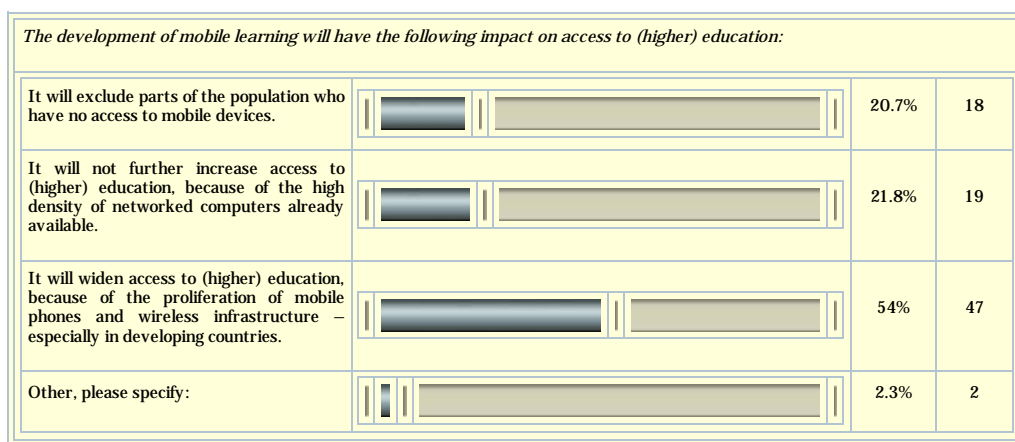
Number of responses: 86

Figure 13. Frequency distribution of responses with respect to expected impact on access to (higher) education

Figure 14 provides information on the anticipated effect of mobile learning on the digital divide. Sixty four percent of respondents suggested that the new digital technology developments will have positive effects concerning access to and costs of wireless technology. Several respondents emphasized that both statements are true to a certain degree: "I believe they complement one another and proceed to stabilize degrees of inequality we are already confronted with. If noticeable (mass), positive changes are to be noticed the time frame in my opinion would be 20 years". Another respondent reminded us that "The cost of technology will go down and access will increase, still, but there will remain parts of the population without access. However, those who previously 'had not' may now 'have', but maybe their technologies will be a little bit older". Only one of 86 respondents did not agree within any of the two statements and stated in a comment that mobile learning would not affect the digital divide at all.

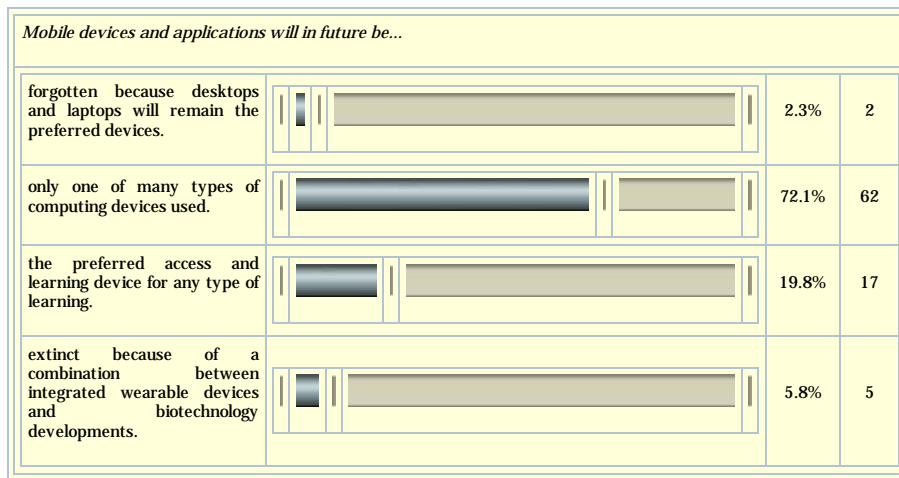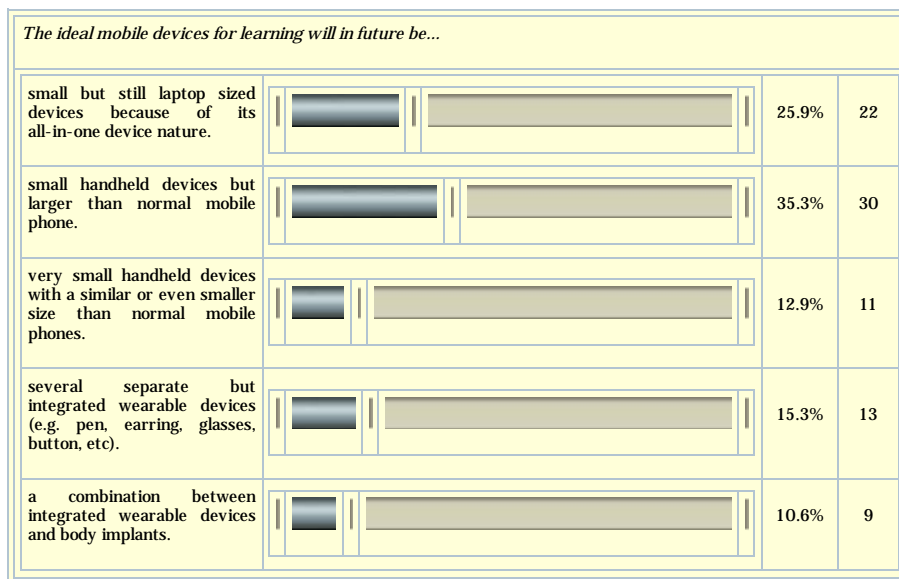| In my view, mobile learning will have the following impact on the digital divide:		
It will bring about a widening of the digital divide as less and less of the developing world and poor communities will be able to catch up with or afford new technologies. The percentages of 'haves' versus 'have-nots' will continue to increase.	23.3%	20
New digital technology developments will make it possible to bring the cost of technology down. Developing countries will leapfrog from little or no technological infrastructure to the latest appropriate wireless infrastructures. The number of available computational devices will increase to such an extent that it will be possible to close down the digital divide.	64%	55
Other, please specify:	11.6%	10

Number of responses: 85

Figure 14. Frequency distribution of responses with respect to the effect of mobile learning on the digital divide

2.7 Future development of mobile learning

Mobile devices and applications are expected to be only one of many types of computing devices used in future, as is evident from 72% of responses depicted in Figure 15 on the significance of mobile devices in the future. Responses concerning the attributes of the ideal mobile devices for learning are depicted in Figure 16.

Mobile devices and applications will in future be...			
forgotten because desktops and laptops will remain the preferred devices.		2.3%	2
only one of many types of computing devices used.		72.1%	62
the preferred access and learning device for any type of learning.		19.8%	17
extinct because of a combination between integrated wearable devices and biotechnology developments.		5.8%	5

Number of responses: 86

Figure 15. Frequency distribution of responses with respect to the significance of mobile devices in the future

The ideal mobile devices for learning will in future be...			
small but still laptop sized devices because of its all-in-one device nature.		25.9%	22
small handheld devices but larger than normal mobile phone.		35.3%	30
very small handheld devices with a similar or even smaller size than normal mobile phones.		12.9%	11
several separate but integrated wearable devices (e.g. pen, earring, glasses, button, etc).		15.3%	13
a combination between integrated wearable devices and body implants.		10.6%	9

Number of responses: 85

Figure 16. Frequency distribution of responses with respect to the attributes of mobile devices in future

The following table summarizes agreements on statements concerning the major weaknesses of mobile devices that might hinder the distribution of mobile learning.

Table 7. Rating on statements concerning major weaknesses of mobile devices that might hinder the distribution of mobile learning

Major weaknesses of mobile devices that might hinder the distribution of mobile learning: Do you agree with the following statements (1 = strongly disagree; 5 = strongly agree)					
	1	**2**	**3**	**4**	**5**
1. Displays and screens are too small to present complex learning material. (Number of responses: 85)	11.8% 10	5.9% 5	20% 17	28.2% 24	34.1% 29
2. Screen size should not be important as mobile devices should be used for communication and interaction purposes rather than for content distribution. (Number of responses: 84)	14.3% 12	21.4% 18	16.7% 14	32.1% 27	15.5% 13

3. Costs of mobile network services will continue to decrease and should not play an important role. (Number of responses: 85)	4.7% 4	18.8% 16	21.2% 18	36.5% 31	18.8% 16
4. Technological advancements make it possible to have sufficient memory for small images, audio and video clips. (Number of responses: 85)	3.5% 3	4.7% 4	14.1% 12	42.4% 36	35.3% 30
5. Device capabilities and mobile network infrastructures are improving to provide sufficient data transmission capacity (e.g. 3G and HSDPA). (Number of responses: 83)	3.6% 3	9.6% 8	15.7% 13	41% 34	30.1% 25
6. Limited battery life of mobile devices is a problem for extensive use. (Number of responses: 85)	8.2% 7	21.2% 18	11.8% 10	29.4% 25	29.4% 25
Totals for rating columns	7.7% 39	13.6% 69	16.6% 84	34.9% 177	27.2% 138

Rating:1 = strongly disagree; 5 = strongly agree

Total number of ratings: 507

3 Discussion and further perspectives

3.1 Integration into the mainstream?

Currently the penetration of mobile learning is low, with only 14% of institutions represented in this study reporting that their institutions indeed have developed course materials for use on mobile devices. The majority of respondents (73%) are from traditional distance teaching institutions, purely online teaching institutions/virtual universities or mixed-mode institutions offering both distance education and face-to-face classes, since the questionnaire was addressed to distance educators via distance education networks. This may have induced a bias in the findings; nonetheless it may be inferred that the application of mobile learning is even much lower in traditional, campus-based higher education and training institutions.

Notwithstanding the low penetration, 55% of distance teaching institutions and 48% of mixed-mode teaching institutions plan on, or are presently developing learning material for mobile devices. A high percentage of respondents (88%) reported being already personally involved in mobile learning projects or to have read publications on the subject, while approximately 71% reported either being actively involved or being informed on mobile learning projects in their own or other institutions.

Furthermore, 64% of respondents suggested that wireless technology developments will have positive effects on closing down the digital divide.

Therefore, it cannot be claimed that mobile learning is part of mainstream education and training yet, but it has potential and there is a demand to move from pilot project status to the mainstream. Organizational student and faculty support is of the utmost importance in order to foster the education innovation process.

3.2 A new generation of distance education?

Properly designed mobile learning can be spontaneous, ubiquitous and pervasive. It affords various opportunities for teaching and learning, especially interaction (two-way communication), flexibility, and maximal access, even in contrast to 'traditional' e-learning. Fifty four percent of respondents suggested that mobile learning will widen access to (higher) education, because of the proliferation of mobile phones and wireless infrastructure - especially in developing countries.

The role that communication and interaction play in the learning process is critical in contemporary learning paradigms. Mobile technologies seem to provide opportunities for optimizing interaction and communication between lecturers and learners, among learners and among members of communities of practice. Mobile learning enhances collaborative, co-operative and active learning.

Based on the criteria of interaction, independence, access and flexibility we can conclude that mobile learning has the potential to become a new generation of distance education in the sense of Garrison (1985) - provided that mobile learning becomes integrated into the mainstream provision of education and training.

3.3 An educational paradigm shift?

The expectations expressed by the respondents concerning the impact of mobile learning on teaching and learning strategies and methodologies, as well as on learning theories, may signify a change in thinking, in that technology is expected to induce changes in the former, while learning theories are expected to remain the same in essence. Only 29% of respondents expect learning theories to change completely, with new learning theories replacing behaviourism and constructivism due to the radical impact of future technologies. The majority of respondents (72%) agreed that mobile learning affords new opportunities for learner support, content development and delivery. However, only 12% of polled distance education experts believed that mobile technologies will "completely change the way we teach and learn", while the majority of respondents (77%) thought that mobile learning would be very helpful in enhancing teaching and learning independent of time and space. An array of new strategies and methodologies were proposed by respondents.

Mobile learning affords new channels of support, among others. One respondent reminds us that "the emphasis should be on 'enhancing' learning opportunities, rather than 'replacing' other forms of teaching and learning".

In terms of the definition of educational paradigm shifts by Peters (2004) and the data collected, we cannot confirm that we face an educational paradigm shift with the emergence of mobile learning. Learning with mobile devices appears to be a further development of 'traditional' e-learning.

3.4 Future development of mobile learning

The final frontier to cross to convince us that mobile learning is the new and next generation of distance education, is for mobile learning to be incorporated into mainstream education.

Approximately 78% of respondents believed that mobile learning will become an integral part of mainstream higher education and training within three to five years. These numbers are in line with results of a study in a corporate setting by Kuszpa & Scherm (2005) who conducted a survey at companies from Germany, Switzerland and Austria. In this study, 69% of respondents estimated that within five years, mobile devices will support learners in their job environment.

Distance teaching institutions are spearheading the development of mobile learning. A prominent example is NKI (Nettskolen Fjernundervisning) in Norway: NKI has been one of Europe's leading distance education providers for decades, offering over 400 online courses. NKI has already developed mobile learning versions of all its online courses within a project in partnership with Ericsson Education (Ireland) funded by the Leonardo Da Vinci programme of the European Commission [1]. This represents a massive transfer of mobile learning into the mainstream.

However, there are also barriers to the success of mobile learning. Beside the technical and economic challenges that were mentioned, it is the support of the faculty, teachers and trainers that is critical for the success of education innovation (Zawacki-Richter, 2005). Acceptance of new media, not only by pioneers and early adopters, but also by the majority of users (cf. Rogers, 1995) is the prerequisite for education innovation. A special analysis on factors that may hinder the development of mobile learning in institutions has been published by Zawacki-Richter, Brown & Delport (2007). An often mentioned critique is that displays and screens of mobile devices are too small to present complex learning materials (62 % of respondents agreed or strongly agreed to this statement). However, some mobile phones already include projection systems, removing the barrier of the small screen and it is possible to attach a small device that projects a full-size keyboard made of light (EDUCAUSE, 2007).

Figure 17. Keyboard and screen projection with mobile phones [2]

Keegan (2005) claims that mobile learning is not perceived to be a satisfactory revenue stream by the telecommunications operators, which is the major barrier to moving mobile learning from single project status to the mainstream. He proposes five solutions to this problem:

"Firstly, there are thousands of universities and further and higher education colleges all over the world. If they can all be convinced to accept mobile learning as their normal means of communication with all their students on changes of timetable, submission deadlines, enrolment procedures and other administrative necessities, a massive mobile learning revenue stream will already be set up. Secondly, the production of a mobile learning development kit for distribution to universities and colleges to enable them to introduce mobile learning will set up another revenue stream. Thirdly, the production of course guides, course summaries, examination reminders, helps with difficult parts of a course, will set up another revenue stream. Fourthly, the production of full course modules for PDAs, handhelds, palmtops, and also for smartphones and eventually for mobile phones, will set up another revenue stream. Finally, the literature of the field needs to be developed, books on mobile learning need to be written, conferences [...] need to be organised" (p. 16).

It was shown that mobile technologies afford new opportunities for teaching and learning which might convince innovative faculty, teachers and trainers to consider adopting mobile learning. Perhaps the hard work for acceptance done in the history of distance education and e-learning will also have a positive impact on the development of mobile learning. It now has to prove the value it can add to the teaching and learning process on a large scale.

Only when such evidence is exhibited, can we share the optimistic estimation of Wagner (2005): "Whether we like it or not, whether we are ready for it or not, mobile learning represents the next step in a long tradition of technology mediated learning. It will feature new strategies, practices, tools, applications, and resources to realize the promise of ubiquitous, pervasive, personal, and connected learning. It responds to the on-demand learning interests of connected citizens in an information-centric world" (p. 44).

References

[1] Brindley, J. E., & Paul, R. (1996). Lessons from distance education for the university of the future. In R. Mills & Tait, A. (Eds.), *Supporting the learner in open and distance learning* (pp. 43-55). London: Pitman Publishing.

[2] Brown, T. H. (2004). The role of m-learning in the future of e-learning in Africa. In D. Murphy, R. Carr, J. Taylor & W. Tat-meng (Eds.), *Distance education and technology: Issues and practice* (pp. 197-216). Hong Kong: Open University of Hong Kong Press.

[3] Brown, T. H. (2006). M-learning in Africa: Doing the unthinkable and reaching the unreachable. *Open and Distance Learning Praxis in Africa*. Pretoria: UNISA Press.

[4] Daniel, J. (1998). Can you get my hard nose in focus? Universities, mass education and appropriate technology. In M. Eisenstadt & T. Vincent (Eds.), *The knowledge web - learning and collaborating on the net* (pp. 21-29). London: Kogan Page.

[5] EDUCAUSE. (2007). *The Horizon Report*. Austin, Boulder: EDUCAUSE Learning Initiative and The New Media Consortium.

[6] Garrison, G. R. (1985). Three generations of technological innovation in distance education. *Distance Education, 6*(2), 235-241.

[7] Gladieux, L. E., & Swail, W. S. (1999). *The virtual university and educational opportunity - issues of equity and access for the next generation*. Washington, D.C.: The College Board.

[8] Keegan, D. (1986). *Foundations of distance education*. Beckenham: Croon Helm.

[9] Keegan, D. (2003). The future of learning: From elearning to mlearning. Retrieved September 13, 2006, from http://learning.ericsson.net/mlearning2/project_one/book.html

[10] Keegan, D. (2005). *The incorporation of mobile learning into mainstream education and training*. Paper presented at the World Conference on Mobile Learning, Cape Town.

[11] Kukulska-Hulme, A., & Traxler, J. (2005). Mobile teaching and learning. In A. Kukulska-Hulme & J. Traxler (Eds.), *Mobile learning - a handbook for educators and trainers* (pp. 25-44). London: Routledge.

[12] Kuszpa, M., & Scherm, E. (2005). *Mobile Learning - Modetrend oder wesentlicher Bestandteil lebenslangen Lernens*. Hagen: Fernuniversität Hagen.

[13] Nipper, S. (1989). Third generation distance learning and computer conferencing. In R. Mason & A. Kaye (Eds.), *Mindweave: Communication, computers and distance education* (pp. 63-73). Oxford: Pergamon Press.

[14] Peters, O. (2004). The educational paradigm shifts. In O. Peters (Ed.), *Distance education in transition - new trends and challenges* (4th ed., pp. 25-35). Oldenburg: BIS.

[15] Peters, O. (2001). *Learning and teaching in distance education*. London: Kogan Page.

[16] Quin, C. (2000). mLearning: Mobile, Wireless, In-Your-Pocket Learning. *LiNE Zine*, Fall 2002. Available at: http://www.linezine.com/2.1/features/cqmmwiyp.htm

[17] Rogers, E. (1995). *Diffusion of innovations*. New York: Free Press.

[18] Soloway, E. (2003). *Handheld computing: Right time, right place, right idea.* Paper delivered at the IEEE international conference on advanced learning technologies (ICALT). July 2003, Athens, Greece.

[19] Srivastava, M., & Reddy, V. V. (2002). Is information and communication technology reshaping the learner support? *University News, 40*(4), 43-54.

[20] Taylor, J. C. (2001). *Fifth generation distance education* (No. 40). Canberra, Australia: Department of Education, Training and Youth Affairs - Higher Education Division.

[21] Wagner, E. D. (2005). Enabling Mobile Learning. *EDUCAUSE Review, 40*(3), 40-53.

[22] Zawacki-Richter, O. (2004). *Support im Online Studium - Die Entstehung eines neuen pädagogischen Aktivitätsfeldes*. Innsbruck: StudienVerlag.

[23] Zawacki-Richter, O. (2005). Online Faculty Support and Education Innovation – A Case Study. *European Journal of Open and Distance Learning (EURODL)*, Volume 1. Available at http://www.eurodl.org/materials/contrib/2005/Zawacki_Richter.htm

[24] Zawacki-Richter, O., Brown, T., & Delport, R. (2007). Factors that may contribute to the establishment of mobile learning in institutions - Results from a survey. *International Journal: Interactive Mobile Technologies (iJIM), 1*(1), 40-44.

---

[1] http://learning.ericsson.net/mlearning2/ (accessed July 2008)

[2] http://gadget-crazy.co.uk, http://digital-lifestyles.info/2007/03/27/texas-instruments-demos-mobile-phone-projector/ (accessed July 2008)