Mobile Assisted Language Learning:

A Literature Review

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ABSTRACT

Mobile assisted language learning (MALL) is a subarea of the growing field of mobile learning (mLearning) research which increasingly attracts the attention of scholars. This study provides a systematic review of MALL research within the specific area of second language acquisition during the period 2007 - 2012 in terms of research approaches, methods, theories and models, as well as results in the form of linguistic knowledge and skills. The findings show that studies of mobile technology use in different aspects of language learning support the hypothesis that mobile technology can enhance learners' second language acquisition. However, most of the reviewed studies are experimental, small-scale, and conducted within a short period of time. There is also a lack of cumulative research; most theories and concepts are used only in one or a few papers. This raises the issue of the reliability of findings over time, across changing technologies, and in terms of scalability. In terms of gained linguistic knowledge and skills, attention is primarily on learners' vocabulary acquisition, listening and speaking skills, and language acquisition in more general terms.

Author Keywords

Mobile assisted language learning, MALL, mobile learning, second language acquisition, mobile technology

INTRODUCTION

Mobile technologies are rapidly attracting new users, providing increasing capacity, and allowing more sophisticated use. This influences cultural practices and enables new contexts for learning (Pachler et al., 2010). The integration of such technologies into teaching and learning has been more gradual, as educators need to understand how they can be effectively used to support various kinds of learning (Kukulska-Hulme & Shield, 2008) and develop effective methods and materials for mobile assisted language learning (MALL), a specialization of mobile learning (mLearning). The main characteristics of mobile learning, such as permanency, accessibility, immediacy, interactivity, situating of instructional activities, are summarized and introduced by Ogata & Yano (2005). While definitions differ, it is obvious that not only technology but also people can be mobile. For the purpose of this paper we define mLearning as a "process of coming to know through conversations across multiple contexts among people and personal interactive technologies" (Sharples et al., 2007, 225) with a focus on contexts. The technology to assist in this process includes any kind of handheld mobile devices such as cell phones, personal digital assistants (PDAs), smartphones, pads, pods, etc. Laptops are today typically not considered mobile in this context, even though they obviously are to some extent. Ogata et al. (2010) state: "computer assisted mobile learning uses lightweight devices such as personal digital assistant (PDA), cellular mobile phones, and so on" (p.8). In the lack of a strict definition, for the purpose of this paper we refer to anything that can be used when walking around.

As mobile technologies provide many advantages: flexibility, low cost, small size and user-friendliness, researchers are exploring how to use mobile technology to support language learning (Huang et al., 2012). However, there are also obvious disadvantages, such as small screen size, limited presentation of graphics (Albers & Kim, 2001), and dependence on networks that may not always provide very high transmission capacity and may be subject to disturbances of many kinds. Despite such shortcomings Thornton and Houser (2005) show that mobile devices can indeed be effective tools for delivering language learning materials to the students. Kukulska-Hulme & Shield (2008) offer a seminal overview of MALL asking whether and how mobile devices support collaborative practice in speaking and listening. The study presented the two main approaches to MALL, content-related and design-related studies. These approaches still dominate in the literature, although the focus is shifting towards design-oriented studies when creating authentic and/or social mobile learning environments (Wong & Looi, 2011).

This review presents an extensive coverage of empirical research, as published in English during the period 2007-2012, concerning the use and effectiveness of MALL in second and foreign language (L2) education with a focus on the methodological, theoretical and linguistic knowledge trends. What theories, research approaches and methods are used when analyzing MALL? Which aspects of MALL are being researched? What are the results so far, and what research gaps are there?

METHOD

The review follows the Webster and Watson (2002) method combining keyword searching and examination of leading journals. First, a set of keywords was identified. Primarily the keywords *mobile learning* together with (AND) *language learning* were used. Further, different combinations of such keywords as *handheld device*, *cell phone*, *mobile phone*, *PDA*, *smartphone*, *mobile, application* together with *language learning* were used. To ensure reliability, search strategies were refined by examining the retrieved articles' abstracts. To further enhance reliability, manual searches were carried out in key journals, including Computer Assisted Language Learning Journal, Computers and Education, Journal of Computer Assisted Learning, Educational Technology and Society and Language Learning and Technology. A further search technique was "snowballing", i.e. following up references in the identified papers and identifying most cited papers. The selection of articles to be included in the review was based on the inclusion criteria presented below. Several international conference papers (such conferences as EUROCALL (European Computer Assisted Language Learning), International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education, mLearn etc.) are also included due to the fact that many of the results of the ongoing projects have not been published yet in peer-reviewed journals as the field of mobile learning with the specific reference to language learning is still in its infancy (Kukulska-Hulme & Shield, 2008).

Papers included were those covering: effects of the use of mobile technology within foreign and second language learning, learners use of technology and attitudes and/or intentions, empirical studies, overview, and/or summary of MALL and CALL (with a focus on the use of mobile technology) research, mobile technology in its relation to language learning within educational settings, published in peer-review journals and conference proceedings in the period 2007 - 2012, effects of technology use on the acquisition of linguistic knowledge and skills (reading, vocabulary learning, writing etc.).

All the identified articles and conference contributions were analyzed in order to assess the papers' quality in terms of the applied theory, approach, method, and themes, using the Grönlund & Andersson (2006) model. After retrieving the relevant literature, the abstracts and the findings/conclusions of the articles were examined. Secondly, approach and method was examined so as to assess the credibility of the claims in the papers. Thirdly the main concepts were identified and organized in an author-centric matrix suggested by Webster and Watson (2002). Finally, the papers were examined to identify the language skills' focus when using mobile technologies in second language and foreign learning and teaching. As most of the reviewed articles were retrieved from highly ranked and cited journals, the methods and approaches employed could be trusted for their quality and credibility. Initially 89 papers were found. 54 of them fulfilled the selection criteria and are thus included. The categories for the analysis of research type and method used were adapted from Grönlund and Andersson (2006).

FINDINGS
Research Approach

In our sample most research was descriptive (44 %), presenting various cases where technical appliances were used. We found only one theory generating study and no theory testing one (Table 1). Theories were used in 46 % of the papers, but mainly to illustrate or interpret findings. We found only one theory specifically designed to cover the MALL field (Sharples et al., 2007). Noticeably, several descriptive studies also include elements of philosophical or theoretical concepts or models.

Descriptive	Describes a phenomenon in its appearance without any use of theory.	24	44%
Philosophical	Reflects upon a phenomenon without data and any use of theory.	2	4%
Theoretical	Reflects on a phenomenon based on some theory but without empirical data	2	4%
Theory use	Applies a theory/theories & models as a framework for the conducted study	25	46%
Theory generating	Attempts to analyze quantitative/qualitative data in a systematic manner with the use of theory with a purpose of (taking steps towards) theory building	1	2%
Theory testing	Attempt to test a theory using quantitative or qualitative data in systematic manner, i.e. just strict theory testing.	0	0%
Total		54	100%

Table 1. Research approach

Method

The most commonly applied method is experiment, with 47 % of the papers (Table 2). Second most common are interpretive studies (28 %). This indicates that the MALL field is in an emerging phase, still under development and in need of more solid empirical evidence in order to underpin theoretical conclusions about how mobile technologies can assist language learning and in order to build theoretical models that are specific to this scientific field.

A significant number of studies illustrate for MALL specially designed intelligent systems for individuals' use when practicing different language skills (Chang & Hsu, 2011; Chen & Chung, 2008; Chen & Li, 2010; Huang et al., 2012; Kaneko et al., 2008 etc.), such as use of Artificial Intelligence methods and technologies. In experiments, use of such systems is frequently compared to a 'traditional' way of teaching and learning a language in educational settings, attempting to show results of the developed software's use on, among others, individuals' second language vocabulary acquisition, listening and/or speaking skills etc. Thus most of these studies present explorative and comparative knowledge. Additionally when exploring learners' intentions and attitudes towards the use of the proposed systems and applications, evaluative knowledge is offered.

Method	Description	Number of articles	%
Argument	Logical argument but not based in any particular theory or relating explicitly or by clear implication to any theory.	2	4%
Case story	Tells about a case but as opposed to a case study there is no strict data collection method.	4	6%
Ethnography	Any attempt to understand actions by systematic observation and interpretation.	0	0%
Experiment	Field experiments included.	25	47%
Grounded Theory		1	2%
Interpretative	Any kind of more strictly performed data collection than a "case story" but not necessarily strictly explained or spelled-out method for interpretation. Case study belongs here but also more limited studies where qualitative and quantitative data is used.	15	28%
Literature study	Only documents used (scientific, policy documents etc.). Not necessarily strict method or even explicitly labeled as literature study	1	2%
Product description	IT product, method or similar, described by the manufacturer or someone else.	4	6%
Survey	This covers also qualitative overviews of several documents and cases.	1	2%
Unclear	Even the widely defined categories above fail to capture the method.	1	2%
Total		54	100%

Table 2. Method

Theories

The theories and models applied in the reviewed literature most often originate from previously established theories of learning, such as constructivism and situated learning theory. The experiments in the reviewed papers are hence typically applied on mature pedagogy. There are, however, also a few studies discussing mobile learning or Mobile Learning Theory or even Modern Mobile Learning Theory in attempts to formulate field-specific theory. There are also more general theories used, such as Activity Theory and Sociocultural Theory. Some theories originate from psychology, such as Cognitive Load Theory and Dual Coding Theory, and some relate directly to technology use, e.g. the commonly used Technology Acceptance Model (TAM). Many papers, however, do not exhibit any clear theoretical background.

Research Content

Analyzing the research topics of the papers, three major categories were found: 'technological concepts of learning' (e.g. Mobile-device supported peer-assisted learning), 'technology-centered concepts' (e.g. SMS –based learning), and 'learning environment' with two subgroups: 'theoretical development' (e.g. Contextualized meaning making) and 'practical aspects' (e.g. Usefulness). Table 4 provides a complete list and shows that most specific concepts, in particular those concerned with theory, are used only in one or very few papers.[1] Only general concepts like MALL are widely shared. This means there is little cumulative research.

Thematic categories	Examples	Concepts

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[1] References in the table are available from the author. Excluded due to lack of space.

Technological Concepts of Learning	Anderson et al. (2008)	Language learning outside the classroom
	Chen & Li (2010)	Context-aware ubiquitous learning
	Chen & Chung (2008); Hsu et al. (2008); de Jong et al. (2010); Cheng et al. (2010); Oberg & Daniels (2012); Petersen et al. (2011); Sandberg et al. (2011); Huang & Sun (2008); Hwang & Chen (2011); Abdous et al. (2012)	Mobile learning
	Chang & Hsu (2011)	CALL
	Comas-Quinn et al. (2009)	Constructivism, situated learning, informal learning
	de Jong et al. (2010); Hsieh et al. (2010); Petersen et al.(2011)	Situated learning
	de Jong et al. (2010)	Knowledge gain
	Demouy & Kukulska-Hulme (2009)	Authentic learning
	Fotouhi-Ghazvini (2009)	Game-based learning
	Hsu (2012)	MALL from cross-cultural perspective, constuctivism
	Huang et al. (2012); Liu (2009); Chen & Li (2010); Cheng et al. (2010); Fallahkhair et al.(2007)	Ubiquitous learning
	Kukulska-Hulme & Shield (2008); Kukulska-Hulme (2009); Miangah & Nezarat (2012); Nah (2011); Wong et al. (2010); Hsieh et al. (2010)	MALL
	Kukulska-Hulme (2010)	Learner-led innovation
	Lan et al. (2007)	Mobile-device supported peer-assisted learning
	Li et al. (2010)	Adaptive learning
	Liu et al. (2008)	Communicative mobile English learning
	Liu (2009), Cheng et al. (2010)	Collaborative learning
	Liu (2009)	Immersive learning
	Oberg & Daniels (2012)	Self-pace instruction
	Sandberg et al. (2011)	CALL, informal learning, game-based learning
	Stockwell (2007, 2008)	CALL
	Wong & Looi (2010)	Seamless language learning design
Technology-Centered Concepts	Abdous et al. (2009, 2012); Ducate & Lomicka (2009); Rosell-Aquilar (2007)	Podcasting
	Cavus & Ibrahim (2008, 2009); Katz & Yablon (2011); Lu (2008); Kennedy & Levy (2008); Saran et al. (2008)	SMS –based learning
	Chang & Hsu (2011); Chen & Chung (2008);Chen & Li (2010); Huang et al. (2012); Kaneko et al. (2008); Petersen & Markiewicz (2008); Stockwell (2007, 2010); Cheng et al. (2010); Sandberg et al. (2011)	Usage of multimedia/hypermedia intelligent systems
	Cheng et al. (2010)	Exchange of ideas through presentations
	Comas-Quinn et al. (2009); Hsu et al. (2009)	Mobile blogs
	Godwin-Jones (2011); Chang & Hsu (2011); Chen & Chung (2008); Chen & Li (2010); Fallahkhair et al. (2007); Huang et al. (2012); Liu (2009); Petersen & Markiewicz (2008); Petersen et al. (2011); Sandberg et al.(2011); Stockwell (2007, 2008, 2010); Huang et al. (2012)	Mobile applications for language learning
	Gromik (2012), Nah (2011); Fallahkhair et al. (2007)	Learning with a cell phone
	Fallahkhair et al.(2007)	Language learning support via iTV and cell phones
	Jian et al. (2009)	Electronic pocket dictionaries
	Li et al. (2010)	Mobile-based e-mail learning (MESLL)
	Liu (2009)	Sensor and handheld augmented reality(AG)-supported ubiquitous learning
	Nah (2011)	WAP site's use for listening activities
	Sandberg et al. (2011)	Added value of mobile technology for learning English

	Song & Fox (2008)	Referential use of mobile devices (PDAs) to enhance learners' incidental vocabulary learning
Learning Environment Theoretical Developmental	Chen et al. (2008)	Content adaption in mobile learning environment
	Comas-Quinn et al. (2009)	Intercultural awareness; interface between learner and context
	Cheng et al. (2010)	Contextual familiarity
	de Jong et al. (2010)	Contextualized language learning
	Huang et al. (2012)	Interactive learning environment
	Hwang & Chen (2011)	Familiar context
	Wong & Looi (2010)	Contextualized meaning making
Learning Environment Practical Aspects	Petersen & Markiewicz (2008); Kukulska-Hulme (2010); Chen & Chung (2008); Chen & Li (2010)	Personalization
	Cheng et al. (2010)	Playfulness
	Comas-Quinn et al. (2009); Kukulska-Hulme (2010); Hsu (2012); Abdous (2009, 2012); Fallahkhair et al. (2007)	Learner-centeredness
	de Jong et al. (2010)	Desirability
	Huang et al. (2012); Chen & Li (2010), Cheng et al. (2010); Chang & Hsu (2011)	Usefulness/ease of use
	Hwang & Chen (2011)	User's percipience
	Cheng et al. (2010)	Student's engagement

Table 3. Concepts used

DISCUSSION AND CONCLUSIONS

This review sought to offer a general picture of research trends in MALL with a focus on second and foreign language acquisition published since 2007 in terms of research approaches, methods, theories and models, and results.

What Research Approaches and Methods Are Used When Analysing MALL? The scientific field of mLearning and MALL generally, as well as L2 acquisition specifically, are emerging so unsurprisingly we found a large number of approaches and theories employed. Most of these originate from other areas, such as applied Cognitive Load Theory (Oberg & Daniels, 2012) and Dual-Coding Theory (Huang et al., 2012) derived from the cognitive psychology; TAM (Cheng et al., 2010) from informatics research, and a number of learning and language acquisition theories. A number of studies introduce mobile learning, MALL and even the Theory of Mobile Learning but it is often not clear how these new concepts differ from other technology-enhanced learning perspectives, for example e-learning or CALL. In general, theories are vaguely used; we found only one theory generating study (Liu et al., 2008) and no theory testing one. The dominating research approaches within MALL for the reviewed years are descriptive studies (44 %) and what we call "theory based studies" (46%), where the authors present a theory which in some way is related to their experiments or case studies. For example, de Jong et al. (2010) employ sociocultural perspectives, where emphasis is on the social motive for second language learning. There is often a lack of a clear connection between the theory and the discussion part in the reviewed papers. There are exceptions, e.g. TAM which is strictly operationalized, but then there may be other gaps; TAM, again, is not related to learning, only to use of technology.

As for the descriptive studies, a typical example is Godwin-Jones (2011) who illustrates the state of language learning applications, the devices they can be applied to, and how they are developed. The descriptive studies often include embryonic elements of philosophical or theory generating categories. For instance, the research conducted by Kukulska-Hulme (2009) describes findings from previous research and reflects upon the phenomenon of MALL without any explicit use of theory.

'Experiment' (non-strictly defined) is the most commonly applied method in the reviewed studies (47 %), followed by interpretive case studies (28 %). Together these two methods make up 75% of the research published 2007 – 2012. Most studies are small-scale, exploratory, and conducted within a short period of time, which makes them rather anecdotal in terms of reliability. This is not surprising given that the field of MALL is in its developmental experimental phase and still needs more solid empirical evidence and guidance in order to underpin conclusions about how mobile technologies can assist language learning acquisition and in order to build theoretical models specific to this field. It is hence still an open question to what extent MALL in the L2 area is indeed different from MALL in other areas.

Within What Theoretical Frameworks the Studies Have Been Carried Out? Theory use in the sample is very scattered. A large number of theories were found but most theories appeared only in one paper; we saw no cumulative theory use. Notably, many concepts appear only in one or a few papers. As one commonly cited criterion of a scientific

field is that a common set of theories is applied, this finding indicates that MALL is yet only a potential field, united mainly by the studies of mobile technologies.

However, despite this character of being an emerging research field undergoing a rapid evolution there are already attempts to create field-specific theory. Sharples et al. (2007) introduces the Theory of Mobile Learning which examines how (mobile) learning stretches across locations, times, topics, and technologies. According to this theory, which is discussed and extended in several papers (Sandberg et al., 2011; Petersen et al., 2011; Hsieh et al., 2010 etc.), learning which takes place in one context can become a resource in other contexts. This effort of creating theory indicates attempts to distinguish the MALL field from other scientific learning areas and theories by raising and discussing its own theoretical perspective. Our study finds that there is, as yet, a lack of specific reference to mobile learning conceptual frameworks and theoretical models, which makes it difficult to clearly distinguish the theory of mobile learning from other learning theories and approaches. MALL theory development is work in progress.

The theories and models applied in the reviewed literature on MALL often originate from grand theories of learning, including constructivism, social constructivism. Activity Theory and Sociocultural Theory are examples often mentioned by studies on MALL (Nah et al., 2008, de Jong et al., 2010). One of the most fundamental concepts of Sociocultural Theory is that the human mind is *mediated* (Lantolf 2000). This mediation is often assisted by the tool use. Hence mobile technology use plays a dominant role in the process of meaning making in terms of mediated nature of human mind. MALL research often employs learning theories where such mediation is an issue, including Situated Learning Theory (Hsieh et al., 2010, Hwang & Chen, 2011), collaborative learning (Chang & Hsu, 2011; Lan et. al., 2007), self-paced learning (Oberg & Daniels, 2012), and seamless learning integrating formal and informal ways and contexts of learning (Wong et al. 2010; Wong & Looi, 2010).

In order to investigate learners' perceived ease of use, perceived usefulness, intentions, and attitudes towards the use of mobile technologies for language learning, TAM, an established theory for this purpose, is commonly applied (Chang & Hsu, 2011; Huang et al., 2012). Most studies show that learners have a positive attitude towards the use of mobile technologies for the second and foreign language acquisition, but there are differences. For example, Huang et al. (2012) show that the designed system (ubiquitous English vocabulary learning system, UEVL) was readily accepted by the students in the sample but while active students were concerned about the perceived usefulness of the system, passive ones were more concerned about the perceived ease of use of the system.

There are theories emphasizing cognitive aspects of learning, such as the Cognitive Load Theory (CLT) which measures the limits of people's working memory capacity in order to investigate individuals' working memory load when, for example, using different specially designed intelligent systems for mobile devices for language learning (Chen et al., 2008; Chen & Chang, 2011; Oberg & Daniels, 2012). Other models applied in the reviewed papers include Moderation Model (Chen & Chang, 2011), Working Memory Model (Chen et al., 2008), and Structural Model (Huang et al., 2012). A number of papers, however, do not have any clear theoretical background but are rather descriptive.

Despite the fact that many authors mention and make an attempt to define mLearning and mLearning theory in the introductions to their studies, it is often unclear how these concepts and theories are operationalized.

What Aspects of MALL Are Being Researched? Studies analyzing the mobile technology's use in the different aspects of language learning have supported the idea that mobile technology can enhance learners' second and foreign language acquisition. Learners' attitudes towards technologies, their intention to use it, and the various actual uses of mobile technology integrated in their second and foreign language learning is a dominating research focus (Chang & Hsu, 2011; Cheng et al., 2010 etc.). The impact of mobile technology on language learning has often been measured by individuals' stated perceptions. This exemplifies what Orlikowski & Iacono (2001) call the *proxy* view of technology. Effectiveness studies focus on how this technology is viewed by individual users where the perceptive, cognitive, and attitudinal responses to technology become the critical variable in explaining mobile technology. This *tool* view of technology is criticized as it fails to take into account the transformational nature of technology; technology brings with it changes not only in procedures – how we do things – but also in our perceptions of what is doable or not, e.g. in terms of accessing distant materials and people. Hence technology itself plays a role in reshaping people's preferences, perceptions, and attitudes and the new teaching and learning methods that evolve are co-constructed in a sociotechnical system rather than engineered. This is called the *ensemble* view of technology (Orlikowski & Iacono, 2001), and this idea of sociotechnical construction – as opposed to purely *social* construction – is something often lacking in MALL studies.

Three key themes have been identified. First, *technological concepts of learning*, where the mobile learning and specifically MALL are often seen as the separate forms of learning together with more established learning theories like constructivism and collaborative learning. A number of other approaches to learning such as situated learning, mobile learning; authentic learning, self-paced learning are discussed when investigating individuals' adoption and integration of mobile technologies in their language learning.

Second, *techno-centered concepts* focus on technology itself as a means of communication between the learner and the content as well as teacher and learner where a shift from sms-based learning towards the development and use of mobile language learning applications in form of intelligent multimedia tutorial systems is noticeable. Finally, the *learning environment* theme focuses on theoretical development and practical aspects of such environments. Much attention is

paid to the different contexts of formal and informal learning, and how mobile technologies are available and can contribute to the individual's language learning acquisition in these different situations.

Despite the fact that a number of authors attempt to define and use the concept of MALL as an independent scientific field, language learning with the support of mobile devices is often seen as a part of CALL (Chang & Hsu, 2011; Sandberg et al., 2011 etc.), mobile-(assisted) learning (Hsu et al., 2008; de Jong et al., 2010). This conceptual ambiguity indicates that the field of MALL needs more conceptualized knowledge in the form of field-specific definitions, theories, models, and solid evidence on how the use of mobile technology can assist second and foreign language acquisition.

In What Ways does the Use of Mobile Technology Facilitate the Acquisition and Development of Linguistic Knowledge and Language Skills? In terms of the gained linguistic knowledge and skills, most of the reviewed papers examine vocabulary acquisition, listening and speaking skills, and language acquisition in more general terms. The review finds several suggestions for language learning benefits in the use of MALL, such as integrating the mobile technology in both formal and informal contexts; the 'fun' moment when engaging learners in authentic learning contexts; the learners' contribution to the creation of the learning content; the use of mobile devices to support the practice of achieving listening and speaking skills effectively etc. Often the usefulness of the mobile technology use for vocabulary acquisition is measured by surveying learners' attitudes. There are also a number of studies attempting to analyze the outcome in terms of learners' language proficiency. However, as most studies are implemented within a short period of time and involve a small number of participants, results are yet inconclusive in this respect.

Studies focusing on grammar learning, pronunciation and writing skills are underrepresented in the reviewed literature. However there are the papers which analyze mobile technology applications on language acquisition in general terms (Rosell-Aguilar, 2007; Fallahkhair et al., 2007; Petersen & Markiewicz, 2008, Liu et al., 2008; Cheng et al., 2010; Abdous et al., 2012; Oberg & Daniels, 2011; Hsu, 2012), often indicate positive attitudes towards the mobile technology use and suggest better results in terms of language proficiency. Very little attention is devoted to individuals' language learning strategies and learning styles when employing mobile devices for their language learning. This knowledge can have a crucial impact on both educators, when for example designing language learning activities adopting mobile devices (development of new applications and intelligent tutorial systems for mobile devices for language learners) and learners, as they can achieve higher proficiency.

Are There Research Challenges in the Field of MALL Research that Require Further Investigation and What Can Be Suggested for the Further Research? There is a lack of empirical studies providing concrete evidence on how the mobile technology use can enhance individual's language learning results. In order to ensure reliability longer studies and larger test groups are required.

In terms of language knowledge and skills, more experimental cases testing more specifically how mobile technology can assist and improve learners' writing process, reading comprehension, pronunciation performance, and second language grammar acquisition are needed.

Moreover, empirical research investigating the possible changes in individuals' learning strategies when employing mobile devices in their language learning is needed in order to be able to make the language acquisition process more effective and to be able to influence the second and foreign language proficiency results. It would also be beneficial to analyze the interconnection between individuals' learning strategies, learning styles, and use of mobile technology. Such knowledge would make an important contribution not only to educators and learners but also to systems developers.

From a pedagogical point of view, research on how the use of mobile technology affects individuals' time management when learning a new language is needed to understand if this technology can open additional learning possibilities, for example in terms of engaged time.

Overall, more theory generating research developing mobile learning theory and constructing new theoretical models in MALL is needed to be able to distinguish the field from other kinds of technology-assisted learning, such as CALL.

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