Mobile Learning and Mobile Assisted Language Learning in Focus

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Abstract

Mobile learning (m-learning) has been applied to foreign language education for more than a decade. Now that the emerging technologies and digital environments for learning have led to innovative learning experiences, there has been an exponential growth in the use of mobile applications for language learning. A growing volume of research has been conducted on Mobile Assisted Language Learning (MALL), emphasizing conceptualization of MALL and investigating the learning outcomes of users of MALL applications in foreign language classes. This paper aims to elaborate on the concept of mobile-assisted language learning (MALL) in association with learning theories and challenges, to present a conceptual framework of MALL design principles and dimensions, and to review existing MALL studies.

Keywords: mLearning, MALL; design principles of MALL; mobile learning environment

Introduction

With the advancement of the Information Age, technology has penetrated almost every aspect of our lives and broadened the space of educational practice through innovative and smart devices, wireless broad-band technology, and innovative application services. This tremendously rapid advancement has led to novel learning methods that are extensions of existing learning theories and has fostered the emergence of a learner-centered and personalized way of learning. With the emerging technologies and growing numbers of multimedia software and mobile applications, learning has become more authentic, context-aware and ubiquitous, in other words, mobile. Thus, the construction of knowledge with reference to individualized experiences and practice have become feasible, making the learning process diversely customizable in terms of abilities, interest, and preferences.

In its early definition, mobile learning, also known as m-learning, was defined as an extension of e-learning through mobile computational devices such as personal digital assistants (PDAs), and mobile phones. It was included with e-learning as a subset of distant learning (Georgiev, Georgieva, & Smrikarov, 2004). Mobile learning case studies and research (O'Malley et al., 2003; Traxler, 2005) have illustrated the benefits of learning opportunities in unfixed settings and times through mobile devices. Mobile learning has been defined as "learning across multiple contexts, through social and content interactions, using personal electronic devices" (Crompton, 2013, p. 4). Mobile learning also offers some value-added aspects such as adaptability to constantly changing context and its on-demand nature. Additionally, Rosman (2008) defined m-learning as "using mobile technologies (such as mobile phones and hand-held computers) to enhance the learning process and it involves delivery of digitalized content to either wireless phones hooked into work and education" (p. 120).

Apparently, the development of mobile learning has superseded its association with e-learning by being available at almost any location and time (Kukulska-Hulme & Traxler, 2005). Ebner, Stickel, Scerbakov, and Holzinger (2009) state, "The increased availability of free wireless network access points affect the way that ends users interact with ubiquitous devices, extending traditional e-learning into a new phenomenon named: Ubiquitous learning" (p. 34). When compared, e-learning takes place away from the classroom setting and binds learners to static desktop learning, whereas m-learning occurs at an unfixed point and time, focusing on ubiquity and flexibility in time and

access. Ubiquity, that is available everywhere, makes it easier for learners to engage in learning activities outside the formal educational locations. Ubiquity is, of course, possible only with sufficient network capacity, which enables online access to the learning content. The immobile PC and internet connection have limited the potential of e-learning to certain locations such as the workplace, classroom or home. However, a wireless mobile device allows learners to access information when in transit, or when they are away from a hard-wired device. The enhanced accessibility of m-learning allows the learner to access and exploit the material in personally preferred places and times. These two chief attributes, ubiquity and flexibility, make learning more deconstructed allowing the learner greater access regardless of concurrent activities(Corbeil &Valdes-Corbeil, 2007).

In m-learning, learners are given a variety of opportunities to "exploit the spontaneous and opportunistic nature of learning on the move" (Kukulska-Hulme & Traxler, 2005, p. 31). As the meaning of learning exits the traditional border of fixed educational settings like classrooms and becomes pervasive and on-the-go through hand-held mobile devices, the nature of mobility is reshaped. There are now a variety of mobile learning contexts for each learner/user. Learning can occur while traveling, walking, working, riding a bus; or the context may be hands-free or eye-free learning (Traxler, 2007). Vavoula and Sharples (2002) suggest that learning is mobile in three ways: space, areas of life and time. Learning can occur at work, at home or during leisure time. The learning may be necessary for different areas of life such as training for work, self-improvement or entertainment and it is mobile in terms of time since it can take place at different times of the day or even during working days or weekends. Kress and Pachler (2007) regard m-learning as a new cultural practice of learning by the means of the mobile device; learners practice and strengthen their understanding and resources while communicating with the world. As mobile devices are fundamentally used for communication with others; learning, that is, meaning-making beyond educational institutions and media use in everyday life, can be integrated into cultural practice and routines in everyday life. Sharples, Taylor, and Vavoula (2007) also define m-learning as "the process of coming to know through conversation across multiple contexts among people and personal interactive technologies" (p. 225). This definition adds a cognitive and social dimension to learning through mobile devices. The emphasis is on context through which the users reshape and develop understanding through routine and social collaboration.

Thanks to the advances in technology, m-learning is available through a wide spectrum of mobile devices including PDAs, mobile phones, small tablets, MP3/MP4 players, iPod touch, e-book readers, IC recorders, games consoles, digital dictionaries, voice recorders and so forth. With varied sizes, designs and operating systems undergoing a rapid innovation serving different needs and tastes, mobile device popularity has grown tremendously, enabling people from all walks of life get connected through various wireless communication technologies such as Bluetooth, Wireless Fidelity (Wi-Fi), 3G or 4G, GPRS and enjoy the small world through mobile devices. Due to the advancement in wireless network communications, these devices become smarter, evolving from being used with limited functions (taking pictures, setting alarm, listening to radio, calculating) to being used with wider functions (surfing the net, connecting to the social networks, gaming, instant messaging and learning applications). By being always-on and serving both as a primary means of social communication and connectivity, "high-end" phones are more often preferred and are popular than the other mobile devices such as tablets or laptops (Lindquist, Denning, Kelly, Malani, Griswold, & Simon, 2007). The portability of mobile phones has made access to information easier and faster (Bradley & Holley, 2011), thus encouraging learners to take part in learning while communicating with others. Due to the high penetration of mobile phones into education and research, theoretical perspectives of m-learning and its effects on learning have been examined (Kukulska-Hulme & Traxler, 2013; Naismith, Lonsdale, Vavoula, & Sharples, 2004; Thornton & Houser, 2005; Traxler, 2009). A new paradigm is emerging to integrate mobile learning through mobile phones to traditional pedagogy.

Learning Theories Related to m-Learning

To maximize the potential of a mobile device as an aid for learning, it is crucial that the educational experiences be based upon sound educational practice and exploit the 'mobility' of the device extensively. To this end, several international conferences such as MLEARN series and workshops series (the International Workshop on Mobile and Wireless Technologies in Education) and European projects such as HandLer, m-learning, MobiLearn, and MLarg have taken place in the field of education. The prerequisites for m-learning as a particular learning type such as 1) identification of uniqueness of m-learning, 2) determination of amount of learning outcomes outside the class, 3) account of practice e.g. learner-centeredness, knowledge centeredness, assessment centeredness, and community centeredness, and 4) ubiquitous function of personal mobile devices are enlisted for the conceptualization of m-learning (Sharples et al., 2007). Although it is claimed as being "immature in terms of theory and practice of pedagogies" (Traxler, 2007, p. 3), mobile learning along with its outcomes has been explored and discussed in various applications such as collaborative learning (Alvarez, Brown, & Nussbaum, 2011; Pinkwart, Hoppe, Milrad, & Perez, 2003; Zurita & Nussbaum, 2004), teacher training (Seppala & Alamaki, 2003), nurse training (Kneebone, 2005), natural science learning (Chen, Kao, Yu, & Sheu, 2004), institutional training for mobile workers (Lundin & Magnusson, 2003), context-aware language learning (Ogata & Yano, 2004), teachers' professional development (Herrington, Herrington, Mantei, Olney, & Ferry, 2009; Summey, 2013), medicine praxis (Brandt & Rice, 2013; Ranson, Mazmanian, & Alvanzo, 2007).

As the results and implications of these studies (e.g., Naismith et al., 2004) point out, m-learning as a form of learning has been associated with other established learning theories. Naismith et al. (2004) propose six types of learning related to m-learning: behaviorist, constructivist, situated, collaborative, informal/lifelong, and support/coordination of learning. From a behavioristic perspective, learning should involve a stimulus and be reinforced by a response to a stimulus.Behavioristic learning through mobile devices can be based on quick feedback or the reinforcement element. In constructive learning, learners construct new ideas or concepts by developing their understanding based on a blend of previous and current knowledge. In the case of m-learning, mobile devices can enable individuals constructing meaning through mobile investigations and hands-on experiences. In situated learning, activities within authentic contexts are promoted, so m-learning is promoted or supported in context-specific environments such as museum or field trips. Drawing on those contexts, mobile devices running context-aware applications support the learning activity. In collaborative learning, social interaction is the key point in developing understanding. Learning through mobile devices promotes learning through social participation, interaction, and collaboration. For informal and lifelong learning, activities outside of a formal learning environment and formal curriculum are promoted. Through mobile devices, users can have access to information out of formal educational context when they think it is necessary for them to reach the source of information. As for support of learning, students are provided with informal learning opportunities, which may be intentional or incidental. They might need to access the subject-matter, lecture notes, assignments, quizzes or exams or learn through games and applications when they are enjoying their pastime fun/activity on mobile devices. Siemens (2005) adds another category of learning activity, namely the theory of connectivism. Connectivism is a blend of behaviorist and constructivist approaches and it suggests that in a networked society, learning takes place in a constantly changing environment and it occurs when specific information sources connect. Learners can see connections between fields, ideas and concepts and manage their own learning by engaging in a network or community. Finally, individualized learningproposed by Cheon, Sangno, Crooks, and Song (2012) refers to the potential of m-learning to allow learners to manage their own learning pace.

The features of m-learning activities have been described by Traxler (2009) as personalized, situated, and authentic. Personalized learning recognizes that learning is personal and adapts to the needs or

wants of each individual; the material is developed, delivered or supported based on this recognition. By situated learning, learning takes place in the relevant context such as in the hospital ward (in the case of nurse training), thus supporting learning that is context-specific. Authentic learning involves exploration and inquiry as well as real-life hands-on experiences. Sharples et al. (2009) propose a framework that presents what distinguishes mobile learning from classroom learning or desktop learning, making it a distinct form of learning. In his framework, there are two dimensions: initiation and management. Learning initiated by the learner himself or the external body (teacher or a curriculum). The process of learning is managed by the learner or others. This framework shows four features of mobile learning. First, mobile learning may be mobile but not necessarily. Learning can occur when learners are outside of or inside of the fixed settings such as lab or classroom where they can use the mobile device. Second, mobile learning may occur in informal settings. Some supportive informal settings such as museum or field trips may be initiated by the others but managed by the learner. Third, mobile learning may be extended and intertwined with other activities. Mobile learning may support the learner while he or she is engaged in other activities and as a consequence of this, determination of exactly when learning occurs is difficult. Finally, mobile learning may involve both personal and institutional technologies. The number of available technologies and resources such as tablets, e-dictionaries, MP3 players, mobile phones can necessitate that students use either institution-provided mobile devices or compatible individual devices for engaging in learning.

Challenges of Mobile Learning

Although the penetration of mobile learning into education has advanced and been warmly welcomed as an innovation (Sharples et al., 2009) and a new paradigm (Rosman, 2008), m-learning environments bring about various challenges. To illustrate, Naismith et al. (2004) identify challenges such as context, mobility, learning over time, informality and ownership. The mobile learning context is created through user participation. Sometimes this occurs through logging on a system with a special password. When a user logs in, the link should be secure to ensure privacy. Mobility capacity does not guarantee support for classroom learning as students might easily engage in activities that are not in line with the curriculum or teaching activity. Furthermore, as learning is varied in time, keeping a log of the mobile learning experience over time is necessary. Informality may create a problem when too much penetration of mobile learning into formal education threatens the social and personal space of learners leading them to abandon using technology for learning. Personal ownership of mobile devices might create a difficulty for institutional control of the technology as students might go off topic. Like Naismith et al. (2004), Motiwalla (2007) also points out that the length of content delivery and interaction overload are also critical points. According to him, m-learning content delivery should be leveraged with "value added features" such as alerts, discussion or interaction platforms, which can help users use their time more efficiently while on the move. Students in the mobile learning context do not prefer to access material for long periods of time (Dean, 2011). The anytime and anywhere nature of mobile technologies might pose a problem of interaction overload since anytime and anywhere connectivity might put users in danger of being distracted and feeling the chaos of a "24 x 7 headache" (p. 594). Other challenges are also listed by Keough (2005), who has taken the challenge from a pessimistic perspective of the function of m-learning. For him, m-learning is technocentric with the aim of being a mobile device to take part in the market rather than for education. The endpoint of satisfying users with high-end devices will never be realized. Additionally, little is known about the flow of information and the relationship between users. Last but not least, "mobigogy" is a necessity, that is, teaching and learning models are needed (Keough, 2005, p. 1). Though some extent of pessimism exists, it seems that the world is dynamic and getting smaller. Technology, teaching and the learning culture has taken the direction of adaptation to the innovations. To understand the practice of m-learning and evaluate its outcomes, it is important that there be a comprehensive pedagogical framework for how m-learning can be designed and delivered to learners, which can inform key considerations for the preparation, and application of instructional materials supported by mobile technologies.

Design of Mobile Learning

As mobile learning has become more commonly applied, the design of such learning programs becomes more important. A distinct lack of theoretical framework for mobile learning in its design principles is emphasized (Cochrane, 2012; Sharples et al., 2009). Several studies (Kukulska-Hulme & Traxler, 2013; Quinn, 2013; Parsons, Ryu, & Cranshaw, 2007) have investigated various factors for consideration when designing any m-learning content.

The following is a collective synthesis of the critical factors and principles to be considered in designing mobile learning environments proposed by Killilea (2012), Levert (2006), Mayer (2001), Naismith and Corlett (2006), and Parsons et al. (2007). Based on the work of these researchers, a conceptual framework of mobile learning is developed and illustrated in Figure 1.

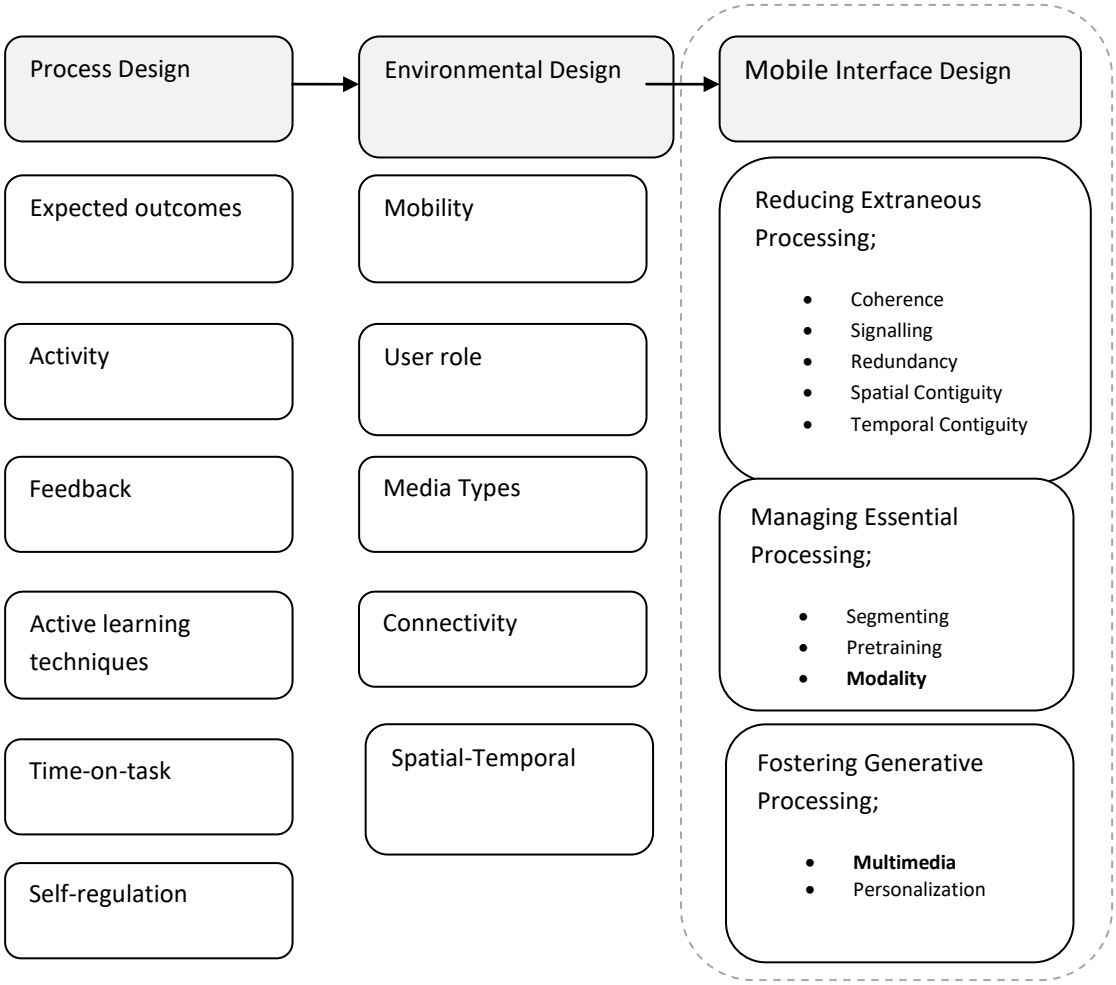

Figure 1. A general framework for design principles in mobile learning. Adapted from Bartolomé & Steffens, 2011; Killilea, 2012; Kukulska-Hulme & Traxler, 2013;Naismith & Corlett, 2006; Parsons et al., 2007; Mayer, 2001; Levert, 2006.

Three design dimensions can be identified: process design, environmental design, and mobile interface design. The first dimension, the process design, delineates the process by which a learner is recruited and engages in the course of mobile learning. It takes into account basic elements such as

expected outcomes, activity, feedback, active learning techniques, time on task and self-regulation (Killilea, 2012; Kukulska-Hulme & Traxler, 2013).

The key points of process design

- When designing a mobile learning process for an activity, expected outcomes must be stated clearly so that learners know what they are supposed to do with the m-learning activity or content.

- The activity must involve data searching, testing, consolidation of learning, personal reflection and skill gaining and it should recognize different learning styles.

- Feedback should be built into the content of learning and it should be immediate and constructive.

- Active learning techniques should be integrated into ways that enable learners to internalize learning through different types of data presentation.

- The time-on-task should be considered carefully allowing each learner to be flexible in organizing their learning at their own pace.

- Self-regulation in a mobile learning environment means choosing between different modes of multimedia presentation, and interaction with the available resources, tools, and agents. When designing m-learning, learners' voluntary choices to organize how and what resources they use must be taken into consideration. This flexibility enables learners to personalize their own learning.

The second dimension, environmental design, highlights the importance of context and content. It addresses accessibility, content specification, and user identification (Parsons et al., 2007).

Key points of environmental design

- Mobility is a broad term and briefly refers to being connected anytime and anywhere. Yet, mobile users must fulfill technical and contextual requirements such as mobile services and appropriate communication spaces to experience m-learning.

- Each user has a role in the ecology of mobility. Users partake in m-learning using a given mobile device differently, for example, a teenager may use a device for social networking such as Facebook, while professionals might use the same device for business correspondences. How they utilize mobile devices must be taken into consideration.

- The media types are related to the m-learning content. The content must be delivered in short units and should be supported with appropriate media types.

- Spatio-temporal factors involve organizing m-learning activity or interactions time- and location-wise. Some m-learning activities or contexts might be fixed in terms of time and setting while others might be adjustable to the learner's preferences or needs.

- Connectivity refers to wireless network access, through local wireless LAN, or over the mobile telephone networks and it enables the delivery of the content providing access to learning

resources. A lack of connectivity can cause disruptions to many mobile activities; therefore, it should be taken into consideration when designing m-learning (Naismith & Corlett, 2006).

The third dimension is the mobile interface design. Since, in mobile learning, the presentation mode can be verbal, pictorial, auditory, or mixed, the multimedia learning design principles proposed by Mayer (2001) provide a promising guide for the design of mobile learning environments. Referencing Sweller's (1994) *Cognitive Load Theory* (CLT) dealing with learning and problem-solving the difficulty, Mayer (2001) integrates different types of the cognitive load with his theory of cognitive processing in multimedia learning environments. According to Sweller (1994), there are three types of cognitive load: (1) *Intrinsic cognitiveload* is imposed by the basic characteristics of the information rather than by the instructional design. This intrinsic load depends on the complexity of learning material, the preexisting knowledge of the learner, and the number of elements to be processed simultaneously in working memory required for learning to take place. (2) *Extraneous cognitive load* is imposed by learning materials. Also described as ineffective cognitive load, it consists of required working memory load which is not directly related to the learning goal (i.e., searching for information to execute a task). (3) *Germane cognitive load* (also termed as effective cognitive load) refers to required tasks that contribute to learning rather than hindering it. When working memory capacity is free from intrinsic and extraneous load, cognitive resources are more efficiently exploited in the acquisition of knowledge and, in turn, learning (Sweller, 1994). As such, Mayer and Moreno (2003) classify three kinds of cognitive processing that learners are engaged in when learning takes place: extraneous cognitive processing (corresponding extraneous cognitive load) caused by confusing instructional design, essential cognitive processing required to represent the material in working memory and influenced by the complexity of material, and generative cognitive processing required for deeper understanding which can be affected by learner motivation.

Principles for reducing extraneous processing proposed by Mayer (2001)

1. **Coherence Principle**: People learn better when extraneous material is excluded. For the designs for large displays, it is advisable to remove any distractions (pictures, illustrations, videos, words, music) that are not relevant to the learning content and learning objectives (Levert, 2006).

2. **Signaling Principle**: People learn better when essential cues or words are highlighted. These cues guide learner's attention and processing during a multimedia presentation. Mobile learning content can be delivered with some essential and relevant cues or words highlighted on the screen to foster learning.

3. **Redundancy Principle**: People learn better from animation and narration than animation, narration, and text. On the mobile device, due to screen size, there is not enough space for lengthy texts without scrolling. Based on both the redundancy principle and the modality principle, it is preferable to have text narrated only. The drawback is that it may take extra time and space to download large audio files to a mobile device (Levert, 2006).

4. **Spatial Contiguity Principle**: People learn better when corresponding words and pictures are presented close together rather than far apart from each other. On a mobile device, the words and corresponding pictures should be aligned near each other on the screen (Levert, 2006).

5. **Temporal Contiguity Principle**: People learn better when corresponding narration and animation are presented simultaneously rather than successively. In mobile learning, popup text or caption labels to illustrate an action or a state depicted in pictures can be used. Clark and Mayer (2008) state that better results can be obtained when feedback is provided on the same page as the exercise or question. It is not advisable to direct a learner to a new window for feedback since separating the elements of learning may hinder learning, creating a cognitive overload.

Principles for managing essential processing proposed by Mayer (2001)

1. **Segmenting Principle**: People learn better when a multimedia presentation is given in user-paced segments rather than as a lengthy and continuous unit.For mobile learning, instructional materials must be organized in a way user can easily manage and control pacing according to his or her preference through the use of a Start/Stop button or Pause button, which yields more effective learning than the material that is presented from beginning to end does (Mayer & Chandler, 2001).

2. **Pre-training Principle**: People learn better from a multimedia presentation when they already know the names and characteristics of key concepts. The mobile device users can be provided with some fundamental concepts before the course or activity to activate their preexisting knowledge which creates connection and fosters learning. The concepts can be provided in textual, auditory or pictorial modes depending on the content.

3. **Modality Principle**: People learn better from pictures with spoken text rather than pictures with printed text. Today audio may be integrated into content and delivered by means of mobile devices, (i.e., podcasts). Using audio to deliver information can economize display capacity for other types of content (text and graphics). Using words in audio format instead of visual text on the screen is effective in simultaneous presentation of graphics and words. However, when there is a need for memorization of a procedural task or complex formulas, written words may be necessary. The modality principle for m-Learning can manifest itself as using audio instead of text where possible and keeping narration (audio) short and easy to download.

Principles for fostering generative processing proposed by Mayer (2001)

1. **Multimedia Principle**: People learn better from words and pictures than from words alone. This enables people to make connections between verbal and pictorial data presentations.In mobile learning, this means creating a small chunk of text and pictures as data. However, the screen size limitation of mobile devices and the resolution quality of pictures needs to be taken into consideration (Levert, 2006).

2. **Personalization Principle**: People learn better from a multimedia presentation when words are presented in a conversational style rather than a formal style. On mobile devices, by using first or second person constructions in a m-learning course or activity rather than only third person constructions creates a more conversational style increasing the feeling of social presence. One can also add a direct comment by an agent (animation or video) that is tagged along with the learner during the course of learning. When there is space limitation, an audio agent might work as an alternate to a video agent. The agent should pop up and then hide when it is done (Levert, 2006).

These design principles can offer insight or guidelines on how to efficiently optimize and exploit mobile learning in parallel with the goals of a particular implementation.

Mobile-Assisted Language Learning

With the availability of the web and telecommunication technologies and the advent of mobile devices, there has been growing interest in partaking in language learning in a more flexible manner. This approach is known as Mobile-Assisted Language Learning (MALL). MALL has evolved from Computer-Assisted Language Learning (CALL) and m-learning. It differs from CALL for its personal use and portability across different contexts. However, it mirrors m-learning as they both focus on contextualized learning, flexibility and active community participation of the learner. Additionally,

MALL exploits key mobile technologies for language learning such as pocket electronic dictionaries, personal digital assistants (PDAs), mobile phones, MP3 players, and tablet PCs (Zhao, 2005, p. 447). Research on using these devices for language learning has dominated the MALL literature, with the findings as to how and to what extent language learning is supported with m-learning. It has been shown that these technologies provide a number of "authentic", "relevant" and "contextual" language learning experiences (Chinnery, 2006, p. 9; Gilgen, 2005, p. 39; Kukulska-Hulme, 2006, p. 123, respectively). Additionally, they provide online environments for learning within a community and sharing resources with others, providing immediate and flexible ways of acquiring a new language (Kukulska-Hulme, 2010).

Language learning has been growing in demand in line with new societal challenges such as the rise of multicultural and multilingual communities and the increase in human mobility (i.e., immigration) due to globalization. The ability to communicate both appropriately and meaningfully with the users of other languages is the principal aim of language learning; however, classic means of learning a language in a predetermined setting and schedule is a limited option. With the intense penetration of technology into our lives, and the popular use of applications running on mobile devices for training, learning and educating, a new digital means (i.e., mobile phones) has integrated mobile learning with language learning. Although there are challenges and design concerns with mobile learning ways of meeting those challenges and concerns are being worked out (Kukulska-Hulme, 2010).

Kukulska-Hulme (2010) has described the concept of MALL within three contexts, the last two of which were also mentioned in the study by Kukulska-Hulme, Traxler, and Pettit (2007): the community as context (i.e., formal and informal education setting), a teacher-driven context ("formally designed") and a learner-driven context ("user-generated"). In each of these contexts, there is the mode of participation (regulated or self-regulated), the model of use (teacher-directed or autonomous), and the model of participation (through specified or proposed teaching activity) through MALL. The concept of MALL can be viewed as a process on the continuum ofteacher-driven versus learner-driven learning. The dimensions of language learning, particularly learner participation in the language learning activities and the use of language, are integrated into m-learning on this continuum (see Figure 2).

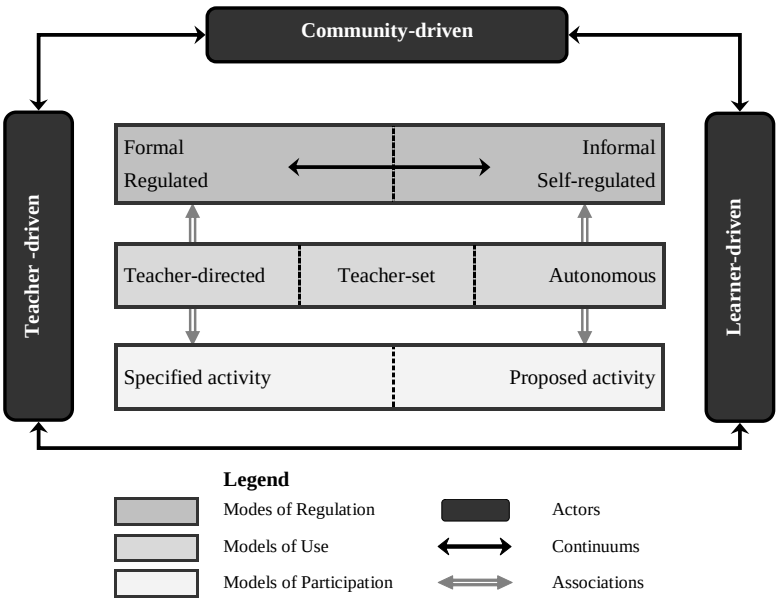

Figure 2. Continuum and associations between modes of regulation and models of use & participation in a MALL environment.Adapted from Kukulska-Hulme et al. (2007), and Kukulska-Hulme (2010).

The MALL programs may employ a number of different learning activities with respect to the learning curriculum. The roles of actors (learners and teachers) in the design of the MALL activities is specified explicitly and placed on the continuum. Though the interaction among learners in a formal setting is not mentioned in the framework by Kukulska-Hulme (2010) and it is not discreetly visible, the role of other people (i.e., peers, colleagues) in language learning and the effect of social interaction on language learning are undeniable. Because the community basically serves to reinforce language learning through social interactions (i.e., peer-to-peer or groups of learners), the community-driven dimension is vital in a MALL context where directing or setting up activities can be the responsibility of the peer group rather than of the teacher and learner solely. As community interaction mediates the teaching and learning in the MALL context, it takes place on a two-end continuum. In the first dimension in the continuum, there is a blend of formal and informal language learning, where mobile learning opportunities of language learning are provided but with a fluid degree of independence for the learners. The formal language learning requires regulation of the process of learning, whereas, informal learning does not necessitate the regulation by other actors, but by the learner himself only. The process is, therefore, self-regulated and learners are autonomous in their learning of language in general. The model of use is a crucial point to conceptualize in MALL. In the second dimension, there are three models of use in the framework (see Fig. 2). The first model of use is teacher-directed activity, where teachers control pace, time and setting as well as learning objectives and outcomes. Learners are not independent but directed by teachers to participate in MALL activities. This model is associated with formal and regulated learning on the continuum. The teacher-set activity model is the second model of use, where the teacher sets the task and expected outcomes but the process and the outcome depends upon the learner's individual needs, ideas and initiative. The third model of use is autonomous learning activity, where the learners are all free to use a mobile device to learn language content or to be involved in language learning activities based on their own personal interests, and curiosity. This is associated with informal and self-regulated learning on the continuum. In the third dimension, there are two kinds of participation model in a MALL process: specified activity model and proposed activity model. In a specified activity model, the learner is provided with multimedia materials or interactive exercises for use on their own mobile device or devices provided by the institution. This specification is associated with teacher-led or set activities models. The aim is to encourage learners to learn on their own through a specified and scheduled activity; the drawback is that learners are expected to engage in the activities but there is no certainty that he or she will utilize them fully especially outside of classroom setting. For example, students can listen to a podcast, review the meaning and pronunciation of the words in the text and do the multiple question tests and get the feedback. The setting is of no importance, they can participate at any place at their convenience. In the proposed activity model, participation is not required but supportive for learning and the learners can choose to take part in extracurricular language learning and they may collaborate with others while doing so. An example could be downloading a podcast, listening and doing the related activities and working with others to complete the task. As such, the proposed activity model is associated with both teacher-set and autonomous learning activity models on the continuum.

MALL studies can be categorized in terms of approaches: content and design and learner need. Content-Based MALL studies focus on the development of language learning materials and activities. Specifically, they focus on the formal context that is relevant to language learning. Certain aspects of language learning through mobile devices have been examined: vocabulary learning via PDAs (Song & Fox, 2008) and language skills such as L2 writing via mobile phones (Li & Hegelheimer, 2013), L2 reading via PDAs (Chang & Hsu, 2011), pronunciation practice (Arashnia & Shahrokhi, 2016; Saran, Seferoğlu, & Çağıltay, 2009) and grammatical accuracy via mobile phones (Baleghizadeh & Oladrostam, 2010). More content-based MALL studies, particularly on L2 listening and vocabulary learning, are reviewed in the following section in detail. All of these studies noted the effectiveness of using mobile devices to learn a second/foreign language, concluding that MALL is a viable option for language learning. However, some of them acknowledge certain limitations such as the small

screen sizes of mobile phones and the cost of SMS (Begum, 2011; Clarke, Keing, Lam, & McNaught, 2008), and the lack of oral interaction and collaboration with others (Kukulska-Hulme & Shield, 2008). The focus on content being a one-way teacher to student communication, rather than among peers or other groups through MALL is pedagogically traditional even as it encompasses emerging technology. Kukulska-Hulme (2009) proposed taking a "move beyond a superficial understanding of the field and focus more on how mobility, accompanied by digital, location-aware technologies, changes learning". This could be achieved by first investigating how mobile tools are actually used by learners in the learning process (Stockwell, 2010), and how the learners` needs are taken into account when creating content (Bayyurt & Karataş, 2011).

The design and learner need approach is taken into account and acknowledged in some studies. These studies are different from those with a content-based approach, where students are provided materials designated by teachers. Rather, these studies focus on students` active participation in L2 language learning. A study on personalized MALL conducted by Chen and Hsu (2008) is an example of personalized language learning for the promotion of reading skills in L2. They propose a personalized intelligent mobile learning system (PIMS) which can estimate learners` reading abilities individually and then recommend appropriate English news articles to the individual learners based on their feedback responses. Unknown vocabulary in the articles can then be explored automatically. The study confirmed that matching the articles according to the proficiency of the students and providing unknown vocabulary to the learners in context promotes learners` L2 reading comprehension. Two other examples of a learner-generated vocabulary content in an authentic environment have been given by Wong and Looi (2010), and Hasegawa, Ishikawa, Shinagawa, Kaneko, and Mikakoda (2008). They have reported the learning effects from learners` augmenting their own vocabulary learning by using their favorite images or movies with their peers. Student-created materials ensure authenticity and social collaboration for learning, and foster language learning through individual and social contexts. There should be more work to improve student motivation and instill enthusiasm to create their own materials either on their own or with peers. Challenges of the design and learner needs approach included students' accepting the new patterns of learning (Stockwell, 2008) and learners' lack of preparedness for autonomous language learning (Hoven & Palalas, 2011).

Previous MALL Studies

There have been a number of MALL studies published over the last decade. These studies have exploited various mobile devices such as handheld devices, cell phones, mobile phones, PDAs, iPads, and mobile applications targeted towards language learning. MALL research has explored the effectiveness of mobile language learning in relation to: the effects of short-term memory and content representation on MALL (Chen, Hsieh & Kinshuk, 2008), users' attitudes towards experience with MALL (Nah, White, & Sussex, 2008), enhancement of language learning by the use of supportive mobile devices (Allan, 2008; Brown, Castellano, Hughes, & Worth, 2012; Gabarre &Gabarre, 2010; Gromik, 2012; Palalas, 2009; Palalas, & Olenewa, 2012), MALL and language learner autonomy (Lyddon, 2016),learners' self-directed use of mobile devices beyond the classroom (Botero, Questier & Zhu, 2018; Lai & Zheng, 2017), collaborative learning (Lan, Sung & Chang, 2007; Lin, Liu, & Niramitranon, 2008), the use of mobile phones for the oral assessment of speaking skill (Cooney & Keogh, 2007; Demouy, Eardley, Shrestha, & Kukulska-Hulme, 2011), mobile assisted oral feedback (Xu & Peng, 2017) the design of MALL for English for Specific Purposes (Hoven & Palalas, 2011), model design for applications for L2 English learners (Ruan & Wang, 2008), use of iPad applications for young learners (Yıldız, 2012) and the effect of MALL on grammatical accuracy (Baleghizadeh & Oladrostam, 2010; Castañeda & Cho, 2016,Liu & Chen, 2012).

A remarkable volume of MALL studies focuses on language skills and vocabulary learning. For example, a volume of studies exist on: the positive effect of MP3 L2 English lessons on oral skill development (Al-Jarf, 2012) and of iPad on speaking skills (Montaga, 2018), the descriptive

specifications of speaking activities on mobile phone for improving English speaking skills (Tuttle, 2013), the effectiveness of web-based translation-annotation application on PDAs for improving L2 English reading comprehension (Chang & Hsu, 2011; Hsu, He, & Chang, 2009), the use of mobile devices to facilitate writing sentences including providing vocabulary, sample sentences, phrases (Hwang, Chen & Chen, 2011), use of iPod for reading fluency (Papadima-Sophocleous, Georgiadou, & Mallouris, 2012).

The studies have focused on the comparison of e-dictionaries and paper dictionaries in terms of reading comprehension and vocabulary retention (Kobayashi, 2008; Koyama & Takeuchi, 2004, 2009), spelling exercises and teaching pronunciation through mobile phones (Arashnia & Shahrokhi, 2016; Butgereit & Botha, 2009; Saran, Seferoğlu, & Çağıltay, 2009; Zhang, 2012), the effect of using SMS versus printed dictionary on academic vocabulary retention (Alemi, Sarab, & Lari, 2012), learning idioms through mobile phones (Amer, 2010), the effect of SMS on learning collocations (Motallebzadeh, Beh-Afarin, & Daliry Rad, 2011), vocabulary learning through SMS (Azabdaftari & Mozaheb, 2012; Başoğlu & Akdemir, 2010; Li, Cummins, & Deng, 2017), the affective role of mobile phones in language learning (Clarke, Keing, Lam, & McNaught, 2008; Çavuş & İbrahim, 2008; Kennedy & Levy, 2008), text messaging and interactivity on vocabulary learning (Kim, 2011), content presentation modes (either listening with auditory message only, or listening with auditory and written messages) on PDAs and proficiency on listening comprehension (Chen & Chang, 2011), students' language learning experiences with their own portable devices for additional listening and speaking practice within a language course (Demouy & Kukulska-Hulme, 2010), listening and speaking skills in mobile game-based learning environment (Hwang, Shih, Ma, Shadiev, & Chen, 2016), students' attitudes about using a mobile phone to access wireless application protocol (WAP) sites for L2 listening comprehension (Nah, White & Sussex, 2008), students' engagement in L2 extensive listening practice outside the class through podcasts on mobiles (Reinders & Cho, 2010), and the effects of multimedia glosses on second language listening comprehension and incidental vocabulary learning in a mobile environment (Çakmak & Erçetin, 2018).

Conclusion

The current paper discussed the concept of MALL in association with learning theories and challenges, presented a conceptual framework of MALL design principles and dimensions adapted from previous studies, and finally reviewed existing MALL studies. As MALL has long been recognized as an area of research in language learning contexts and MALL studies are being published with increasing frequency, which has "shed a very positive light on the potential of the role that mobile devices may play" (Stockwell & Hubbard, 2013, p. 2), the conceptual framework, language learning process and outcomes have been explored in the studies. The studies undoubtedly contribute to the field of MALL research with their comprehensive focus on the applications of MALL in language classes. Some of them highlighted the fact that it is of great importance for m-learning partakers such as learners, teachers, researchers, content developers and designers to be well aware of pedagogical and technical issues underlying effective MALL implementations (Burston, 2014; Chinnery, 2006; Reinders & Pegrum, 2015; Stockwell & Hubbard, 2013). To fully realize the potential of MALL, there should be a strong harmony between pedagogical methodology and technological opportunities in future research of MALL (Burston, 2014). The framework of MALL design principles and dimensions proposed in this paper can help build such integration when developing and realizing MALL applications. Future MALL studies could be planned on deploying emerging mobile platforms and applications for the long-term implementation of MALL studies where technology access and pedagogy has been congruent, and also on reviewing quantified learning outcomes of MALL.

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