

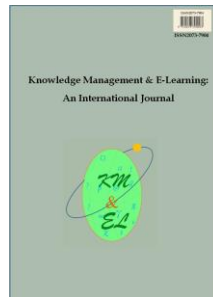
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**Impacts of mobile technologies, systems and resources on language learning: A systematic review of selected journal publications from 2007-2016**

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## **Impacts of mobile technologies, systems and resources on language learning: A systematic review of selected journal publications from 2007-2016**

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**Abstract:** This study examined the mobile-assisted language learning studies published from 2007 to 2016 in selected journals from the aspects of adopted mobile devices, mobile learning systems/resources, and the benefits and challenges of utilizing mobile devices or learning systems/resources. The results revealed that the traditional mobile devices (e.g., Personal Digital Assistants, PDAs) and the current popular mobile devices (e.g., smartphones and tablet PCs) were frequently adopted for language learning in different time periods, while wearable devices have not been adopted by any language learning research so far. In addition, most of the studies used researcher-developed learning systems/resources, while the use of educational affordances of free applications or resources needs to be promoted. Furthermore, the abundant benefits of using mobile devices or mobile learning systems/resources for language acquisition were found in many studies, such as providing substantial chances for learning, and providing or building authentic environments for learners' meaningful knowledge construction; on the other hand, the studies also reported several challenges (e.g., insufficient practice time and the lack of effective learning strategies) to be overcome in the future. Finally, several suggestions are provided for researchers or practitioners to conduct their future work.

**Keywords:** Mobile technologies; Language learning; Mobile learning; Literature review; Trend analysis

**Biographical notes:** Dr. Qing-Ke Fu is currently a lecture at the School of Teacher Education in Huzhou University, China. His research interests include trend analysis, digital game-based learning and mobile learning.

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### **1. Introduction**

In the past decade, mobile technology has exhibited its great benefits during the teaching process (Cavus & Ibrahim, 2009; Hwang, Shi, & Chu, 2011; Lai & Hwang, 2015). It has become increasingly pervasive to apply mobile technology in language acquisition activities (Burston, 2015; Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Sandberg, Maris, & de Geus, 2011). In the meantime, researchers have attempted to investigate the characteristics of different mobile technologies (e.g., mobile phones, PDAs, tablet PCs) as well as the functionalities they provide (e.g., presenting text, pictures, and videos) for language learning (Burston, 2014; Kukulska-Hulme & Shield,

2008; Wu et al., 2012). Several researchers have further reported positive outcomes of mobile learning (Abdous, Camarena, & Facer, 2009; Liu, 2009; Wu et al., 2012). To sum up, mobile technologies have made a vital contribution to the development of mobile language learning.

Due to the rapid evolution of mobile language learning, several studies have tried to systematically investigate mobile technology-supported language learning from the various aspects of MALL. For example, Hwang and Tsai (2011) reported the rapid growth of the research on language learning after reviewing the literature in selected Social Science Citation Index (SSCI) journals from 2001 to 2010. Duman, Orhon, and Gedik (2015) reviewed the studies published in the SSCI journals from 2000 to 2012 and reported that 41% of the target studies (n=29) used cell phones, followed by 24% which utilized PDAs, and used diverse features, such as SMS (14 %), GPS (9%), MMS and Wi-Fi (7%), and so on, to deliver learning materials. Wang, Liu, and Hwang (2017) announced the trend of ubiquitous language learning in museums, from individual learning in 2009-2011 to ubiquitous location-aware learning in 2012-2014.

In addition, Yang's (2013) is one of the few studies reviewing the research on mobile assisted language learning from 2005 to 2013. The study analyzed the pedagogical benefits of various emerging mobile technologies such as short message service (SMS), instant message (IM), microblogging, and augmented reality. Golonka et al's (2014) is another study that examined the effectiveness of various types of technologies for foreign language learning, such as course management systems, interactive white boards, electronic dictionaries, intelligent tutoring systems, chat forums, wiki, and mobile/portable devices via reviewing over 350 published studies. In this early review study, they found that only one study adopted tablet PCs, which engaged students in more reading and collaborative behaviors, and no study tried to explore the effectiveness of iPods. In addition, the research that adopted mobile phones primarily used its Short Message System (SMS) feature to support students' language learning, and some of these studies reported significant effects of the SMS groups on immediate tests of vocabulary learning compared to the groups learning with the Web and paper; however, practice of vocabulary via SMS usually consumes more time due to the limited screen size of mobile phones.

It was found that most review articles intended to analyze the trends of mobile-assisted language learning from various dimensions; however, the issues regarding the impacts of mobile technologies and resources on language learning were seldom investigated in depth. Researchers have pointed out that the adoption of mobile devices, mobile learning systems, or resources might play an important role in language learning (Hwang, Tsai, & Yang, 2008). Therefore, this study aimed to investigate the trends of MALL from the aspects of mobile devices and mobile learning systems/resources. Accordingly, the salient benefits and challenges of utilization of mobile devices and mobile learning systems/resources were analyzed based on empirical evidence reported in the publications in selected SSCI journals from 2007 to 2016. It is expected that, via answering the following research questions, helpful suggestions can be provided for future research and educational practices:

- (1) What was the development situation of mobile assisted language learning in terms of learning devices from 2007 to 2016? What were the development trends in the second (2012-2016) period when compared to the first (2007-2011) period?
- (2) What was the development situation of mobile assisted language learning in terms of learning systems/resources from 2007 to 2016? What were the

development trends in the second (2012-2016) period when compared to the first (2007-2011) period?

- (3) What were the benefits and challenges when mobile devices and learning systems/resources were used for language learning?

## **2. Method**

### *2.1. Data collection*

With the intention of ensuring the quality of empirical evidence, the top 10 SSCI journals related to technology-enhanced learning and technology-enhanced language learning were selected based on the statement that SSCI journals have higher impacts in the field (Duman et al., 2015; Hwang & Tsai, 2011). These 10 journals are *Computers & Education* (C&E), the *British Journal of Educational Technology* (BJET), *Interactive Learning Environments* (ILE), *Educational Technology & Society* (ETS), the *Journal of Computer Assisted Learning* (JCAL), *Educational Technology Research and Development* (ETR&D), *Computer Assisted Language Learning* (CALL), *ReCALL*, *Language Learning & Technology* (LLT), and *System*.

Meanwhile, the search terms were identified as ("mobile" or "ubiquitous") and ("language learning" or "literacy learning"). The types of target papers were restricted to "article", and the time span was limited to 2007-2016. A total of 114 papers were found as a result of the search.

To narrow down the selected papers for the review, the inclusion criteria were identified as follows: the target papers for review must be closely related to mobile-assisted language learning; to be more specific, they must include mobile language learning activities, survey and/or correlational analysis of mobile language learning, and the development (and evaluation) of mobile language learning systems/resources; publications such as review articles, position papers, commentaries, editorials and so on were excluded from this review. After screening and negotiation by two data analysts, 86 papers were included in the review.

### *2.2. Coding scheme*

In this current study, the coding schema is used for analyzing the content of these target papers, including the mobile devices, mobile learning systems/resources, language acquisition, and measured result.

Based on the coding of Wu et al. (2012), mobile devices are coded into seven sub-items, namely Tablet PCs, Smart phones, Traditional mobile devices (e.g., notebooks, PDAs), Wearable devices, Mixed/varied, No use of devices, and Not-specified. "Mixed/varied" refers to more than one type of mobile device being used in the research, and "No use of devices" indicates that the research does not include language learning activities, and hence no mobile device is used (e.g., review papers or the studies relating to the investigation on students' perceptions of MALL).

Mobile learning systems/resources refers to the software, system, or resources designed and/or used for mobile language learning. In this dimension, there are seven coding items, namely Researcher-developed mobile system, Free applications (apps) or systems, Commercial apps or systems, Web resources, Mixed/varied, No use of systems

or resources, and Not-specified. “Mixed/varied” refers to more than one type of learning system/resource being used in the research, and “No use of systems or resources” means that the study did not intentionally use any learning systems or resources.

Language acquisition refers to the language areas measured, and includes listening, speaking, reading, and writing, while measured result indicates the result of measurement on language acquisition, consisting of positive, negative, and no significant difference.

### *2.3. Coding procedure*

After the coding schema was identified, two groups of data analysts received the explanation of the coding schema by the researchers, then each group began to encode the 86 papers independently. When the preliminary encoding work was over, the researchers and data analysts discussed and negotiated the inconsistent coding items until they were identical, thus completing the coding procedure.

## **3. Results**

### *3.1. Trends of mobile devices*

This section indicates the current situation and growing trends of mobile devices and applied systems/resources in mobile language learning in the period 2007 to 2016. To be more specific, the study also investigated the trends in mobile devices and applied systems/resources in the first (2007-2011) and second (2012-2016) 5-year periods of this decade.

As shown in Table 1, in the past decade, traditional mobile devices were most used for mobile learning (34.9%), smart phones ranked second (24.4%), tablet PCs and mixed/varied devices ranked third (both 9.3%) without considering “Not-specified”; there was no application of wearable devices in language learning in these 10 years.

In respect of the growing trend, firstly, a larger number of smartphones and tablet PCs were involved in language learning in the second (2012-2016) period compared to the first (2007-2011). At the same time, traditional mobile devices significantly decreased (from 80% to 16.4%) in the second period, reflecting the strong motivation to apply new technologies and their functionalities in language learning.

Secondly, the growth of mixed or varied devices (from 4.0% to 11.5%) indicates that there was a more obvious trend that different mobile devices were applied simultaneously in a specific language learning activity in the second (2012-2016) period. This reveals that learners began to use their own mobile devices in learning activities (because usually the learning devices provided by educational institutes are the same), demonstrating that the ownership of mobile devices is beneficial to the realization of learners’ autonomy. Finally, the considerable growth in “no use of devices” implies that, apart from teaching activities, researchers started to broadly focus on more issues related to mobile language learning in the second period, for example, developing a situation-driven mobile tutoring system for learning languages and communication skills (e.g., Khemaja & Taamaallah, 2016), EFL (English as a foreign/second language) students’ perceived benefits of mobile learning and their use behaviors (e.g., Dashtestani, 2016), and EFL students’ attitudes and perceptions of their ubiquitous learning process (Garcia-Sanchez & Lujan-Garcia, 2016).

**Table 1**  
Descriptive statistics of mobile devices in the selected studies

	Total	2007-2011	2012-2016
	n (%)	n (%)	n (%)
Smart phones	21 (24.4)	4 (16.0)	17 (27.9)
Tablets PC	8 (9.3)	0 (0.0)	8 (13.1)
Traditional mobile devices (e.g., notebook, PDA)	30 (34.9)	20 (80.0)	10 (16.4)
Wearable devices	0 (0.0)	0 (0.0)	0 (0.0)
Mixed/varied devices	8 (9.3)	1 (4.0)	7 (11.5)
No use of devices	7 (8.1)	0 (0.0)	7 (11.5)
Not-specified	12 (14.0)	0 (0.0)	12 (19.7)
Total	86	25	61

3.2. Trends of learning systems/resources

With regard to learning systems/resources, Table 2 shows that most studies developed and utilized their own learning systems to satisfy the needs of specific learning activities (48.8%), while only a few studies used existing apps, systems, or resources. By comparing the ratio of learning systems/resources adopted in the first (2007-2011) period, it was found that the studies using researcher-developed mobile systems decreased noticeably (from 68.0% to 41.0%), while there was a large increase (from 4.0% to 14.8%) in the use of free apps and systems in the second period (2012-2016). This implies the trend of developing and using free or commercial apps based on educational requirements.

**Table 2**  
Descriptive statistics of learning systems/resources in the selected studies

	Total	2007-2011	2012-2016
	n (%)	n (%)	n (%)
Researcher-developed mobile system	42 (48.8)	17 (68.0)	25 (41.0)
Free apps or systems	10 (11.6)	1 (4.0)	9 (14.8)
Commercial apps or systems	4 (4.7)	1 (4.0)	3 (4.9)
Web resources	5 (5.8)	2 (8.0)	3 (4.9)
Mixed/varied	7 (8.1)	1 (4.0)	6 (9.8)
No use of systems or resources	10 (11.6)	1 (4.0)	9 (14.6)
Not-specified	8 (9.3)	2 (8.0)	6 (9.8)
Total	86	25	61

### 3.3. The measurement of language acquisition

According to the data in Fig. 1, among the studies measuring listening skills, 60.0% reported positive results and 40.0% reported no significant difference; as for speaking, 83.3% reported positive results and 16.7% reported no significant difference. In addition, 80.0% of the measurements of reading skill reported positive results, while 20.0% reported no significant differences. The only two studies measuring writing skills reported positive results. It was concluded that although mobile learning could generally benefit students' acquisition of language skills, there was still room for improvement. For instance, Huang, Liang, Su, and Chen (2012) developed an interactive e-book learning system on tablet PCs; however, the students learning with the developed system did not outperform those learning with printed books in terms of reading accuracy. They concluded that merely transforming the printed materials for children into digital contents did not make good use of the interactive features of e-books; moreover, failing to taking into account the childrens' reading behaviors and difficulties could be another reason for such a disappointing result.

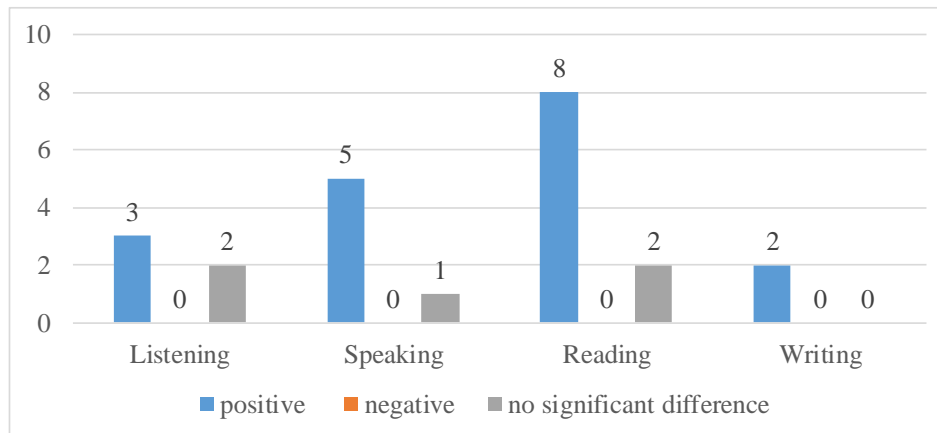


Fig. 1. The result of measurement of language acquisition

## 4. Discussion and conclusions

### 4.1. Mobile devices adopted in educational settings

In the last decade, traditional mobile devices (e.g., PDAs) in early times and the current smartphones and tablet PCs, with their features of portability, social interactivity, context sensitivity, connectivity, and individuality (Klopfer & Squire, 2008), have provided language learners with another new type of learning approach different from traditional learning and the web-based learning usually supported by desktop computers. For example, PDAs with Radio-Frequency Identification (RFID), and smartphones with Global Positioning System (GPS) have made context-based learning outside the traditional classroom a typical application of mobile technologies (Hwang et al., 2008; Hwang, Tsai, Chu, Kinshuk, & Chen, 2012). To be more specific, in respect of taking advantage of mobile devices to support language acquisition, Cavus and Ibrahim (2009) sent vocabulary learning materials from a PC to a traditional mobile phone via the Bluetooth interface, and then the phone sent learning materials in the format of SMS text messages to learners' traditional mobile phones. Huang, Yang, Chiang, and Su (2016)

made use of smartphones with GPS to help fourth-grade students learn in a situational English vocabulary learning environment. Ahn and Lee (2015) utilized speech recognition technology in smartphones to assist students in interacting with mobile devices and other learners in a virtual life environment, improving students' speaking proficiency. This implies that, no matter whether using traditional mobile devices or new types of smart mobile devices, they have something in common; that is, mobile language learners can decide by themselves to learn anytime and anywhere (Liu, 2016). This novel learning approach has attracted a great deal of attention, to some degree also because of the urgent need to implement the learner-centered learning theory, advocated by current education reformers.

Differing from traditional mobile devices such as PDAs and cell phones, smartphones and tablet PCs, as a symbol of smart mobile devices, provide better support for content delivery, language input and output, social interaction and the construction of authentic learning environments as a result of better and stronger portability, computability, interactability, and emerging functionalities (Sun & Cheng, 2002; Cheng, Hwang, Wu, Shadiey, & Xie, 2010). Also, since smart mobile devices are extensively used (including by learners in school), the mobile device ownership of learners has been particularly highlighted and strengthened, which has promoted the extensive use of smartphones and tablet PCs in language acquisition (Agbatogun, 2014). Furthermore, they started to replace the important position of PDAs as the representative of traditional mobile devices in mobile language learning in the second (2012-2016) period. However, wearable devices are likely to be the learning tool of the next generation in education following smartphones and tablet PCs (Viseu, 2003). Bower and Sturman (2015) analyzed the opinions of some educators and literature, and identified 14 affordances of wearable technologies, for example, in situ contextual information, recording, simulation, first-person view, communication, feedback, engagement, presence, and so forth. Their findings implied that wearable devices could strengthen and expand the pathway of information input and output, thereby ideally allowing for the construction of enhanced, immersive, and interactive learning contexts for language acquisition, which could assist in conducting language acquisition outside the classroom in one's leisure time; as such, merging language acquisition into daily life would be truly possible.

#### *4.2. Learning systems/resources*

It was discovered that most of the research utilized systems and resources developed by the researchers themselves. In a study by Chang and Hsu (2011), a synchronously collaborative translation-annotation system based on PDAs was developed to enhance university students' reading comprehension, which produced positive learning effects. Furthermore, Ali, Segaran, and Hoe (2015) proposed a 3D Talking-head with spoken text and on-screen text learning system based on tablet PCs to assist college students in correcting their pronunciation, and obtained satisfactory results. As shown in these two representative studies, most of the researchers chose to develop the system or resources on their own in view of the need to integrate specific learning strategies or treatment objectives.

However, with the development of mobile technology, new technology devices such as smartphones and tablet PCs were used extensively in recent years; commercial and free applications or resources based on these devices were largely available on the market. This corresponded to a substantial increase in the research based on free systems or software in the second (2012-2016) period, even though the quantity of such research was still limited, which still revealed some remarkable benefits. For example, Mompean



and Fouz-Gonzalez (2016) made use of Twitter in an attempt to enhance the online participation of EFL learners at a language school in Spain and to correct their pronunciation of vocabulary which they often mispronounced, and received positive results. In addition, in Liu's (2016) study, Instant messaging (IM) was used to send English vocabulary, and then students learned the vocabulary through constructed concept-mapping. The results implied that those students who adopted constructed concept-mapping outperformed those who used IM or text-only. It is concluded that based on the consideration of saving manpower, materials and money, and helping more learners, more research should investigate the educational affordances of free applications or resources on the market for language learning, especially the educational value of social interactive free software (e.g., Facebook, Twitter), which is extensively used and highly popular among teenagers. These studies should also develop corresponding teaching strategies and assist learners in enhancing their language learning achievements by making full use of the educational affordances of these free apps or resources.

#### *4.3. Benefits and challenges of the utilization of mobile devices and learning systems/resources*

In this section, the benefits and challenges of using mobile devices and learning systems/resources for the learning of listening, speaking, reading, and writing in the target studies, are discussed on the basis of the measurement of the four language skills.

Listening and speaking ability are the core elements of communication, but foreign language learners usually lack the authentic environment that native learners possess, and also lack verbal and aural practice (Cohen, 2012; Hwang, Shih, Ma, Shadiev, & Chen, 2016). Thus, Liu (2009) constructed a sensor and augmented reality (AR)-supported ubiquitous learning environment. Students made use of this learning system to obtain contextual learning materials on campus, had a conversation with a virtual learning tutor, collaborated with peers to tell a story, and reported positive results in the aspects of listening and speaking.

Hwang et al. (2016) constructed a game-based jigsaw game to assist students in reading out loud sentences by organizing cards in daily life, and mutually practiced speaking and listening through the game with the help of peers. The results revealed that the experimental group students who learned in the game-based jigsaw activities significantly outperformed the control group students who learned with traditional instruction methods; however, there was no significant difference between the two groups in terms of their listening performance. It is believed that the system provided abundant opportunities for students to practice speaking the sentences, but peers who listened to the sentences might match the vocabulary through guessing (because there were limited picture cards for each group). Therefore, there was not enough training offered by the system for the students to practice listening.

Kessler (2010) found that speaking fluency of graduate students when recording with mobile devices (MP3 player) was significantly better than those recording in the audio laboratory, owing to the fact that learners hold more flexibility for choosing their recording environments and then felt less anxiety when learning with mobile devices.

In a study by Willoughby, Evans, and Nowak (2015), they announced that junior kindergarten-age children learning the alphabet with alphabet e-books did no better than those learning with a paper alphabet book, due to the former spending more time activating the object hotspots rather than learning the alphabet. It was suggested that

adults should do some scaffolding work (e.g., parent-child interaction in shared book reading) to guide children's attention and engagement.

In order to support first-year university students' learning of TOEIC listening and reading outside of class using Nintendo Ds mobile, Kondo et al. (2012) designed a learning module, and the results revealed that the experimental group with the learning module significantly improved the reading performance, but did not show more improvement in the listening performance compared to the control group. The reason is that the participants spent more time reading than listening, and listening needs more time to practice.

Chen and Chang (2011) discovered that in a mobile listening comprehension activity based on PDAs, learning by dual mode (audio and textual input simultaneously) is beneficial to listening comprehension for all levels of language proficiency, compared to by single mode (auditory only); however, it was only helpful in decreasing the cognitive load of the group with lower proficiency.

Gromik (2012) conducted a case study to examine the effectiveness of the cell phone video recording feature to enhance university students' speaking skills, and reported a significant result after a pre- and post-test, indicating that mobile learning is beneficial to becoming an active producer of content by virtue of mobile devices' features.

In the aspect of reading skills, Chen, Teng, Lee, and Kinshuk (2011) found that delivery digital learning materials using QR codes cannot significantly improve their reading comprehension if they only provide them with a reading strategy (e.g., scaffolded questioning).

Huang et al. (2012) designed an interactive e-book learning system to enhance students' reading accuracy using tablet PCs, and found that students learning with the proposed learning system did not significantly outperform those learning with a printed book because the learning system failed to provide interactive learning resources other than the interactive components (e.g., annotation, bookmarking).

In another study conducted for improving reading comprehension, Chang and Hsu (2011) developed a synchronously collaborative translation–annotation system to mutually support learners to mark up and make annotations for unfamiliar vocabulary, which substantially enhanced the university students' reading comprehension. According to Harris and Sipay (1985), the process of reading consists of symbol decoding, vocabulary, comprehension, and reflection. It might hinder meaning construction, slow down the speed of reading, and then influence the reading performance if the learner is not able to understand the meaning of vocabulary while reading (Chang & Hsu, 2011).

In addition, there are some other studies listed as follows, which were conducted for promoting reading skills and reported positive results. Lan, Sung, and Chang (2013) developed a mobile-based cooperative EFL reading system to help teachers to execute learning materials and facilitate cooperative reading activities. Wang and Smith (2013) regularly delivered reading materials to students for learning via mobile devices, and increased their exposure to English and learning motivations, while also reporting some disadvantages of mobile learning such as their small screens for reading materials, and considering that mobile phones should be for personal life rather than for formal learning. Hemmi, Narumi-Munro, Alexander, Parker, and Yamauchi (2014) used the free Flipnote Studio software for Nintendo DSi and a course website to support language teaching activities for some dispersed students during a year-abroad programme. It was found that this approach improved their learning motivation and eliminated their fears in the process

of learning abroad. Lin (2014) announced that owing to the mobility and spontaneity offered by tablet PCs, the senior high school students using them spent more time, read more books, and made significant improvement compared to the PC group students, indicating that a teacher-directed and mobile-assisted reading approach is a useful strategy for engaging students more in learning.

As for writing skills, two studies demonstrated positive results. Hwang, Chen, Shadiev, Huang, and Chen (2014) designed a situation-based learning system to support primary school students to practice writing in familiar contexts; thus, the students learning by the proposed system were inspired to do more writing practice and were capable of writing more elaborated sentences. Andujar (2016) found that chat-based conversation in Mobile Instant Messaging could lead to the construction of knowledge and second language development as well, due to plenty of opportunities for interaction and feedback.

To summarize, these studies clearly conveyed the benefits of using mobile devices or mobile learning systems/resources in language acquisition; that is, learners could obtain substantial chances to learn anytime and anywhere, and it would also be easy to learn in a relatively flexible environment. If dispersed students are linked together in mobile learning activities, a learning community is easy to construct, and the students' learning motivation and enthusiasm would be improved. Besides, the multimedia in mobile devices strengthened learners' ability of handling information, and the interactive functions were beneficial for the training of language input and output. More importantly, mobile devices or learning systems/resources provide or build authentic environments for learners' interaction with learning contents (including other learners, teachers, physical objects, etc.) in real-life, in order to construct meaningful knowledge. When mobile devices or learning systems/resources are integrated with other technologies, such as educational games, AR, virtual reality (VR), abundant playful and meaningful learning opportunities are exposed to language learners. In addition, when learning with their own mobile devices, students are inclined to play the roles of active learners and content producers as well as knowledge acquirers.

In the meantime, there are some challenges which need to be overcome in the future. Aside from mobile devices' small screens and no surveillance of learning out of class, the most critical challenges include lacking enough practice, lacking appropriate teaching strategies to guide students to effectively use mobile devices and learning systems/resources, and failing to provide critical and pertinent learning components for specific learning outcomes when designing and developing mobile learning systems/resources.

#### *4.4. Conclusions and suggestions*

Based on the findings of this study, several conclusions are made, and suggestions are provided for future research and educational practices in the field of mobile-assisted language learning.

- (1) In the last decade, traditional mobile devices (e.g., PDAs) and the current popular mobile devices (e.g., smartphones and tablet PCs) have offered an innovative learning approach for language learners; especially, the popular mobile devices have demonstrated their potential in the last 5 years. The next generation of mobile devices--wearable devices--has not yet appeared in any research on language acquisition, but their potential educational value is worth focusing on and examining.

- (2) In terms of learning systems/resources, although the majority of researchers developed their own system or resources based on their specific research or educational aims, more free applications or resources were used in the studies in the recent 5 years with satisfactory outcomes. As a result, exploring the educational affordances of these free apps or resources and applied strategies is worthwhile and would be a valuable contribution to the field.
- (3) Abundant benefits of using mobile devices or mobile learning systems/resources for language acquisition were found in many studies such as providing substantial chances to learn anywhere and anytime, and providing or building authentic environments for learners to interact with learning contents in real life to facilitate meaningful knowledge construction. There are, however, some challenges that need to be overcome in the future, such as sometimes lacking appropriate teaching strategies to facilitate students' use of mobile devices or learning systems/resources effectively.

Therefore, several suggestions are proposed as follows:

- (1) Future studies should further explore the educational affordances of smartphones and tablet PCs in various teaching contexts (e.g., context-based learning), and pay more attention to the benefits of the integration of mobile devices with some educational technologies or approaches (e.g., AR, VR, or educational games). In the meantime, the benefits of wearable devices in language learning should be explored.
- (2) Researchers can develop their own teaching systems or resources for the purpose of conducting exploratory or confirmatory research, but more attention should be paid to how to effectively embed teaching strategies into the developed systems or resources. As for applied research, it should focus on the educational affordances and applied strategies of free language learning apps or resources on the market, especially the educational value of social interactive free software (e.g., Facebook, Twitter), which is extensively used and highly popular among teenagers.
- (3) It is important for teachers or researchers to design more learning activities and provide meaningful learning contents to engage learners in real-life situations for practicing language skills. Flipped classrooms could be a good approach to engage students in more in-class practice (Lai & Hwang, 2016). It is also important to design and construct mobile learning systems to connect in-class and out-of-class learning to cultivate a collective learning atmosphere, paying careful attention to the design and utilization of teaching strategies to effectively guide students to learn using mobile technologies.

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