Chapter 7
The Latest Technologies for Mobile Learning

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Abstract This chapter reviews the latest technologies and their applications in facilitating mobile learning in the new age of education. It introduces and explains the key functions of various technologies and discusses the possible challenges in their applications faced by users. The results provide insights into the planning and preparation for blended learning, with mobile learning integrated into the conventional way of curriculum delivery.

Keywords Mobile learning · m-learning · Blended learning

Introduction

The emerging mobile devices and innovations in communication technologies keep changing the daily lives of human beings and societies. The utilisation of smart phones and other handheld devices have also been extended to education, which has helped the development of mobile learning (m-learning) at different levels. For example, interactive and visual elements have been added to the teaching contents for primary school students through the use of tablets in order to make their learning more interesting; and discussion forums have been added to the mobile learning platforms which encourage adult learners to input, share and exchange their opinions for promoting a better peer learning environment. The recent developments in m-learning have also been integrated with other educational technologies such as 3D techniques (Zakota, 2019) and augmented reality (AR) (Kassim, Abdullah, & Sanusi, 2018). They have been adopted for various educational purposes, such as enhancing learners' self-regulation (Yun, Fortenbacher, & Pinkwart, 2019), digital storytelling (Hussain & Shiratuddin, 2019), and providing a situated, authentic and personalised learning experience (Ally & Prieto-Blázquez, 2014). No matter which

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target group is being served, stakeholders who are involved in "creating" a meaningful m-learning experience should be very familiar with the usage of the latest technologies and their effects and learning outcomes for learners.

This chapter aims to introducing the common and latest supporting technologies that are applicable in m-learning, with a main focus on how their functions contribute to a better learning experience for the end-users when compared with conventional learning.

Technologies Applied in M-Learning

In recent years, the rapid development of m-learning and its applications to support and facilitate a better learning experience for students has been mainly due to the continuous advances in mobile devices and the increasing use of wireless communication technologies. Examples of mobile devices range widely, including smartphones, PDAs, tablets, mobile media players, notebook computers and other similar handheld devices with high mobility for users (Duman, Orhon, & Gedik, 2015; Vrana, 2015). Although most of the devices are not purposely designed for mobile learning, their built-in features, such as cameras, video/media players, social media applications and WiFi connectivity—plus the flexibility of connecting and interacting with different kinds of interfaces and applications—have provided a favourable environment which has helped to inspire educators and academic bodies to integrate various mobile tools into their curriculum delivery.

As stated by Ferreira, Moreira, Pereira, and Natércia (2015), the applications of mobile technologies for education through the blended use of diverse approaches, systems and devices are being carried out in different parts of the world. Some examples of technologies that are extensively used in mobile learning include (1) the learning management system that can be operated not just on desktop but in a mobile environment; (2) the global positioning system (GPS) which enables the implementation of location-based learning; and (3) the technology of AR which further enhances the ease of learners in acquiring knowledge in reality by interacting with real objects. However, the examples quoted above, plus other peripheral technologies, do not "stand alone" in contributing to a meaningful learning experience for learners. Instead, it is more likely that there will be a blended use of different technologies and learning tools which make learning more "enjoyable" and "flexible" from the perspective of users (García-Peñalvo & Conde, 2015; Parsons, 2014; Tsinakos & Ally, 2013).

The following sections highlight key examples of m-learning technologies, and their functions which help to enrich the knowledge of educators and, at the same time, lead them to review existing practices in their teaching processes. The understanding of the latest m-learning technologies and their applications will help educators to further improve and add "value" to their curriculum delivery if the right m-learning technologies are selected.

Learning Management System

Used broadly by many educational institutions, a learning management system (LMS) is expressed in various forms, including "course management system" (CMS), "managed learning environment" (MLE), "learning support system" (LSS) and "virtual learning environment" (VLE) (Chung, Pasquini, & Koh, 2013; Saroha & Mehta, 2016). As an e-learning platform, LMS was originally designed for facilitating distance learning and the offering of various online learning courses in higher education which gave flexibility to students with an alternative choice of learning mode other than the conventional face-to-face learning (Gros & García-Peñalvo, 2016; Hung, Lam, Wong, & Chan, 2015; Navimipour & Zareie, 2015).

LMS Functions

As described by numerous scholars, the key functions of LMS cover the management and administration of courses and programmes; the provision of information and distribution of course content to students; tracking students' performance and status of learning; and enabling discussion and interaction among educators and students (Itmazi, Megías, Paderewski, & Vela, 2005; Konstantinidis, Papadopoulos, Tsiatsos, & Demetriadis, 2012). As further explained by Jurado (2013), an LMS enables both one-way and two-way communications, including teacher-to-student, student-to-teacher and student-to-student. Kasim and Khalid (2016) provided a more comprehensive description of LMS functions by categorising them into three different aspects: (1) learning skills tools, (2) communication tools and (3) productivity tools, as illustrated in Fig. 7.1. Typical examples of functions performed in different aspects are highlighted which project a clear picture of how educators or stakeholders can use the system for supporting and improving students' learning experience in real practices.

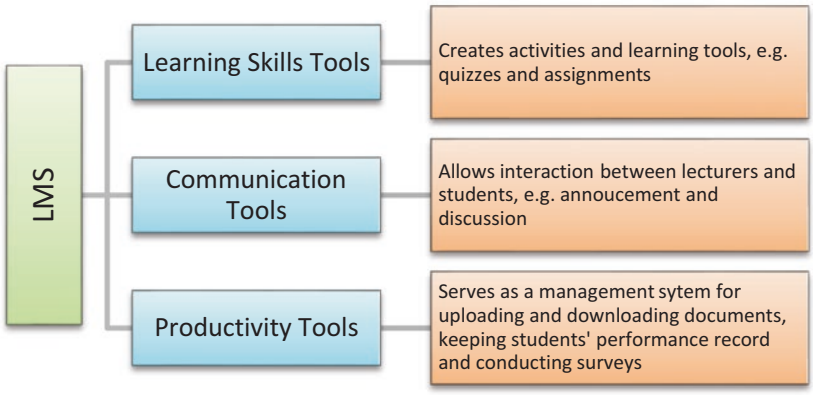

Fig. 7.1 Functions performed by a typical LMS (Kasim & Khalid, 2016)

Development of LMS: An Extension from E-Learning to M-Learning

Moodle, WebCT, Blackboard, ATutor, Carvas and Desire2Learn are common examples of LMS being used by institutions for supporting e-learning (Lu, Newman, & Miller, 2014; Madeira, Silva, & Palma, 2012). Due to the significant increase in the use of mobile devices by students nowadays, many existing LMS service providers have integrated and converted the original versions used in the desktop environment into a mobile-usable version—the "mobile learning management system" (m-LMS). As pinpointed by Hung et al. (2015), the majority of m-learning services available at this stage are basically operated by LMS. The mobile version keeps all the original functions of LMS which enable educators to distribute learning materials and information to students, and conduct online teaching and assessment, such as the provision of online teaching videos and online quizzes. At the same time, it provides an interactive platform through the functions of online forum and messenger which allow group discussion and sharing of opinions among students and educators for facilitating cooperative learning. The transformation of conventional LMS to m-LMS has led to a key advantage for users—its convenience and flexibility in gaining access to the learning system anytime and anywhere, which creates a more favourable foundation and environment for promoting m-learning in the new era (Hamuy & Galaz, 2010; Lowenthal, 2010).

The technical issues of converting all contents to be used from the original LMS setting into a mobile environment which fits different types of mobile devices seem no longer a problem with the advances in technologies and the introduction of new operational systems. Nowadays, any user can easily gain access to the m-LMS by using the web browser application available in their mobile devices. Illustrated below in Fig. 7.2 is a typical example of an LMS operated in a desktop environment.

Fig. 7.2 An example of LMS operated in a desktop environment

Fig. 7.3 An example of m-LMS with the contents automatically fitted to the screen size of a mobile device in the environment of a web browser

The same contents can also be accessed by using a mobile device through the built-in web browser as shown in Fig. 7.3. A slight change in the layout can be observed due to the difference in screen size in the two different platforms. In principle, the contents and layout will be automatically adjusted to fit the screen sizes of mobile devices to improve the readability and ease-of-use for the end-users. Yet, the access to the m-LMS by using the web browsers in mobile devices still has its limitations. For example, common problems reflected by users are that they cannot stay logged in for long hours and the presentation of the contents may not be nicely fitted on the screen.

The introduction of LMS apps in recent years has eliminated these limitations (see Fig. 7.4 for examples of LMS apps available in the market). After downloading the LMS apps, end-users can gain access to the system at any time by just one click without entering log-in names and password every time which has further enhanced the usability of LMS when operated in a mobile setting.

Challenges of LMS Applications

Although LMS is considered the most frequently used option for e-learning as highlighted by Bogdanović, Barać, Jovanić, Popović, and Radenković (2014), it cannot be overlooked that there are still many limitations which hinder the use of such a learning system from the perspectives of students, educators and institutions. Even though the increase in the use of mobile devices has successfully created a new option for students in accessing LMS at anytime and anywhere, the overall usage rate of m-learning is still low. According to the works of different scholars

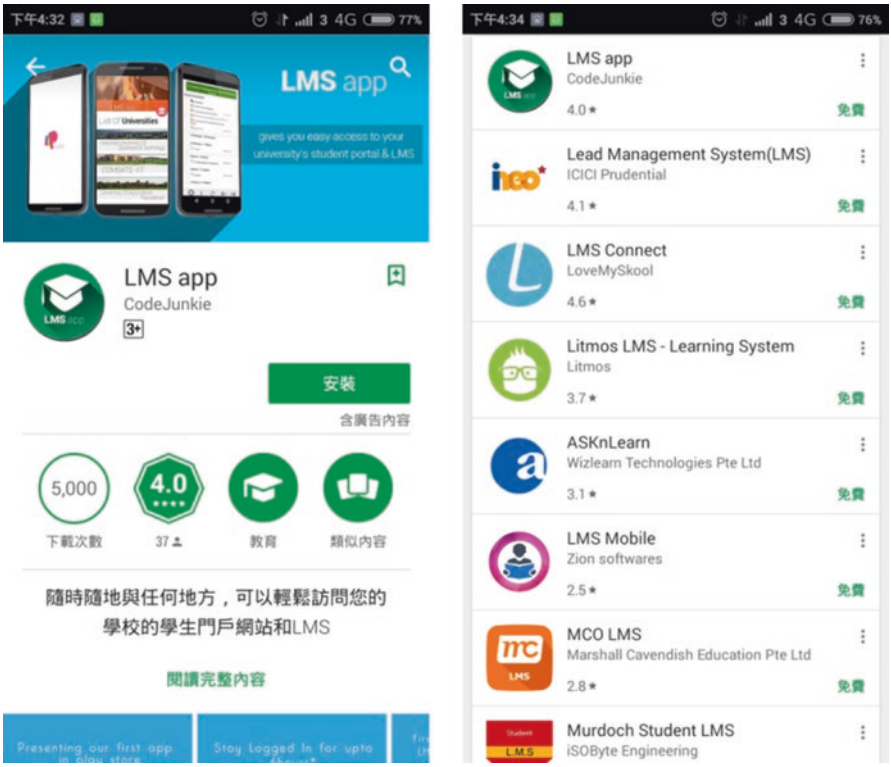

Fig. 7.4 Examples of m-LMS apps tailor-made for mobile devices

(Bogdanović et al., 2014; Chu, Hwang, Tsai, & Tseng, 2010; Jurado, 2013; Leavoy, 2016; Mays & Wiggill, 2016; Pappas, 2014), various challenges are being faced by institutions in the use of LMS, both the desktop and mobile versions. A summary of the key difficulties being confronted by different stakeholders is given in the following table (Table 7.1).

Global Positioning System (GPS)

GPS Functions and Applications in Daily Life

According to Zahradnik (2016), a global positioning system (GPS) refers to a group of satellites operating in the earth's orbit, from which signals can be transmitted and detected by receivers on the ground for generating useful information, including location, distance, speed and time. As a built-in feature installed in mobile and other devices, the GPS is widely utilised by different sectors for offering various kinds of location-based services. Examples of services vary depending on the applications

Table 7.1 Challenges in the use of LMS applications

Key challenges	Problems of LMS/m-LMS in detail
Poor design of the learning content	The learning contents are mainly written in text only.
	The readability is low if the contents cannot be optimised but are presented in lengthy sentences and paragraphs which may discourage students from learning online.
	The use of multimedia (e.g. video, audio and graphics) is limited, which fails to attract students and draw their attention.
Shortcomings of mobile devices and network connectivity	The short battery life of mobile devices may limit the duration of using m-LMS.
	The screen sizes are generally small for mobile devices, leading to difficulty in reading the learning contents.
	Typing by using mobile devices is less convenient when compared with desktops, creating barriers to discussion and sharing of information in the forum.
	The hardware requirements of mobile devices are high and not all people can afford to purchase a high-quality smartphone.
	Network connectivity in some locations or countries is poor which hinders the development of m-learning, including m-LMS.
	Data transferring and wireless communication fees can be very high in some countries, which may prevent people from learning online.
	A majority of LMSs only enable users to access their contents online, but there is no accessibility when staying offline.
Lack of student motivation	Students mainly use LMS for accessing learning materials, such as only downloading lecture notes. Other functions such as the discussion board or forum are rarely used by students if they are not requirements set by the course.
	It has become a trend for some students, and even teachers, to utilise less formal communication channels for sharing learning information or initiating group discussion on course issues, such as WhatsApp and other social communication networking tools. Some consider LMS as too formal or bounded by its usage for academic purposes which has demotivated students from using it.
	Students can be easily distracted by various stimuli in their surrounding environment when m-LMS is being used, leading to lower concentration on e-learning when compared with face-to-face learning.
Inexperienced teaching staff applying e-learning	Subject matter experts may not be knowledgeable about using IT and may hesitate to applying LMS in their teaching.
	Teaching staff generally receive no formal training on how to transform dull subject contents into interesting e-learning resources.
	In general, it takes time for teaching staff to become familiar with LMS applications before they can start integrating them into their curriculum delivery. Most of them have no instructional design knowledge in advance, meaning that it is less likely for them to optimise the use of LMS even if LMS training is provided.

(continued)

Table 7.1 (continued)

Key challenges	Problems of LMS/m-LMS in detail
Cost implications	For initiating the use of LMS, institutions have to pay the cost of development and technical support. The fees charged by commercial LMS service providers can be expensive.
	Even if free/open source LMS can be used, the add-on functions or tailor-made features may require extra fees to be paid to suppliers.
	Institutions which develop their own LMS have to invest money for the development project. Setting up one's own servers and long-run IT support may involve a huge investment.

Table 7.2 GPS applications in different sectors and their corresponding examples

Sectors utilising GPS	Examples
Agriculture	GPS data collected can help precision soil sampling and determine localised variation of chemical applications and planting density.
Aviation	The GPS provides useful data which enables the planning of safe, flexible and fuel-efficient routes for airlines.
Ground transportation	The GPS is used to locate vehicle location, making it possible to provide useful information to passengers such as approximate waiting time for public transport, or to enhance the accuracy of navigation systems for drivers.
Recreation	Positioning information on the GPS can help tourists or outdoor adventurers with safer exploration anywhere in the globe.
Environment	Preservation and protection of endangered species can be facilitated by GPS tracking and mapping functions.
Health care	The positioning of victims in accidents enables speedy rescue searches to be conducted.

used by the general public, such as Google Map for identifying locations and offering navigation services to applications used in specific situations such as conducting rescue searches in accidents or emergencies (GPS.gov, 2017). A few sectors which have benefitted from the use of the GPS and their corresponding examples of applications are illustrated in Table 7.2.

GPS Applications in Education

With no exceptions as in other sectors, GPS technology has also been extended and utilised in education. For example, Prasad and Aithal (2017) stated that the GPS is a key element for facilitating location-based M-learning which allows learners to gain access to different learning contents based on their location information detected by the GPS. It also helps mobile context-aware learning (MCL) and authentic learning as described by Sun, Chang, and Chen (2015) which offers a more favourable environment for learners to associate their learning with real-life

situations when knowledge transfer is no longer bounded by or has happened in a conventional classroom setting.

There are numerous practical examples of GPS applications in enhancing m-learning. For instance, a mobile plant learning system (MPLS) was developed based on GPS technology which allowed young students to search and identify plants to be located nearby by referring to an electronic map (Huang, Lin, & Cheng, 2010). As an outdoor learning activity, a database with information on known plants, including their features and locations in the map area, was developed for creating the MPLS. While enjoying the outdoor learning activities, students were instructed to go to different locations based on the e-map installed in their mobile devices. Once a specific plant was found, students can observe the real objects and, at the same time, gain access to the database which provides detailed information about the plant. In addition, the system also has a sharing function which allows students to share their photos, locations and text information in their learning process. Such a function has helped to enrich the existing database of known plants and, moreover, the creation of a new database with unknown plants to be found in other locations also promotes peer learning among students.

One point that should be highlighted is that educators tend to combine the use of the GPS with other technologies in creating m-learning experiences for users. For example, Smith, Bradley, Cook, and Pratt-Adams (2012) have conducted a study on how urban education can be delivered through the use of a mobile learning tour programme. The programme was developed by using a media gaming platform 'Mscape' with GPS as the positioning tool which enables learners to receive learning contents, that is the past and present stories on certain locations when they walked along the tested area. This illustrates a typical example of how game-based and location-based learning can be combined to create a more interesting and meaningful learning experience for users. The popularity of a mobile game "Pokémon Go", with the integration of both GPS and AR technologies may have also led educators in new directions for m-learning design. A recent case of a college in the United States which used "Pokémon Go" as a theme in its physical education course and promoted exercises through walking and searching for Pokemon characters (as described Ryssdal, 2016) may project how GPS and other m-learning technologies can be utilised to motivate our learners in the future.

Limitations of GPS Applications

Research with the main focus on examining the shortcomings of GPS applications in education is rare at present. However, studies investigating the general applications and accuracy of GPS, as well as other location-based technologies of a similar nature, are numerous (Basiri et al., 2017; Koyuncu & Yang, 2010; Liu, Darabi, Banerjee, & Liu, 2007). In principle, the key challenges of GPS application can be classified into two categories as summarised in Table 7.3.

Privacy and safety concerns may affect learners' trust in using GPS-based software for an m-learning experience. Whether such uncertainties can be removed or

Table 7.3 Challenges of using GPS applications in education

Key challenges of GPS applications
Users' perspective
Service providers offering GPS location services can potentially store, use and sell users' data, such as location history, activities and preferences, for profit.
Users may feel insecure about disclosing their locations to others due to privacy and safety concerns.
Technical perspective
GPS technology can function well in outdoor but not indoor positioning. Signals transmitted in an indoor environment will be very weak as they are always blocked or reflected by the walls of buildings, leading to a decrease in accuracy in generating positioning information.

not depends mainly on the regulations on how data should be collected and used by service suppliers, and the terms agreed by customers on their using the GPS-based learning software. From a technical perspective, the weakness of GPS in its accuracy in indoor positioning can be resolved by the use of other indoor positioning technologies, such as beacon-based and dead-reckoning positioning systems which supplement and automatically switch from the GPS when m-learning software detects users to be situated in an indoor environment (Basiri et al., 2017).

Augmented Reality (AR)

AR Functions and Applications in Daily Life

Tan, Chang, and Kin (2015) define "augmented reality" (AR) as a technology which enables the display of "virtual contents superimposed upon real-life objects". As further elaborated by Van Krevelen and Poelman (2010), AR is not limited to visual stimuli, but has possible applications in generating stimuli in all senses, including sound, odour and physical stimuli in real contexts. Through using computer-generated graphics, sound and other forms of stimuli, AR enables a mixing of virtual elements with reality which creates a new way for users to see, hear or even touch, and such a learning experience seems to be more meaningful for students when compared with the conventional way of learning in a classroom environment (Emiroğlu & Kurt, 2017; Van Krevelen & Poelman, 2010).

In principle, AR differs from virtual reality (VR) in its ability to combine and align both real and virtual objects in three dimensions which allows interactions with users in a real environment in real time. For AR applications, basic hardware is required, including the presence of a high-resolution camera, efficient storage space and a powerful processor, plus other supporting technologies such as a GPS system, image recognition software and other interfaces (Bower, Howe, McCredie, Robinson, & Grover, 2014).

Referring to numerous studies (e.g. Chi, Kang, & Wang, 2013; Mekni & Lemieux, 2014; Shin et al., 2010), the applications of AR cover a variety of different areas, including medical, manufacturing, marketing, navigation, tourism and civil

Table 7.4 AR applications in different sectors and their corresponding examples (Mekni & Lemieux, 2014)

Sectors utilising AR	Examples
Medical	An integration of ultrasound imaging with AR enables health practitioners and pregnant women to view the interior of the abdomen.
Military	An animated terrain can be created and displayed by using AR technology which can assist the planning of military intervention.
Manufacturing	Graphical assembly instructions for products can be made by using AR technology which increases the ease and reduces the time spent on staff training.
Advertising	Visual advertising messages can be added in a football field and be seen by the audiences at home with the help of AR while in live broadcasting.
Tourism	Tourists can use an AR interactive visualisation system installed in their mobiles to provide information on different points of attraction in a self-guided itinerary.
Navigation	A car windshield heads-up display which shows the actual front view of the vehicle with AR routes, highway exits and other information overlaid in 3D can be referred to by drivers.
Urban planning	A projection-based AR tabletop interface can help to create a simulation of a certain site or area which helps to make urban planning easier for engineers.

engineering. A summary list of AR applications in different sectors is illustrated in Table 7.4.

AR Applications in Education

There are numerous papers on AR applications in education, among which is a comprehensive review conducted by Bacca, Baldiris, Fabregat, and Graf (2014) which stated that AR technology is being applied extensively in the learning of science, humanities and arts disciplines. The AR applications assist in the explanation of topics and provide additional information which helps to enhance the learning performance and motivation of learners—key advantages agreed by various scholars (Bacca et al., 2014; Chang et al., 2014; Jara, Candelas, Puente, & Torres, 2011). Also, the use of AR technology to improve the presentation of learning content and its interactions with users in the presence of real-life learning objects seems to have been the key factor leading to the rapid development of such a technology in education (Liou, Yang, Chen, & Tarng, 2017; Tan et al., 2015).

With m-learning becoming more popular due to the continuous advances in mobile technologies, the transformation of AR to mobile augmented reality (MAR) has also drawn the attention of educators in the new era of learning (Emiroğlu & Kurt, 2017). As already noted, such a technology has already been extensively applied by educators and learning contents such as AR images can be shown on the display screen of portable devices for improving the effectiveness of m-learning for the end-users (Kidd & Crompton, 2016).

The introduction of Google Glass has shown its potential for facilitating the AR applications by creating various kinds of m-learning experiences for users in different disciplines. At this stage, the function of Google Glass which enables immediate language translation while a user is looking at a paragraph of text (e.g. a book written in a foreign language or a menu in a restaurant) provides a good foundation for the development of an AR or MAR learning experience for the general public across the linguistic boundaries (Rauschnabel, Brem, & Ro, 2015). According to the study by Leue, Jung, and tom Dieck (2015), visitors at an art gallery can put on their Google Glass which produce AR images and information related to the art pieces during the gallery tour. Information such as artists' backgrounds, themes, the meaning embedded in the art pieces, and their association with the corresponding history and culture can be shown concurrently on the screens of the glasses, together with the real objects, or listened to by the users in audio format during their museum tour.

Another recent study conducted by Chaballout, Molloy, Vaughn, Brisson III, and Shaw (2016) also illustrated how health science students can benefit from using Google Glass in their clinical simulation practices. The results showed that students learned better in AR simulations generated by Google Glass when compared with the conventional method of paper-based learning. Moreover, the AR applications have also been strengthened or extended with the integration of gesture detection or motion capture technologies. For example, Lin et al. (2017) recommended the integration of Google Glass with Ubii (ubiquitous interface and interaction), an interface system connected to a number of smart devices in an environment which detects and translates the gestures of users into commands for operating Google Glass without physically touching the device in reality. Such an application can be applied in m-learning with interactive AR contents to be created for learners in different subject areas. To further extend the application, a recent study by Pavlik (2017) tried to examine the use of an IT-driven experiential media platform for helping learners with disabilities. All of the above studies helped educators and m-learning designers to see how AR technologies can be applied to cater for the diverse needs of learners in the future.

Last but not least, while many educators and m-learning designers are exploring how AR technologies can be applied in supporting education, an interesting study was conducted by Liou et al. (2017) which attempted to compare AR and VR utilisations in students' learning experience. By involving a group of young students (10–11 years old) studying an astronomy course as the sample, their experience of using both AR and VR technologies during the course was examined. The findings showed that AR functioned better in reducing the mental load of students and helped to make it easier to acquire the subject knowledge due to its key advantage of integrating virtual objects with reality. The difference in mental load helped students to perform better in AR learning and they perceived AR learning contents to be more useful when compared with the use of VR technology.

Table 7.5 Challenges of using AR applications in education (Akçayır & Akçayır, 2017)

Key challenges of AR applications in education
Users' perspective
AR may be difficult to be used by some students who have their own learning preferences or needs.
The time spent in using AR could be more than with conventional learning—For example, the time spent in learning how to use an AR learning software may not be worthwhile when compared with simply reading a textbook.
It is difficult to be conducted in large group as interaction with the same learning object is required.
Technical perspective
Low sensitivity in triggering recognition
Location-based services/GPS errors
Other technical problems of learning devices, including camera and Internet connection

Challenges of AR Applications

The extensive literature has shown that AR applications can enhance the learning experience of learners in different aspects, but a recent review of the area by Akçayır and Akçayır (2017) has pinpointed the shortcomings of such a technology in the setting of education, with key findings shown in Table 7.5.

It will only be a matter of time before these technical limitations can be resolved with the continuous advances in technology, similar to the situation of GPS applications. However, it will be a significant challenge for educators to re-shape the learning styles and preferences of students if AR is going to be added as a kind of teaching approach in different subject areas. Training will be essential for learners to ensure the effectiveness of AR applications in m-learning. Investment in setting up an AR learning environment which combines technology with learning contents will also be one of the considerations of institutions if such an approach is going to be implemented in the long run.

Instant Messaging and Social Networking Apps

Besides the GPS and AR applications discussed above—which have shown great potential in transforming the conventional way of learning into a new era of m-learning experience for users—it is possible that other IT applications that are being used by the general public for communication in their daily lives may also help learners to learn at any time and any place. The use of instant messaging and social networking apps are two typical examples which are being explored by academics and practitioners for their potential integration with m-learning, and the challenges to be tackled before such a platforms can be fully utilised for educational purposes.

Instant Messaging, Social Networking and their Potential Applications in M-Learning

Due to the continuous advancement of mobile functions and telecommunication technologies, people can contact anyone easily by using mobile apps installed in their handheld devices. The use of instant messaging and social networking apps has become part of our daily lives, which has led to concern among educators about how such applications can be utilised and extended in promoting both formal and informal learning in an m-learning environment. For example, a recent study by Barreh and Abas (2015) illustrated how mobile learning can be implemented and enhanced through the use of SMS and Facebook. The results showed that students were more receptive in using both media for tasks such as the sharing of ideas, discussion and conducting learning activities if they were in the appropriate format for users.

In fact, SMS is no longer the most popular means of instant messaging used in a mobile environment. Church and Oliveira (2013) highlighted other apps, such as "Line" and "WhatsApp", which enable users to send instant text messages, photos, videos and even files of various formats, to individuals and groups easily and conveniently. Even though mobile instant messaging apps are widely used nowadays, studies on how they can be applied in promoting learning are limited and disorganised. The study conducted by Tang and Hew (2017) is one of the few exceptions, which aimed at providing a comprehensive review on this particular aspect. As highlighted in their study, not only text but the integration of audio and video in one single interface makes instant messaging apps very user-friendly when compared with the conventional LMSs which students consider as too complicated in their operations. The audio recording function also supports language learning with dialogic activities such as focused discussion being easily promoted by using the media. Functions such as adding 'emoji' in messages, instant photo-taking and an online visual phone also help users, especially learners on online courses, to develop their social presence and strengthen their motivation to participate actively in collaborative and peer learning tasks with no boundaries of geographical location.

Facebook is a typical example of social networking platforms. It can be defined as a public/semi-public profiles created by users and their articulations with other users to exchange and share information (Gikas & Grant, 2013; Pimmer, Linxen, & Gröhbiel, 2012; Salehan & Negahban, 2013; Shen, Kuo, & Ly, 2017). As the most popular social networking platform, with active users reaching two billion in June 2017 (Kallas, 2017), it is in a leading position, far ahead of other players in the market, including YouTube, Instagram and Twitter. With such a huge user population, various scholars have tried to highlight the potential and advantages of integrating social networking with learning (Lomicka & Lord, 2016; Rennie & Morrison, 2013; Traxler, 2016). In particular, Traxler has pinpointed the key characteristics of social networking platforms which enable the delivery of a more

"timely, personalised and contextual experience" for learners. These will be the advantages of using the social networking platform and may help to overcome the general criticism of the conventional way of learning as being based too much on mass-production.

Challenges of Instant Messaging and Social Networking Applications in M-Learning

While users are motivated to learn through the use of instant messaging and social networking apps, numerous scholars have also highlighted their potential problems which may be created in the m-learning experience for users as highlighted in Table 7.6 (Bosch, 2009; Bouhnik & Deshen, 2014; Lauricella & Kay, 2013; Mao, 2014; So, 2016; Tang & Hew, 2017):

It can be observed that the key challenge in using both channels in m-learning is concern about privacy by both learners and teachers. Communications after school hours and the risk of exposing their personal lives to others may make both parties hesitate, which may hinder the development of m-learning activities to be delivered by both channels. Clear guidelines should be provided by institutions on how the channels concerned should be used to fine-tune users' expectation. Also, learning activities should be carefully designed if delivered through social networking platforms. Educators should think carefully about how learning activities can be developed to fit this informal learning channel and how "entertaining" it can be as perceived by users so that they will be more willing to play an active learning role while enjoying the "fun" provided in the learning process.

Table 7.6 Challenges of using instant messaging and social networking applications in education

Key challenges of instant messaging and social networking applications in education
Instant messaging
Formal language is less likely to be used in the communication process, leading to the risk of miscommunication and misinterpretation of messages among users.
Difficulty in restricting the time of message delivery leads to the risk of intrusion into the private lives of both learners and teachers.
No guidelines are set for teachers on when and how frequently they should respond to messages. Students may expect immediate answers and feedback which can differ from the teachers' expectations.
Social networking
Students can be easily be distracted by other contents posted in the platforms and become less productive in their learning process.
A majority of students still perceive social networking platforms as a kind of "entertainment" rather than a means for "learning".
Both teachers and students may hesitate about "adding" each other in the network as some may not want to expose their private lives to others in non-school hours.

Conclusion—Implications for Education in the Future

The examples discussed in this chapter represent only a small cluster of existing technologies that can be applied by institutions to produce a better m-learning experience for students. As highlighted at the beginning of this chapter, a blending of more than one technology should be applied at the stage of curriculum design as this helps to create a fruitful m-learning experience for users. The decisions on which technologies should be applied depend on a number of factors, including the subject area, budget and students' learning preferences/styles—as well as the capability of educators and m-learning designers on how technologies can be combined well with the learning contents to fit the needs of students.

Through the discussion of some existing m-learning technologies in this chapter, the author would also like to conclude that well-designed m-learning applications should share some similarities in two key aspects as listed in Table 7.7.

Users should experience minimal barriers (e.g. ages, languages, locations and time) when using m-learning technologies. The effectiveness of m-learning can be further enhanced, assuming that the compatibility and connectivity of applications across various mobile platforms will no longer be a concern under continuous advancement of technologies in the future.

How m-learning technology can be designed to become more enjoyable should be a hot topic for future investigation. It is believed that a well-designed m-learning application should have close connection with users' daily experience and it should facilitate interactions and sharing of opinions with peers which help encourage users to develop a "habit" of using such technologies in their daily lives, like the use of Facebook and other social media at this stage. Besides, the critical issues of how educators can add "fun" elements into the m-learning applications and how they can motivate learners to take implicit learning should be left for future considerations by educators in their planning of using m-learning technologies on a case-by-case basis. This chapter has summarised the existing state of m-learning technologies—their applications and key considerations—that help informing decisions on adopting such technologies in curriculum delivery.

Table 7.7 Key factors leading to a well-designed m-learning application

High Usability
User-friendly for all with diversity needs
Easy access at anytime and anywhere
Affordable to all
Compatible to all mobile devices with no specific hardware and software requirement
Enjoyable learning experience
Should have close connection with one's daily life
Encourage not just explicit but implicit learning of users
Add "fun" elements in the m-learning design
Interactions among users can be the key to facilitate peer learning and enrich their learning experience

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