

## Designing Constructivist Mobile Learning Activities

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## **Introduction**

The most common communication tool among young learners is mobile phones as illustrated by Colley and Stead (2004) in their study of developing tools for mobile learning for students aged between 16 and 24. Mobile phone devices, known as smartphones, are relatively inexpensive compared to a laptop. Similar to the trends of having smartphone devices among young adults in developed countries, it is usual for Saudi students in higher education to own a smartphone. According to Traxler (2008), smartphones have the potential to be a key component of students' learning experiences because these technologies are familiar, universal, personal, lightweight, and portable. This means that smartphones appear to offer a medium for learning to be carried out anytime and anywhere because of their portability and convenience for students in higher education institutes. This research is aimed at understanding the design of mobile learning activities to support Saudi students in higher education contexts. According to O'Malley et al. (2003), mobile learning is "any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" (p.6). In addition, mobile learning activities are activities that involve using mobile apps by learners to construct or support their learning (Baharom, 2013). This paper describes the pervasiveness of mobile technologies, followed by the affordances of mobile technology and mobile learning. Finally, the social constructivism approach is reviewed and then aligned to the mobile learning affordances.

### **Pervasiveness of Mobile Technologies**

The pervasiveness of using mobile technologies in daily practices is found in many studies and reports. According to Ranine and Fox (2012), more than 86% of mobile technology users in their study used their phones to make real-time inquiries, such as making a decision

about restaurants and finding information to solve a problem. Another study conducted by Kennedy (2006) showed that college students usually use their phones as a personal tool for communication with peers by making calls, texting, taking photos, and creating videos. Moreover, a report of the UK Joint Information System Committee (2005) illustrated two reasons behind the strong relationship between learners and mobile technologies. The first reason is due to the fact that mobile phones are considered part of modern life. The second reason is that learning should reflect on “changing expectations of how, when, and where we learn, and they should motivate learners to become more active and engaged in their learning” (p.26). Thus, providing learners with mobile learning activities could increase their motivation.

According to Kukulska-Hulme’s (2009) study, there are three main reasons to introduce mobile learning in higher education institutes. The first reason is to improve access to learners; second is to improve access to learning throughout exploring more potential methods for learning and teaching; third is to align with policies of institutions. In addition, another study was conducted by Vavoula (2005) to compare learners who used mobile technology for learning purposes and learners who do not take advantage of mobile tools. Her study showed that mobile learning is “more interactive, involve more flexibility, more content, communication and collaboration with others” (p.17). Therefore, mobile technologies can support learning and improve communication.

### **Affordances of Mobile Technologies**

According to Bates (2005), instructors need to understand the different forms of new technologies and explore the proper situations to effectively use these new technologies for learning and teaching. Different educational technologies provide different learning affordances; thus, they should be wisely selected to maximize students’ learning experiences (Baharom,

2013). However, there is a need to explore and understand the affordances that a new technology can provide to effectively support the learning experience. Affordances as described by Norman (1988) are the perceived properties of things that determine how things could be used. Using Bower's (2008) method of diagnosing the affordance requirements, the researcher examined the raw capabilities of smartphones and tablets devices as presented in Appendix A. Bower (2008) matches learning tasks with appropriate learning technologies by looking at action potential of technologies. This method of analysis is suitable for the purpose of this review, because it supports the educational and collaborative design of learning activities (Bower, 2008).

According to Nimon (2006), a smartphone is more than a phone; it is a device that allows users to play, work, socialize, and express themselves; it allows them to personally customize its features and layout and some users view it as an extension of themselves. Thus, these devices are not just communication tools; they are for self-representation, self-organization and whatever other benefits they could afford to users. Although the affordances analysis of smartphones and tablets shows various positive insights of these technologies, there are several negative affordances or constraints that need to be considered to deliver effective learning materials (Baharom, 2013). Discussing these negative affordances provide instructional designers and researchers with knowledge to overcome them. The obvious constraint of mobile technologies is screen size, which, according to Nix's (2005) study, causes difficulties for learners. In addition, Lee et al. (2005) indicated that it is not only the screen size issue, but learners also had some difficulties with screen resolution. Another constraint of mobile technologies is the keyboard size (Adipat, 2005). Nevertheless, a usability test conducted by Kukuska-Hulme (2007) shows that a small screen size may not be a major challenge for learners because they are familiar with the capabilities of mobile devices. In addition, the literature reveals other negative affordances.

According to Parsons and Ryu (2006), the short battery life of mobile devices is considered a major constraint of mobile learning. Moreover, other studies indicated that memory size, operating systems, and different browsers are also constraints of mobile technologies (Baharom, 2013; Corlett et al., 2005). In addition, Goundar (2011) highlighted that software and hardware of mobile devices could affect the design of mobile learning activities, such as file format, memory size, and navigation issues.

Moreover, other research indicated the reliability of mobile technologies networks as a constraint. According to Wang and Higgins (2005), the network speed during uploading and downloading can be another limitation of mobile learning. Moura and Cavalho (2008) encountered this constraint when learners were uploading pictures to Mobile Flickr. Another study by Hummel et al. (2003) indicated losing connection as a main constraint of their mobile learning project. Thus, mobile learning environments need reliable network speeds to ensure user satisfaction (Baharom, 2013). Furthermore, the cost issue can be considered another constraint for mobile learning. According to Wang and Pan (2008), many mobile learning applications require smartphone or tablets to use them, which could be an obstacle for some learners who have yet to make a purchase. Moreover, some studies reported the cost of data plans as another constraint (Moura & Carvalho, 2008; Baharom, 2013). Finally, Johnson (2001) indicated network literacy as a constraint of mobile learning and students need to be aware of how to use the Internet safely. Learners need to learn some skills and ethics to evaluate materials on the Internet and to produce content for various media.

### **Affordances of Mobile Learning**

In addition to the discussed affordances, mobile technologies can facilitate mobile learning and offer invaluable learning opportunities to users. As mention earlier mobile learning

is “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” (O’Malley et al., 2003, p.6). Therefore, it is essential to understand how mobile technologies are used for learning purposes.

According to Cochran (2010), the potential affordances of mobile learning are the ability “to bridge pedagogically designed learning contexts, facilitate learner-generation contexts, and content (both personal and collaboration), while providing personalization and ubiquitous social connectedness, that sets it apart from more traditional learning environment” (p.134). The ability to personalize learning is an essential feature of mobile learning environments that distinguish them from other learning environments. According to Thomas (2005), mobile learning offers flexibility, ubiquity of accessing information, and increased motivation. He also stated that mobile learning promotes the revolution of “ always-on learning, accessible to the masses, but tailored to individual” (p.5). Moreover, Peters (2007) claimed that mobile learning provides enough information ‘just in time’ and ‘just for me’. In addition, Peters (2009), states that mobile learning offers individuality, a “unique scaffolding that can be customized to the individual’s path of investigation” (p.117). Therefore, key components of mobile learning are contextual, ubiquitous, and personal.

There are various studies about mobile learning that have been published. Table 1 presents the general ideas of mobile learning affordances from these studies.

Table 1  
*Summary of Mobile learning Affordances*

Mobile learning affordances	Sources
Authentic; contextual; engage learners with contexts; situated.	(Alexander, 2004; Kukulska-Hulme &Traxler, 2007; Kearney et al., 2012)
Just in time; access to information quickly.	(Baharom, 2013; Goundar, 2011)

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Provide learning anytime and anywhere.	(Baharom, 2013; Goundar, 2011)
Flexibility.	(Goundar, 2011; Shih & Mills, 2007)
Easy to carry;	(Shih & Mills, 2007; Goundar, 2011; Baharom, 2013)
Familiarity.	(Baharom, 2013; Goundar, 2011)
Device accessibility.	(Hashemi et al., 2011)
Promote learning communities; collaboration.	Kearney et al., 2012; Parsons & Ryu, 2006; Hashemi et al., 2011)
User-centered; personal.	(Park, 2005; Traxler, 2007)
Promote motivation; encourage participation.	(Hashemi et al., 2011; Shih & Mills, 2007)
Dynamic environment.	(Leung & Chan, 2003)
Connect digital devices.	(Baharom, 2013; Hashemi et al., 2011)

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Therefore, mobile learning affordances as presented in Table 1 provide general information that help to understand mobile learning. In addition, Parsons and Ryu (2006) illustrated that the mobility affordance is a fundamental part of mobile learning and it should be discussed when mobile learning is introduced. The literature of mobile learning reveals some aspects of mobility as presented in the following Table 2. These aspects are recommended to be part of designing activities of mobile learning.

Table 2  
*Summary of Mobility Aspects*

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Aspect of Mobility	Distribution	Sources
Multiple contexts	Learners are free to move within, between, and beyond several contexts, topics, or disciplines.	(Wang, Wiesemes & Gibssons, 2012; Peters, 2007)
Interactive communication	It is not one way of communication between learners and instructors; it involves knowledge construction through	(Wang, Wiesemes & Gibssons, 2012)

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	participating and collaboration.	
Familiarity	Familiarity and ease of using devices and mobile applications.	(Passey, 2010)
Autonomy	It provides learners with autonomy to access resources where and when they want	(Pyu & Parsons, 2009)
Interaction between technology and learners	It involves interaction with mobile devices and fixed technologies/computers.	(Kukulska-Hulme et al., 2009)

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Furthermore, other studies highlighted specific affordances to thoroughly understand mobile learning. According to Shih and Mills's (2007) study, participants of their mobile learning project were more motivated as they appreciated the flexibility and convenience of using SMS for learning purposes. Their study also indicated an increment in learners' collaboration and in the level of interaction between learners and instructors. In addition, Naismith et al. (2004) claimed that mobile learning promotes a space for shared conversations so that effective learning occurs. This is because learners can converse with each other through questioning and sharing their description and knowledge about the world. Thus, mobile learning is not just allowing learners to access interactive content and static resources; it also allows them to create meaning through interaction and discussion (Baharom, 2013; Caudill, 2007). In addition, mobile learning provides learner-centered activities, but it also promotes social connection as in the discussion of affordances of mobile learning in Table 1.

According to Kukulska-Hulme et al. (2009), the affordances of mobile learning are particularly suited to support learning rooted in constructivist, social, contextual and collaborative principles. In addition, Cobcroft et al. (2006), acknowledge that mobile learning allows learners to create their own content and collaborate with their peers beyond the

classroom. Therefore, mobile learning and the social constructivist approach can fit well together.

### **Social Constructivism**

According to Sexton (1997), constructivism is made up of a progression of notions ranging from social perspectives to a more fundamental constructivist view. However, the most common feature is that learners construct knowledge based on their own experiences (Palincsar, 1998). Mobile devices offer learners opportunities to collaborate and use context in their learning. These technologies also allow for constructing knowledge based on others' views, which makes the social constructivist paradigm more appropriate as a theoretical principle for designing mobile learning activities (Baharom, 2013).

Social constructivism has risen from Vygotsky's work (1896 – 1934) where the core of the theory is social contributions. According to Van de Veer (2007), the theory of constructivism centralized the notion that we must look at the socio-cultural context of humans in order to understand their inner mental processes. Social constructivism is associated with constructivism as a knowledge development theory (Baharom, 2013; Van de Veer, 2007). In addition, Jonassen (1991) illustrated that learning is a social activity because learners interact with each other and with the environment surrounding them. This means that understanding and meaning making result from social encounters within the learners' contexts. Thus, learners construct knowledge based on their social experiences when using mobile learning activities to support their learning. In order to design mobile learning activities, other works that illustrated attributes of the social constructivist learning environment are reviewed in Table 3.

Table 3

*Summary of social constructivist principles*

Framework of Jonassen (1999)	Pedagogical Principles (Knuth et al., 1993)	Bonk and Cunningham (1998)
Reflection and constructive articulation. In order to improve learners' mental models, their learning should allow them to articulate their reflections.	Learners responsible for strategies and methods of learning (Process of knowledge construction).	Group learning activities that are meaningful and match learners' interests or experiences.
	Learners engage in learning activities that allow them to evaluate other solutions (multiple perspectives).	Learners should explore various examples or explanations from different sources
Authentic and contextual situation. Learning activities need to reflect real-world contexts or be in it.	Learning activities are realistic and in relevant contexts.	Authentic problems that reflect real-world problems.
Active manipulation and observation. Learning activities that allow learners to observe the outcomes of their manipulation.	Learners define learning issues and determine directions.	
Collaboration. Learning activities that allow learners to collaborate and be an active learner in the community of knowledge building.	Learning activities provide social interaction during learning processes.	Social dialogue opportunities to allow learners-to-learner and learner-to-instructor conversations. These opportunities could be gained by providing learning activities that have multiple solutions. Learners have opportunities to negotiate meaning, to discuss conflicts, and to build agreements.

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	Learners use various representations, modes/technologies.	Technologies can be used to help learners generating ideas and build knowledge within peer communities.
Intentional reflection “Technologies need to engage learners in articulating what learning goals are in any learning situation and support them.” When learners realize their learning outcomes and are able to reflect on the process and strategies to achieve them, their ability to construct new knowledge will be better.	Learners encouraged to explain their knowledge construction (Why and How).	Learners should be able to reflect on the gained knowledge and the learning process both individually and in groups.

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To ensure that the principles of social constructivist are more comprehensive, this researcher combined all attributes of constructivist learning environments presented above as follows:

- Allow learners to control and own their learning.
- Allow learners to explore multiple views from different sources.
- Allow learners to experience situated and authentic learning activities.
- Allow learners to be engaged in learning activities.
- Allow learners to collaborate and share knowledge.
- Allow learners to use various media/technology.
- Allow learners to recognize their reflections.

The literature reveals various categories of mobile learning activities that are aligned with pedagogical principles of social constructivism and can support higher education learners. For instance, Baharom (2013) classified mobile learning activities into four categories: contextual activities, reflective activities, collaborative activities, and multiple perspective activities. In addition, Patten et al. (2009) categorized learning activities for handheld devices into administration, referential, interactive, micro-world, collaborative, location aware, and data collection. Using the comprehensive principles of social constructivism and affordances of mobile technology, five categories of learning activities were generated. The following diagram provides a visual representation of the categories aligned with their comprehensive principles. These different types of mobile learning activities are not meant to be comprehensive, but they provide an overview of how mobile learning activities could be designed to support learners.

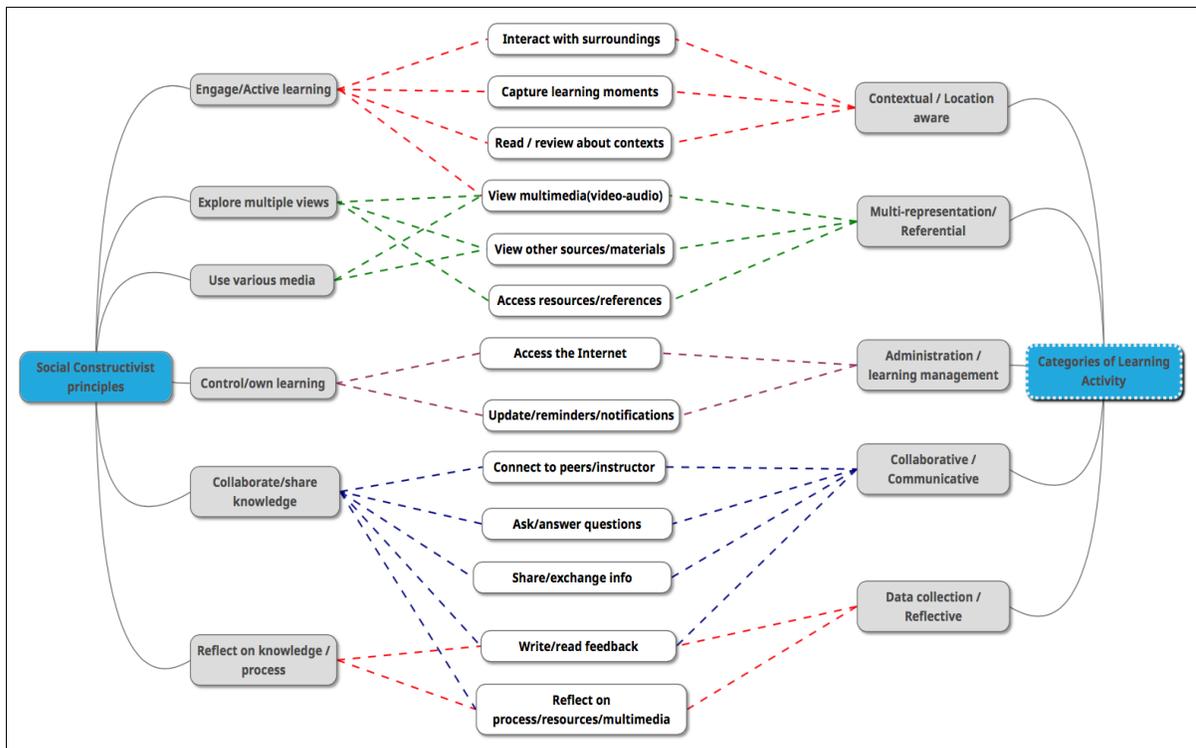


Diagram 1 Categories of mobile learning activities

**Contextual Activities**

There are various ways in which learners construct meaning from given contexts (McRobbie & Tobin, 1997). Designers and instructors should take advantage of different learning contexts to extend learning beyond the class times. According to Duffy and Jonassen (1992), learning activities must provide assistance and contexts to aid learners in making sense of the environments they encounter. In other words, learning activities should be designed to take advantage of learners' multiple contexts. In addition, multiple contexts themselves should provide authentic learning environments. According to Ryu and Parsons (2006), authentic learning environments support the combination of the real-world activities with the digital representation of information. This means that mobile learning can link associated information or contexts to learning activities in digital representation forms. Thus, learners would be able to explore phenomena and recognize concepts via combined digital and physical objects. According to Traxler (2009), authentic learning involves a learning environment that contains real-world problems and includes learning activities that are interesting and important to learners. Authentic learning activities enable learners to use their representations of the world in a formal learning environment. Thus, the authentic learning environment enhances learning by bringing meaningful and realistic activities to learners.

**Multiple Perspectives Activities**

The theory of social constructivism assumes that a learner's learning is based on several contexts. Constructing complex knowledge requires multiple recourses and contexts. Complex conceptions that are poorly defined need several illustrations and representations (Baharom, 2013). Therefore, if learners are supported to connect related knowledge through multiple representations, they will construct knowledge from the concepts being studied (Spiro, 1991).

Learners will be able to expose different perspectives, and mobile learning activities can provide such an opportunity. According to Hannafin and Land (1997), technology supports access to multiple tools and resources that lead to the construction of meaning through connecting new knowledge to prior understandings and conceptions (p.170). Moreover, Jonassen (1992) stated that using available tools to promote multiple views on reality in the learning environment is one aim of the social constructivist theory. This means that information does not come from a single source in social learning environments; it comes from multiple resources through different medias.

### **Administrative Activities**

These learning activities enable learners to access information, and receive updates and notifications. An example of these administrative activities is offered by the Global Groupware mobile app. Instructional designers can design learning activities that include calendar sharing, collective writing, shared database access, and virtual meetings with each learner to discuss progress and share information. According to Tangney et al. (2006), administrative applications have little pedagogical philosophy in educational domains; however, they can be used to provide scaffolding and support knowledge structure. In addition, Corlett et al. (2005) suggest that there is no need to customize mobile apps for administrative activities as learners could use apps available in the mobile devices they are already familiar with. Therefore, there are potentials for learners to fully utilize their mobile devices as digital organizers that could assist them in managing their studies.

### **Collaborative Activities**

The core principle of a learning environment in social constructivism is collaboration. According to Dunlap and Grabingre (1996), group activities for learning are essential for learners to build their knowledge. They enhance their knowledge and share the meaning of the context through argument and reciprocal learning. Learners learn from their peers and their instructors. Collaboration with peers allows learners to test their information and build new knowledge (Dunlap & Grabingre, 1996). Thus, social interaction with others will be encouraged through collaborative activities.

During the collaboration activities, learners share their viewpoints and ideas. They also collaborate to build new knowledge and solve problems (Duffy & Cunningham, 1996). According to Dabbagh (2005), there are three different categories of activities for collaborative learning including collective knowledge construction, collective negotiation such as argumentation and debate, and reliance on other students and teachers as resources (p.36). Therefore, discussion and combining ideas with peers is a substantial feature of collaborative learning (McRobbie & Tobin, 1997, p.199). Thus, learning activities should allow learners to share knowledge, reflect on content, and solve problems that can be done in a project-based form or through peer activities.

### **Reflective Activities**

Successful learners have the ability to analyze and evaluate their learning process (Dunlap & Grabinger, 1996). According to Dabbagh (2005), reflection on learning is the thinking process about what has been learned as a way of giving meaning to events or situations. This process includes understanding and applying new knowledge in different contexts. Thus, providing learners with learning activities that enable them to reflect on their own learning

process is essential in mobile learning environments. These learning activities can increase learners' awareness about their own learning process in order to apply gained knowledge in different contexts (Dabbagh, 2005).

According to Baharom (2013), social constructivist learning environments include learning activities that allow learners to reflect on their experience and prior knowledge, and to restructure new knowledge. Moreover, a mobile learning environment gives the opportunity for learners to provide self-evaluation, and immediate reflection (Traxler, 2009). Thus, a learning technology designer should provide a space for reflection in the activities of mobile learning. For instance, the integration of an SMS mobile application could allow learners to comment, discuss, or support the ideas of other learners.

### **Conclusion**

The aim of this literature review is to inform on the best design for mobile learning. Mobile learning is defined as “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” (O'Malley et al., 2003). However, research shows that learning activities are core elements when designing learning environments. Therefore, mobile learning activities involve learners using mobile apps in the construction of their learning (Baharom, 2013). It was found that principles of social constructivist learning are suitable for designing mobile learning activities. Aligning social constructivist principles to previous studies and affordances of mobile devices' five learning activities are categorized. These categories involve contextual, multiple representatives, administrative, collaborative, and reflective learning activities. However, these categories are supportive of each other and are not

separate entities. For instance, contextual learning activities that capture learning moments can also be learning activities for reflection and multiple representations. Feedback activities are not only collaborative, but also reflective activities. The proposed mobile learning activities are not meant to be comprehensive, but they could provide an overview of how mobile learning activities could be designed and support learners.

This paper set the stage for practical implications of mobile learning by providing the theoretical construct to guide the design. However, additional data including study context, target audience, their needs, background, resources and technology available to them is needed. Methods of collecting this data include a student focus group, observation, and attending faculty regular meetings. After collecting all necessary data, a first prototype of mobile learning activities will be designed and tested to get information about further refinements.



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