



Review

Mobile and ubiquitous learning in higher education settings. A systematic review of empirical studies



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ABSTRACT

Mobile and ubiquitous learning are increasingly attracting academic and public interest, especially in relation to their application in higher education settings.

The systematic analysis of 36 empirical papers supports the view that knowledge gains from instructionist learning designs are facilitated by distributed and more frequent learning activities enabled by push mechanisms. They also lend themselves to the activation of learners during classroom lectures. In addition, and as a particular advantage of mobile technology, “hybrid” designs, where learners create multimodal representations outside the classroom and then discussed their substantiated experiences with peers and educators, helped to connect learning in formal and more informal and personalized learning environments.

Generally, empirical evidence that would favour the broad application of mobile and ubiquitous learning in higher education settings is limited and because mobile learning projects predominantly take instructionist approaches, they are non-transformatory in nature. However, by harnessing the increasing access to digital mobile media, a number of unprecedented educational affordances can be operationalised to enrich and extend more traditional forms of higher education.

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Contents

1. Introduction	491
1.1. Findings and limitations of previous reviews	491
1.2. Educational technology in higher education	492
2. Materials and methods	492
2.1. Research question and goal	492
3. Search strategies and techniques	492
3.1. Selection process and inclusion and exclusion criteria	492
4. Data coding and analysis	493
5. Characterisation of the sample	493
6. Results: pedagogical strategies and outcomes	493
7. Instructionist education	493
7.1. Ad hoc and post hoc transmission of lectures	493
7.2. Supplementary text and multimodal materials	494
7.3. Activation and formative assessment	494
8. Situated action and contextual scaffolding	495

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9.	Constructionist learning	495
9.1.	Designing linguistic representations (written and recorded speech)	495
9.2.	Designing visual representations (photographs and videos)	496
9.3.	Hybrids of situated, constructionist and collaborative designs	496
10.	Discussion and critical analysis	497
10.1.	Key messages: the value of mobile technology in higher education	497
10.2.	Limitations and directions for future research	498
11.	Conclusion	499
	Supplementary data	499
	References	499

1. Introduction

Like no previous technology, mobile technology has spread at an unprecedented pace in the last few years. For example, in 2014, the number of mobile phone subscriptions reached six billion (ITU, 2014). Mobile devices are considered cultural tools that are transforming socio-cultural practices and structures in all spheres of life (Pachler, Bachmair, & Cook, 2010). This transformation is considered central even from an evolutionary perspective because it empowers humankind to engage in interactions that are free from the constraints of physical proximity and spatial immobility for the first time (Geser, 2004). Digital mobile devices such as cell phones, PDAs, and smart phones are also being used increasingly often for educational purposes. The educational use of digital mobile technology is at the core of vibrant and expanding streams of research known as mobile and ubiquitous learning. Both concepts are strongly interconnected. While some authors describe ubiquitous learning as a next-generation form of mobile learning where technology fades more into the background (Park, 2011), the terms are often used interchangeably (Hwang & Tsai, 2011). In essence, both approaches strongly emphasise the notion of 'context' in learning. The field of mobile learning conceives the crossing of contexts as one of its constitutional characteristics (Pimmer, 2016). For example, in one of the most widely accepted definitions, Sharples, Taylor, and Vavoula (2007) define mobile learning as "the processes of coming to know through conversations across multiple contexts among people and personal interactive technologies". Similarly, in ubiquitous learning studies, mobile and portable technologies are conceived either as tools that allow learners to access information irrespective of their physical context, for example on a bus (Chen, Chang, & Wang, 2008) or, alternatively, as a way to provide learners with location-based information, for example while they are exploring a butterfly garden (Liu & Hwang, 2010).

To ground the present research on prior literature, the two underlying tenets are briefly and selectively introduced in the next sections: findings from prior mobile and ubiquitous learning studies, and, more broadly, the role of digital media in higher education settings.

1.1. Findings and limitations of previous reviews

To date, the educational qualities of mobile and ubiquitous learning have been examined in a number of settings: in formal education settings in and outside the classroom (e.g. Frohberg, Göth, & Schwabe, 2009), in the workplace (e.g., Pimmer & Pachler, 2014), and in the context of lifelong learning (e.g., Sharples, 2000). Regarding higher education, some authors expect mobile learning to radically transform this field by providing "new strategies, practices, tools, applications, and resources to realise the promise of ubiquitous, pervasive, personal, and connected learning" (Wagner, 2005). Two recent meta studies provide an overview of

and insights into the emerging socio-technical phenomenon (Hwang & Tsai, 2011; Wu et al., 2012). Wu et al. (2012) found in their meta-analysis that research has most commonly concentrated on the effects of mobile learning, followed by design aspects, the investigation of the affective domain during mobile learning and the analysis of learners' characteristics. Regarding the course subjects, mobile learning was studied primarily in the setting of language and linguistics courses, followed by computer classes and health sciences (Wu et al., 2012). The authors also noted the predominance of higher education settings among mobile learning environments; more than half of the learners included in the meta-analysis were from post-secondary education environments (Wu et al., 2012). Similarly, Hwang and Tsai (2011) reported that higher education students were the most often researched target group for mobile learning studies. Notably, in both meta-analyses, most of the included studies reported positive learning outcomes.

In these reviews, relatively little attention was paid to the different forms, practices and outcomes of mobile learning and their theoretical underpinnings. For example, in the instructionist sense of learning, mobile devices can be used to test vocabulary (Brett, 2011), while a constructionist approach might have students use mobile devices to create video materials (Zahn et al., 2013). While both uses could be labelled "mobile learning", the associated learning activities and underlying theories are diverse and are likely to result in different forms of engagement and educational effects. One of the first reviews that differentiated mobile learning on the basis of different theoretical strands was written by Naismith, Lonsdale, Vavoula, and Sharples (2004). They distinguished behaviourist, constructivist, situated, collaborative, informal and lifelong learning categories. Their review, however, was based on examples and was not systematic. Another literature analysis was conducted by Frohberg et al. (2009). In their critical review of mobile learning projects, the authors used activity theory (Engeström, 1987; Sharples et al., 2007) as an analytical framework. They analysed more than 100 projects according to the categories *context*, *tools*, *control*, *communication*, *subject* and *objective*. Frohberg et al. (2009) observed that although mobile phones are primarily communication devices, communication and social interaction played a surprisingly small role in mobile learning projects. However, the reviewers did not focus on higher education settings, and more importantly, their review included projects that were published before the end of 2007. As noted in subsequent systematic reviews, the number of mobile learning studies increased sharply after this period (Hwang & Tsai, 2011; Wu et al., 2012). In the more recent analysis of mobile lifelong learning projects, Arrigo, Kukulska-Hulme, Arnedillo-Sánchez, and Kismihok (2013) also suggest that most of the projects were centred on the distribution of content instead of on social interaction between tutors, teachers or peers using mobile devices.

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