Breaking the boundaries of space and time: A review of applications of bring-your-own-device in higher education

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Abstract

Throughout history, various technologies have been used to bridge the boundaries of time and space, from 19th-century postcard education to present day mobile technology. Previous reviews examining the first decade of the new millennium showed many research projects using institutionally owned equipment, mostly supporting a teacher-centred approach and with a focus on content delivery. With the rapid development of small, portable and smart devices since 2007, devices becoming ubiquitous in the lives of students of today, has the focus of research changed? This paper reviews journal articles published 2009–2014 with the aim to examine how mobile devices are applied to bridge the boundaries of space and time in higher educational settings, and thereby supporting networked learning for the campus classroom as well as the online student. A search in major databases for English language journal articles was conducted with phrases "mobile learning" and "higher education". We found 109 articles indicating some form of bring-your-own-device (BYOD) philosophy. Categorizations were made primarily based on the abstracts. About 85 per cent of the articles were empirical in nature. Another eight per cent were theoretical and/or argumentative. The remaining articles were reviews, method development or meta-analyses. Subjects of study in the empirical articles were primarily students, but also faculty or a combination of those appears. Geographically, most studies are concentrated in the English-speaking parts of the world, although for instance Sub-Saharan Africa could benefit from development in this area. Not surprisingly, the top three countries by number of publications are USA, UK and Australia. About a third of the articles did not deal with the dimensions of time and space explicitly. Several of the non-empirical articles are among them, and so are a group of empirical articles that examined behavioural intents, perceptions, and attitudes amongst students and faculty. The principal phenomena studied with respect to the bridging of time and space was social media, the most common variety being podcasting, followed by text- and instant-messaging and social networking. Another group addressed how learning management and support systems could be developed to better support flexibility in time and space, or attitudes, intentions and perceptions regarding mobile learning implementations. Results indicate a shift from teacher-centred content delivery approaches towards student-centred communicative approaches. Recent improvements in network infrastructure and device usability seem to afford this development for teachers and students alike. However, a more thorough analysis of the material is required to validate such a claim.

Keywords

BYOD, Higher Education, Mobile Learning, Review

Research Context

This paper discusses the idea of technology-enhanced participation in higher education. Participation breaking the boundaries of time and space has been practised for nearly 200 years; at least from a take-off in the 1830s experiments of distributing higher education through postcards. Later, networked technologies such as TV, telephone-conferences, Internet, and computer conferences were introduced in higher education to break the boundaries of time and space. Nevertheless, during recent decades enhancement of such participation have gone through further changes. From being a practice mainly dependent on computerised desktop technologies, since 2007 a rapid development have included the emergence of small portable, wireless and smart devices such as laptops, smartphones and tablets. In higher education settings, these technologies are possible to apply as tools to support participation in terms of communication between students, teachers and content, thus promoting networked learning. The application of such tools follows at least two different philosophies. One of these emphasises equipment owned and distributed by an institution. In higher education, such a philosophy was commonly practiced in courses and programmes that built on participation in campus-based teaching, and the

application of computer labs. The other philosophy extends participation beyond the physical limits of campus-based education while it emphasises the use of personally owned equipment. The application of such a philosophy has earlier been possible in distance-based education where students and teachers are physically separated. However, it was more in terms of devices that were located in the homes of students, for example, equipment such as desktop computers and telephones. The societal and technological development since the introduction of smart mobile devices implies extended conditions to afford the possibility to bridge space and time. These conditions reach beyond the earlier boundaries of participation while mobile wireless devices afford communication regardless of the location. Students of higher education have extensive access to such devices. Usually, they own and have access to more than one device. Moreover, these devices are integrated into students' and teachers' everyday communication. This condition drives the emergence of a so-called bring-your-own-device (BYOD) philosophy as a foundation for technology-enhanced participation in higher education. The concept of BYOD was coined by Intel in 2009 and originally referred to the practice of people bringing personal devices to their work environment, but it is increasingly being used in educational contexts. The 2015 Horizon Report lists BYOD as an important digital strategy for higher education with a time-to-adoption of one year or less (Johnson, Adams Becker, Estrada, & Freeman, 2015). The application of these devices in higher education settings has been researched within the field of mobile learning since the turn of the millennium. Reviews (e.g., Frohberg, Göth, & Schwabe, 2009) of this field from the first decade of the 2000s shows that mobile devices supported a teacher-centred approach focusing on content delivery. A conclusion from these early studies is that the potential of the communicative aspects was deemphasised. With the development of smart mobile devices that are integrated into everyday life, there is reason to believe that BYOD-philosophies that fosters networked communication between students and teachers has emerged within the study of mobile learning in higher education. Nevertheless, reviews of the recent development are needed to validate such a claim.

Aims and Objectives

Therefore, the purpose of this study is to review, analyse and discuss how mobile devices are applied for networked learning in higher educational settings. This review deals with the following research questions.

- How are mobile devices applied to bridge the boundaries of space and time in higher educational settings?

Design

This literature review is currently in its early stages. A search in major online databases and scientific journals was conducted with keywords "Higher Education" and "Mobile Learning" for articles published during the years 2009 through 2014. This resulted in 166 articles meeting inclusion criteria after removing conference articles, editorials and articles not explicitly addressing higher education and mobile learning. Within these articles, we identified 109 that indicated some form of BYOD philosophy. Other requirements for inclusion were that they had to be in English, and that full text must be available. Due to the fairly large number of articles, most categorizations were made from reading the abstracts only. Those categorizations need to be verified by a more thorough study of the full articles.

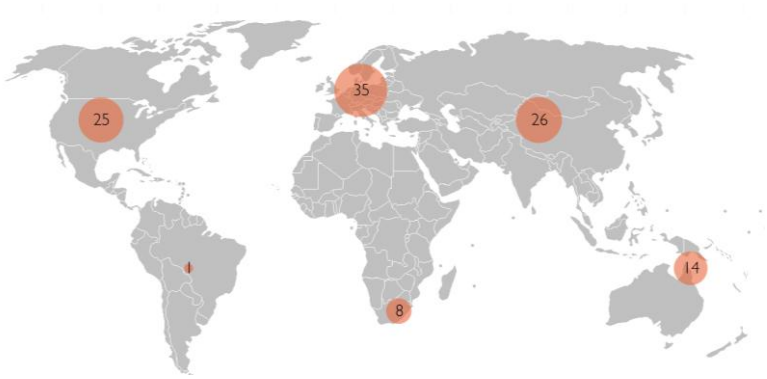

Figure 1. Geographic distribution of articles over continents by first author's affiliation.

The final corpus of 109 articles consists of 93 empirical studies, nine theoretical or argumentative texts, four literature reviews, two method developing works and one meta-analysis. The empirical studies used students (73 studies), faculty (6), or both (14) as subjects. In the results, illustrations for observed phenomena have primarily

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been made with the most well-cited articles according to results from Google Scholar. A wide range of methods is employed, such as surveys (66 articles), case studies (19), action research (6), and design-based research (5). Few studies try to examine educational outcomes (24), even fewer employ methods that allow them to be used for quantitative meta-analysis. Only one appears to use an experimental design. Eight appears to use a quasi-experimental design, of which only four incorporates a control group in the design. The distribution per continent, based on the first author's affiliation, is displayed in figure 1. English speaking regions, like North America, Europe and Oceania are over-represented. South America (1) and Africa (8) shows relatively few publications. Note that all African studies are from a single country, South Africa. The countries with the most publications were USA (21), UK (18), Australia (10), South Africa (8), and Taiwan (5).

Results

Dimensions of space and time

Thirty-six articles *did not explicitly address time and space* dimensions in the abstracts, or such a classification was not applicable. Almost half of the non-empiric articles in the corpus are amongst them (five theoretic, two reviews and one meta-analysis). Most of the empiric articles (15) discuss student and faculty behavioural intentions, attitudes and perceptions towards mobile and networked learning in higher education (e.g., Cheon, Lee, Crooks, & Song, 2012). There were eight articles employing a *same time–same space* model of BYOD use, half of which deals with using student phones with audience response systems during lecturing (e.g., Zarraonandia, Aedo, Díaz, & Montero, 2013). Other examples of same time-and-space applications of mobile learning were: using QR codes in class as a learning aid (Traser, Hoffman, Seifert, & Wilson, 2014), or Augmented Reality applications to visualize architecture models (Fonseca, Martí, Redondo, Navarro, & Sánchez, 2014). Further, eight articles could be identified with a *mix of fixed and flexible space and time* implementations, for instance, using mobile note taking software in and out of class (Schepman, Rodway, Beattie, & Lambert, 2012), or combining class, online and mobile activities to strengthen and develop different abilities related to numerical methods (Cepeda, 2013). A slight majority of the research (56 articles), however, addresses the flexible aspect of mobile technology for networked learning in one way or another, which we examine further in the next section.

Bridging boundaries

Social media in various forms emerges as the principal phenomena being studied for the bridging of time and space in networked learning. *Podcasting* (18 articles) is the most popular use of media in the reviewed articles. Although considered an "old" application for BYOD, it still seems to be of interest with a fairly even distribution of publications over the years reviewed. McKinney, Dyck and Luber (2009) compared listening to downloadable educational podcasts with participation in physical lectures and saw significantly better results for the podcast condition. Abdous, Camarena and Facer (2009) also found positive results with podcasting for multiple instructional purposes (for instance, to critique student projects and exams, in roundtable discussions, or for guest lectures) in language learning. Popova, Kirschner and Joiner (2014) examined the effects of primer podcasts and found that they "help students bridge the conceptual distance between new and prior knowledge, better understand the topics in the lectures and stimulate thinking more deeply about the lecture's content" (p. 330). There are, however, some studies that suggest that students prefer the face-to-face environment over the mobile learning opportunity podcasts can provide (e.g., Kazlauskas & Robinson, 2012). *Text- and instant messaging* (7 articles) is the second most studied social media and is reported to benefit interactivity and student engagement. Two studies report positive educational outcomes, Cavus and Ibrahim's oft-cited experiment in using SMS for new English language word learning (2009), and Hayati, Jalilifar and Mashadi's study of using SMS for teaching English idioms (2013). *Social networking* (7) was the third most studied category. Student perceptions of learning with phones and social networking (Gikas & Grant, 2013) reveals both advantages and frustrations, whereas the perceptions of the use of Twitter to facilitate learning in marketing courses were largely positive in Lowe and Laffey's study (2011).

Aside from social media, a couple of other categories affecting networked learning through the bridging of time and space are emerging. Eight articles are concerned with *system development*, e.g., how university learning management and support systems are perceived by students and/or how they can be improved to foster student acceptance and improve usability (e.g., Koole, McQuilkin, & Ally, 2010). Seven studies explore student *intentions, perceptions or attitudes* with regards to mobile learning implementations (e.g., Lowenthal, 2010). Another three articles are exploring *contextualization* of learning, like Yau and Joy's evaluation of a mobile context-aware framework for managing learning schedules (2009).

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Discussion

The vacuity of studies from Africa, apart from the Republic of South Africa, is notable considering the efforts made to advance higher education in Sub-Saharan Africa using distance- and mobile technologies. It is possible that this is an effect of the exclusion of conference proceedings and language bias, as only English language journals have been included. The authors of this paper have for instance participated in the Rwanda International Conference on Technology in Education 2012 where several mobile learning studies were presented. Similarly, South America might be misrepresented due to language bias. Therefore, bias effects on the bridging of space and time might appear in the data. The result shows that BYOD-philosophies are applied to bridge the boundaries of space and time in higher educational settings. Nevertheless, many of these studies do not explicitly conceptualise it in terms of BYOD. But, these applications rely on various social media to bridge the boundaries of space and time for networked learning. Such applications might indicate a shift from teacher-centred content delivery approaches to student-centred communicative approaches. However, to validate such claim this review project needs to proceed with a deeper analysis of the sampled corpus. Such analysis needs, among other things, to dig deeper into the full-text articles to verify and expand on the preliminary results of this short paper. Moreover, to find a trustworthy result from such analysis it needs to generate descriptive statistics as well as quotes that help to illustrate the problem the review deals with.

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