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Colloquium

Supporting printed books with multimedia: A new way to use mobile technology for learning

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Introduction

The last decade has witnessed an incredible advance in broadband and wireless technologies and their impact on each component of our daily lives. Depending on these developments, from business to health, various sectors try to use Internet and mobile devices intensively to increase their effectiveness and efficiency. Similarly, in accord with Rogers's (1983) adopter categorisation in his famous book *Diffusion of Innovations*, some educators, even though they are accused of being resistant to innovations, are eager to adopt these new technologies in educational settings, especially in distance education where mobile technologies seem to be the unique media to satisfy its famous slogan 'whenever and wherever' (Bradley, Haynes & Boyle, 2006; Churchill & Churchill, 2008; Quinn, 2001; Steinfield, 2003; Virvou & Alepis, 2005).

Mobile learning and printed textbooks

Mobile devices are the only technologies that can be with us everywhere and at all times. Compared with mobile technologies, traditional distance education technologies such as radio, television and computers have several limitations. You cannot carry a radio, television or computer with you all the time. Moreover, radio and television allow one-way communication without providing any interaction opportunity between a teacher and a learner. In contrast, mobile technologies, as long as the designs of the educational materials are developed based on adequate learning theories and instructional design principles, can deliver education when and where it is needed. Mobile technologies can also contextualise the learning environment with its interactive multimedia presentational capabilities such as video, audio, graphics, integrated media and two-way communication (Ally, 2004; Churchill & Hedberg, 2008; Green, Facer, Rudd, Dillon & Humphries, 2005; Traxler, 2007).

In spite of its great potential, the use of mobile devices for learning is still in its infancy and the term 'mobile learning' is still unclear. A significant amount of literature presents the potential of mobile technologies for learning, but most of them are techno-centric and overlook the pedagogical issues (Hwang, Kuo, Yin & Chuang, 2010; Looi *et al*, 2009; Motiwalla, 2007; Traxler, 2007). Currently, for educational aims, mobile devices are used mainly to enhance collaboration through short messaging services, to disseminate/access information via the Internet, to share files, to ask anonymous questions and to deliver courseware and quizzes, etc (Churchill & Churchill, 2008; Churchill & Hedberg, 2008; Motiwalla, 2007).

Some disadvantages of mobile learning devices are small screen sizes and keypads. In contrast, one of the advantages of mobile technologies is that they can be complementary to the existing educational settings and materials (Bradley *et al*, 2006; Motiwalla, 2007). According to Bradley *et al* (2006), mobile devices offer students the opportunity to use multimedia learning content.

However, scrolling on a small screen, where information is text-intensive, is an important factor in reducing the performance, satisfaction and effectiveness of mobile devices for learning (Jones, Buchanan & Thimbleby, 2003). Therefore, learning content designed for mobile devices should include less text and more audio in place of textual information. In addition to auditory materials, graphics, animations and videos can also be used to develop learning content for mobile devices (Bradley *et al*, 2006). Moreover, mobile devices should help a learner 'make meaning of complex information, and this must be done within the context of the task at hand' (Albers & Kim, 2001). It is clear that further research is needed to show the advantages, challenges and limitations of mobile devices for learning and for appropriate learning pedagogies.

2D bar code technologies such as QR Code (a matrix code (or two-dimensional bar code) created by Japanese corporation Denso-Wave in 1994) and Microsoft Tag offer the possibility of the easy use of multimedia content such as video, audio, animation, pictures, etc, to support learning from printed textbooks more effectively and meaningfully (see Figures 1 and 2). By simply scanning or snapping a printed bar code from a mobile phone, one can quickly gain access to any website or multimedia content such as learning objects via the Internet. Even though 2D bar code technologies are developed for different aims such as advertising, this innovation will simplify the application of Mayer's (2001) assumptions concerning the use of multimedia in learning. According to Mayer (2001), 'learners can better understand an explanation when it is presented in words and pictures, rather than when it is presented in words alone' (pp. 1, 63). Here, words and pictures can be called multimedia, including printed text, on-screen text, static pictures, animated pictures, videos and audios.

In his book, Mayer (2001) declares that while learning from the text-only books results in the poorest retention and transfer performance, learning from books that include both text and illustrations and from computer-based environments that include on-screen text, illustrations, animations and narrations results in better performance. Even though text-only books are not effective, they are still one of the main learning resources for traditional face-to-face and distance education environments. Therefore, integrating mobile multimedia into printed textbooks with the help of 2D bar code technologies could facilitate meaningful and deeper learning. Depending on this integration, a person will be able to use both his/her input channels (dual channel). When exposed to inputs from auditory/verbal and visual/pictorial channels, a learner can build verbal and pictorial representations of these inputs and build connections between them, resulting in meaningful and deeper learning (Mayer, 2001; Mayer & Moreno, 2003). In addition, Mayer

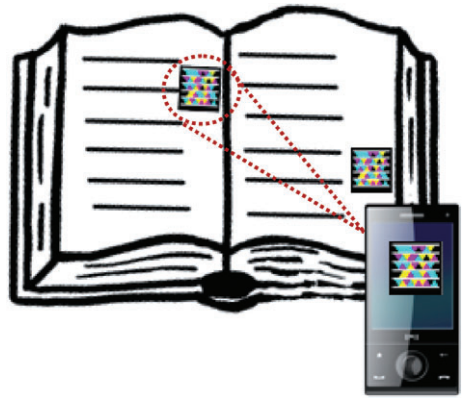

Figure 1: Scan or snap the 2D bar code on the textbook

Figure 2: Access the multimedia learning content as soon as scanning a 2D bar code

(2001) points out that well-designed multimedia content can activate a learner's cognition even if the textbook is boring or the learner is behaviourally inactive, and this activation results in more meaningful and deeper learning.

In addition to meaningful learning, the integration of mobile technologies into printed textbooks with the help of 2D bar codes has the potential to reduce cognitive load. Mayer and Moreno (2003) declare that a person's cognition can process a limited amount of input from auditory/verbal and visual/pictorial channels at a time. In contrast, meaningful learning can require intensive cognitive processing to select, organise and integrate both of the words and images. Split attention (Sweller, 1999), for example, is one of the types of cognition overload. In a computer-assisted learning environment, when text is placed at the top of the page and the associated pictures are placed at the bottom, a learner's attention can be split between the two. She/he cannot view and read these inputs at the same time. Mayer and Moreno (2003) offer narration of the words to present the on-screen text, because the narration of words allows a learner to use his/her dual channels—processing the words in the verbal channel and processing the images/animations in the visual channel. Therefore, the processing workload in the visual channel is reduced. Bradley *et al* (2006) find that using more auditory input than textual information is particularly beneficial, because a learner can focus on audio more easily than text in a mobile environment. Supporting a printed textbook with mobile multimedia, such as narration to depict visuals such as pictures, graphics and animations, may increase the effectiveness of learning.

Conclusion

In short, using 2D bar codes to support printed textbooks with mobile multimedia can increase the effectiveness of these traditional and indispensable knowledge resources for both face-to-face and distance education environments in overcoming the cognitive load problem.

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