Chapter 5
Emerging Technologies for Interactive Learning in the ICT Age

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ABSTRACT
Based on the review of educational technology research, this chapter describes and discusses how emerging technologies are integrated into the teaching and learning process to facilitate the learner-content, learner-learner, learner-instructor, and learner-interface interactions, as well as the new opportunities and challenges brought by them. Technologies discussed in this chapter are categorized into four types based on their distinct interactive features. Guidelines for applying them to facilitate interactive learning are proposed at the end of the chapter, based on the case studies of four interactive learning systems selected from the literature.

INTRODUCTION
Interactive Learning Systems (ILSs) can be defined as learning systems in which different components act upon each other to facilitate learning. The inherent interactive features of Information and Communication Technologies (ICTs) (Sims, 1998) are considered an important component of ILS (Sabry & Barker, 2009) that affects students’ learning processes. The advancement of ICT, especially the rapid development of emerging technologies, provides great potential with respect to the enhancement of interactivity in its complex level and functionality. As a result, interactivity that began with simple “click-to-select” in early teaching machines now includes infinite, user-created virtual environments such as Second Life. At the same time, the focus of ILS design
Emerging Technologies for Interactive Learning in the ICT Age

has shifted from exploiting new technologies to exploring the integral relationship between ICT and learning theories, seeking to design learning systems based on robust theoretical foundations (Jonassen, Peck, & Wilson, 1999; Vrasidas, 2000; Mandell, Sorge, & Russell, 2002; Kirschner, et al., 2004; Wang, & Woo, 2007).

To understand this shifting paradigm in ILS design, the four sections in this chapter focus on the various ILS design features that can be supported by the emerging technologies and collaborative learning theory. The first section provides a brief definition of ICT and four types of interactivities, and discusses the role and potential of ICT in promoting such interactivities in learning systems. The second section examines the different interactive features supported by emerging ICT tools. All ICT tools discussed in this section are new technologies that have emerged in the past decade, categorized into four types: (a) educational networking; (b) web-based learning; (c) mobile learning; and (d) classroom equipment. The third section describes four cases of instruction from the literature to show what interactive features are made available in those cases by the ICT tools; and how such features are used to facilitate different types of interaction. The fourth section then explores the affordances of ICT tools and their implications for interactive learning under the theoretical framework of collaborative learning. The chapter concludes by proposing general guidelines for applying emerging technologies in designing effective ILS.

THE ROLE OF ICT IN INTERACTIVE LEARNING SYSTEM DESIGN

Information and Communications Technologies (ICTs) are defined as “a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information” (Blurton, 1999, p.1). The advancement of ICT has created many exciting opportunities in field of education, with upgraded functionality and availability of new tools. From teaching machines to personal computers, from E-mail to Web 2.0, from audio-visual aids to interactive multimedia, the emergence of new technologies resulted in significant changes to our educational systems, creating more blended and personalized learning modes with an emphasis on activity, collaboration and exploration. However, in contrast to the rapid development and wide use of ICT in all educational sectors in the past few decades (Anderson & Kanuka, 2003), little progress has been seen in students’ academic performance during this period. For example, a report published by the U.S. Department of Education (2010) reveals that the average reading and mathematics scores for American 17-year-olds in 2008 were not significantly different from the scores in the early 1970s. Such finding can be rather heart-sinking considering that most schools didn’t even have a computer in the early 1970s.

In fact, the criticism and suspicion over the role and impact of ICT in education has long existed, symbolized by the famous debate between Clark (1983, 1994, 2001) and Kozma (1991, 1994) in the early 1980s and throughout the 1990s. After reviewing the comparative studies on ICT and media in education, Clark (1983) concluded that “…media do not influence learning under any conditions … that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition” (p.445). Kozma (1991) on the other hand, emphasized the “integral relationship” between media and instructional methods; and argued that “many of these methods would have been difficult or impossible to implement in other media” (p.205). He acknowledged the unique affordances, capabilities, and benefits of technologies, but also cautioned that the ability to exploit the benefits of technologies depends on an understanding of the relationship between technologies’ capabilities and the nature of effective learning.
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