Chapter 2
Interactivity of Information Representations in e-Learning Environments

Kamran Sedig
The University of Western Ontario, Canada

Paul Parsons
The University of Western Ontario, Canada

ABSTRACT

This chapter is concerned with interactivity of information representations in e-learning environments (ELEs)—where interactivity refers to the quality or condition of interaction with representations in an ELE. An ELE is any interactive computer-based software that mediates and supports learners' engagement with information. This chapter draws upon literature from the areas of human-information interaction, distributed cognition, and learning sciences with the goal of developing and exploring the features of a preliminary framework for thinking about interactivity in the context of ELEs. In this chapter we provide some background and motivation for such a framework, and identify and elaborate upon 10 structural elements of interaction that affect the interactivity of information representations: actual affordances and constraints, articulation mode, control, event granularity, focus, action flow, reaction flow, propagation, transition, and perceived affordances and constraints. Each of these has an effect on the learning and cognitive processes of learners, and the overall interactivity of an ELE is an emergent property of a combination of these elements. Collectively, these elements can serve as a framework to help thinking about design and analysis of interactivity in ELEs.

DOI: 10.4018/978-1-61350-441-3.ch002

INTRODUCTION

Interactive e-learning environments have the potential to facilitate learning; their effectiveness, however, has not lived up to original optimistic expectations (Kulik & Kulik, 1991; Jonassen & Reeves, 1996; Alessi & Trollip, 2001). In this chapter we use the term e-learning environment (ELE) to refer to any interactive computer-based software that mediates and supports learners' engagement with information. Examples of ELEs include interactive mathematical software, interactive physics simulations, interactive biology animations, and interactive geovisualizations. These ELEs facilitate learning through activities such as reasoning about the growth of fractal patterns, analyzing the workings of a cell, exploring weather patterns and ocean currents, investigating the structure of chemical bonds, and so on. The main characteristic of ELEs is that they display and allow interaction with information in order to facilitate learning. As such, the framework proposed in this chapter treats ELEs as technology-independent; that is, they may be implemented with desktop computers, tabletop computers, tablets, and so on, all of which may or may not be networked to other sources of information such as the internet.

When ELEs are designed well they can support information processing functions of their learners to carry out cognitive activities (Brey, 2005). In the past, many ELEs have played a secondary role in cognition and learning; that is, they served simply as aids or amplifiers of cognitive abilities (Dror, 2007). This is especially the case when ELEs are thought of as vehicles for passively maintaining and displaying information, rather than as technologies that engage learners in reflective, critical thinking (Jonassen & Reeves, 1996; Jonassen, Peck, & Wilson, 1998). When designed with their interactive features at the forefront of consideration, ELEs not only can amplify learners' cognitive abilities, but also can become partners in cognition (Salomon & Perkins, 2005; Dror, 2007; Bruner, 2005). In this manner, ELEs have the potential to reorganize learners' thoughts and to facilitate deeper understanding of information (Pea, 1985). ELEs, by distributing the information-processing load of the visual information, can allow learners to think in partnership with the represented information (Sedig & Sumner, 2006). The theory of distributed cognition states that the internal mental processes of the learner, combined with external representations of information, form a system with which the learner's cognition is distributed across. Thus learning cannot be analyzed from the perspective of an individual in isolation, since it requires an interplay between the mind of an individual and things in the external world. In other words, learning is an emergent property of interactions among internal and external representations of information (Karasavvidis, 2002). This is true of a learner solving a problem using an abacus, a slide rule, or a computer. In order to perform high-level learning activities, such as reasoning and decision making, one often combines and processes information from both internal and external representations, in an integrative and dynamic manner (Zhang, 2000). In the case of ELEs, representations such as text, maps, and images comprise the interface, and the learner's cognition is distributed across their mental representations and the representations of the ELE. Thus the careful design of appropriate representations is of critical importance for supporting learners' thought processes.

It is often the case that researchers discuss only high-level details of ELEs, such as pedagogy and learning theory (Alessi & Trollip, 2001). However, if the low-level details of ELEs, such as interaction and interactivity, are not recognized and taken into consideration systematically, they may not achieve their intended goals, and can even have negative effects on learners (Dascal & Dror, 2005). A number of studies have shown that these low-level details affect the quality of learning (e.g., Golightly, 1996; Sedig, Klawe, & Westrom, 2001; Liang, Parsons, Wu, & Sedig, 2010). For example, Sedig et al. (2001) showed