Chapter 4
Importance of Interface Design in e-Learning Tools

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ABSTRACT
This chapter discusses a number of issues pertaining to interface design in e-Learning Tools (ELTs)—where ELTs refer to computer-based software that mediates and supports learners’ engagement with educational information. The design of the interfaces of ELTs involves two main components: representation and interaction. This chapter discusses eight issues that need to be considered when designing and evaluating ELTs: 4 regarding representation design and 4 regarding learner-information interaction design. The issues of representation design are: (1) selecting, (2) coupling, (3) encoding, and (4) scaffolding. The issues of interaction design are: (1) focus, (2) flow, (3) multiplicity, and (4) compositeness and externalization. Each of these is discussed and one study involving a tool is presented for each issue to highlight the importance of paying attention to that issue when designing and evaluating the interface of ELTs.

INTRODUCTION AND BACKGROUND
In the early days of the use of computers for educational purposes, there was a great deal of optimism about the role that they would play in improving the quality of learning (Alessi & Trollip, 2001). However, later on this optimism gave way to questions about whether computers actually made any positive effects on learning (Kulik & Kulik, 1991). Much of the lack of optimism was because of how computers had been used to deliver educational content—that they were simply used as vehicles for displaying and communicating information (Jonassen & Reeves, 1996). Simple delivery of content in the form of digitized information does not necessarily offer...
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any greater advantage over delivery through static media such as books. The main potential of computational tools lies in the fact that they can allow learners to actively interact with educational content (Jonassen & Reeves, 1996). Indeed, being interactive should be an essential characteristic of computer-based educational tools (Aldrich, et al., 1998; Cairncross & Mannion, 2001).

In this chapter I use the term e-Learning Tool (ELT) to refer to any computer-based software that mediates and supports learners’ engagement with educational information. Accordingly, ELTs are not meant to simply disseminate information to learners, nor behave in a didactic fashion to teach content directly, but rather act as tools that learners use to think about the information in an active manner (Jonassen, et al., 1998). In this chapter, I am specifically concerned with the interface of ELTs. The interface of an e-Learning Tool (ELT) is its epistemic locus (Brey, 2005; Liang, et al., 2010). This is where the mind meets a body of information and engages with it. Through the process of interaction with it, information is given meaning and gets integrated into learners’ mental structures. This leads to the conversion of information into personal knowledge and understanding.

Interface design is challenging. A great deal of research effort has been devoted to figuring out how to make tools easy to use and their interfaces intuitive so that users can perform their tasks efficiently and effectively (Preece, et al., 2002). However, the goal of ELT design is not to always minimize effort and make things easier for learners. Rather, the main idea is to encourage and help learners to consciously and reflectively think about the material with which they are engaged (Sedig, et al., 2001). The interface of such tools, besides needing to be easy to learn and intuitive to work with, should be able to engage learners in analytic exploration, hypothesis formation, knowledge construction, and interpretation of information.

The interface of any ELT is comprised of two components: representation and interaction (Sedig, 2004; Yi, et al., 2007). The proper design of both these components of an ELT plays a crucial role in its utility and efficacy. Design of the representation component of an ELT is intended to create encodings of information that support learners’ perceptual as well as cognitive processing of the information through observation. In other words, representation design is concerned with how information should be encoded and displayed. The same information (e.g., concepts and/or structures) can be encoded and presented to learners using different types of representations. Different representation types can influence learners’ reasoning and thinking about the encoded information differently, as well as affect the amount of cognitive effort that learners need to exert to carry out their mental activities (Zhang & Norman, 1995; Cheng, et al., 2001).

Design of the Learner-Information Interaction (LII) component of an ELT is intended to support how learners act upon the represented information. LII design is concerned with what can and should be ‘done’ with the represented information, what ‘actions’ should be made available to learners to work and think with the represented information, and how to implement these ‘actions’ and their subsequent ‘reactions.’ LII design focuses on the discourse and dialogue that takes place between learners and the represented information. It is through interaction with the representations that learners can restructure and modify them in order to optimize and enhance their epistemic utility for learning purposes. Just as there can be different ways of representing information, there can also be varied ways by which learners can interact with these representations (Sedig & Sumner, 2006). Some ways are more conducive to reflective thinking and learning purposes, while others can have undesirable learning outcomes (Sedig, et al., 2001; Sedig, 2009).

Interactive learning activities involving represented information can be analyzed at multiple levels of granularity: tasks, sub-tasks, actions, and events. For instance, given a learning activity, such as understanding a complex 3D mathemati-
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