Chapter XXVI
Instructional Effectiveness of Learning Objects

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ABSTRACT

There has been a clear lack of rigorous empirical evidence on the effectiveness of learning objects (LOs) in education. This chapter reports the results of four experimental studies that investigated the effectiveness of drill-and-practice and simulation-type LOs in comparison to more traditional teaching methods. Results suggest that a simulation LO that works as a tool to support students' exploration process can be especially helpful to students' inquiry learning, but drill-and-practice LOs are less effective than traditional teaching methods in procedural learning. Findings also strongly suggest that we should not see LOs and traditional methods as rivals but as being complementary to one another. The authors hope that the results can inform teachers, instructional designers, and content producers as to what aspects they should consider when designing and implementing LOs in different educational contexts.

INTRODUCTION

High expectations have always been placed on new learning technologies, and the worldwide enthusiasm now directed at learning objects (LOs) presents no exception. Over the last few years, vast amounts of resources have been dedicated to the development, use, and standardization of LOs and LO repositories, in both the public and private sectors (e.g., McCormick & Li, 2006; Rehak, 2006). Several books (e.g., Littlejohn, 2003; Spector, Orchazda, van Schaak, & Wiley, 2005; Wiley, 2002a), special issues of journals, (e.g., *Educational Technology*, 2006; *Journal of Educational Multimedia and Hypermedia*, 2004; *Learning, Media and Technology*, 2006), and symposia (Duval, Hodgins, Rehak, & Robson, 2003; Visser & Amirault, 2002) have been devoted to LOs. Some authors, from educators (e.g., Gibbons, Nelson, & Richards, 2002; Urdan & Weggen, 2000) to corporate leaders (Hodgins, 2006) believe that the LO approach offers the potential to transform education and enables it to reach a new level. Wiley (2002b) goes even further, claiming that technological innovations such as the LO approach can result in a paradigm shift in the way people learn and the ways in which educational materials are designed, developed, and delivered to the learners.

Even though there is no consensus about the definition (McGreal, 2004), learning objects (LOs) are generally understood to be digital learning resources that can be shared and accessed through the Internet and reused in multiple teaching and learning contexts. The core idea behind the LO approach is to make educational materials broadly accessible, searchable, and reusable beyond their original contexts (Nurmi & Jaakkola, 2006). Although sharing and reusing of digital and non-digital instructional materials has been a goal of different educational practices for a long time (e.g., Collis & Strijker, 2002; Parrish, 2004), reuse has been difficult with traditional digital resources, since they have been designed with one target audience or context in mind. LOs, in contrast, are specifically designed for reuse, flexibility, and interoperability (McGee & Katz, 2005). This is the true beauty of LOs—they can be used by different people, for different purposes, and in different contexts (Bennett & McGee, 2005). In an ideal situation, little if any customization would be required to reuse LOs in a new environment (Richards, 2002). In these situations, a teacher could pick and choose from among the available LOs, simply aggregating them into the new entity. This requires that LOs have no tight contextual dependencies because contextual dependencies limit possible audiences. However, in most cases the original design context of an LO and its contexts for reuse do not correspond, and the LO must be contextualised. This contextualisation is vital, because without a context, an LO (like any learning resource) has very little educational value (Parrish, 2004). LOs can be contextualised by being embedded within various instructional activities (Nurmi & Jaakkola, 2006).

Besides their flexibility, LOs can offer other advantages over traditional teaching methods. For instance, due to their illustrative power, simulation type LOs are generally considered to be very effective tools for learning many complex phenomena. They can provide a safe and customizable learning environment in which students can perform experiments virtually by manipulating variables, observing the outcomes, and receiving feedback for their actions (de Jong, 2006). In contrast to a traditional laboratory working, a simulation can reveal processes or abstract laws that are invisible in natural systems and may provide support for perceptual understanding of concepts that might be otherwise too abstract and difficult to comprehend (Goldstone & Son, 2005). Furthermore, a simulation can reduce the cognitive demands of physical laboratory experiments by providing students with a "cleaned-up," idealized version of the complex and messy real world, while still retaining a necessary level of theoretical authenticity (Hennessy, Deaney, & Ruthven, 2006). The major criticism of the use of simulation LOs has been that when using simulations, students are asked to learn in fundamentally different way than that of scientists in an authentic environment (Steinberg, 2000). The other concern has been that a simulation may oversimplify complex systems.

The benefits that other types of LOs can provide for learning in comparison to traditional teaching methods are less obvious. For instance, a majority of the available LOs are very simple drill-and-practice applications (McCormick, Jaakkola, & Nurmi, 2008). The main aim of a drill-and-practice LO is to transmit the content from the LO to the learner, who passively receives and acquires the prescribed knowledge and reproduces it when required (Nurmi & Jaakkola, 2006). A good ex-