

# Innovations in Learning Technology

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## INTRODUCTION

New products and ideas are continually being developed and introduced into the workplace. A cursory observation of any field, for example, medicine, telecommunications, transportation, information management, or the military, will reveal a wide array of new technologies and techniques that have been introduced over the last decade. Many of these innovations have radically transformed the way we work and live. Innovative technologies are also radically changing the way we teach and learn. Among the most well-known recent examples of these learning technologies are multimedia, educational games, software for developing presentations, video conferencing, and the World Wide Web (WWW). In addition, the continuous expansion of the power and availability of technology means newer, better, faster, and cheaper technologies will always be available to assist educators in transforming the learning process.

The design, development, and use of learning technologies are processes synonymous with change and innovation. Any new technology offers a number of potentially important enhancements to the way people teach and learn (Surry, 2005). In order to better understand the inherent link between technology and innovation, we must first understand the historical development of learning technologies, and become familiar with the different characteristics of learning technology innovations.

## BACKGROUND

The field of learning technology has a long history of innovation. Saettler (1968) traces the earliest learning technology innovations back to the instructional practices of the Elder Sophists in ancient Greece. Thorndike's efforts to make the study and practice of education more scientific (Shrock, 1995) and Pressey's early work with teaching machines in the 1920s (Troutner, 1991) are commonly cited as key factors in the

birth of modern learning technologies. The success of large-scale training efforts during World War II led many researchers to focus on media, especially audiovisual instruction, as an important learning technology (Ely & Plomp, 1996). These seminal developments were followed by a series of major technological innovations including programmed instruction, instructional films, instructional radio, and instructional television (Saettler, 1968). Concurrent with the development of these new learning technologies, innovative theories such as formative evaluation, behavioral psychology, the systematic design of instruction, and criterion-referenced testing represented significant innovations in the teaching and learning process (Reiser, 2007; Shrock, 1995).

In addition to these older innovations, many other innovations in learning technology have been introduced in more recent years. Among the newer innovations are the Internet, electronic performance support systems, and learner-centered environments (Reiser, 2007). Jacobs and Dempsey (2007) describe a number of learning technology innovations that will have an impact in the near future including object-oriented programming to make the development of lessons easier, faster, and less expensive, electronic training jackets, and artificial intelligence. The number of innovations to enhance learning will likely expand at an increasingly fast pace in the future. As the pace of innovation quickens, educators will have to become more critical and better-informed consumers of innovation in order to allocate resources most effectively and to decide between competing technologies. Developing a framework for categorizing types of innovations will be a vital step in helping educators become better consumers of innovation in the future.

## TYPES OF INNOVATIONS

Innovations come in a variety of forms. Many of the most well known educational innovations have been technology-based, for example, computers, smart

boards, digital projectors, and virtual reality simulations. Other innovations have involved new processes or theories. Constructivist learning environments (Jonassen, 1991), authentic assessment, social learning (Bandura, 1977), and multiple intelligences (Gardner, 1993) are examples of process or theoretical innovations that have influenced the learning process in recent years. Still other innovations have had a more organizational scope. Large-scale school reform efforts, national curriculum restructuring movements, standardized assessments, and the emergence of fully online universities are all examples of organizational innovations that are currently in use.

Every change is different. Every new product or process contains a unique combination of characteristics that interact in complex, unpredictable ways. For example, some innovations require widespread modifications to an educational organization while others are limited to a small number of people. In addition to the scale of the innovation (widespread or local), there are numerous other characteristics by which an innovation can be described.

**Dimensions of change.** In an effort to understand the various characteristics of an innovation, to develop a standard terminology, and to create distinctive categories of innovation, many researchers have discussed the various dimensions of change. Pettigrew and Whipp (1991), for example, discuss a change in terms of its content, process, and context. Utterback (1996) describes innovations as being either incremental or radical. Siegler (2006) describes the dimensions of change from a psychological perspective as path, rate, breadth, variability, and source. Rogers (1995) writes that potential adopters perceive an innovation in terms of five attributes: relative advantage, compatibility, complexity, trailability, and observability. Gilbert (2001), writing specifically about learning technologies, offers four dimensions: individualization, standardization and access, personalization, and “communitization.”

At this point, there is no single widely accepted typology of learning technology innovations. Developing such a typology would be an important step in better understanding the potential for different categories of learning technologies to enhance education, and would lead to new insights into the complex problem of fostering innovative uses of learning technologies. It is likely that elements of a general typology would be based on the dimensions of change theories, and would include such basic characteristics as the form

of the innovation (technology or process), its scale (macro- or micro level), sequence (synchronous or asynchronous), and intentionality (mandatory or voluntary participation).

**Form.** The form of an innovation refers to whether the innovation is primarily a product, a process, or a system. A product innovation is a tool or aid, such as a computer or a data projector. A process innovation is a new theory, practice, or instructional method, such as moving from pen and paper tests to portfolio assessments. While many researchers (e.g., Joseph & Reigeluth, 2005) combine the terms product and process, and correctly suggest that all innovations contain at least some aspect of both product and process, the two will be discussed separately here.

Product innovations can be defined as any new tool that is employed to the attainment of a goal. Product innovations (e.g., computers, projectors, wireless networks) are the types of innovations most people think about when they talk about technology. They are physical, tangible, and observable. Process innovations are more difficult to observe and harder to describe. They can be defined as any modification to an existing practice that is not dependant on new tools to be effective. Process innovations (e.g., new teaching techniques or theories) are less tangible and are often not thought of as technologies by most people. The current trend, however, is to use a broader definition of technology that includes not only tools and systems, but the scientific and technical knowledge needed to use the tools effectively (Cardwell, 1995). Under this broader definition, learning technology innovations include not only products such as computers, but new theories and practices, as well as new systems for designing, developing, and delivering instruction.

**Scale.** Scale refers to the impact an innovation has, or is intended to have, on an organization. In general, we tend to think about impact as being either macro level or micro level (Garcia & Calantone, 2002; Surry & Farquhar, 1997). Macro level innovations impact a broad spectrum of people or processes within an organization, often requiring significant modifications to the organization’s structures and policies. Macro level innovations are somewhat analogous to Utterback’s (1996) concept of radical (or discontinuous) innovations in that they often require an organization to completely rethink the skills, processes, products, and systems that are currently used. Implementing a macro-level learning technology change, a system-wide school restructuring

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