

# Educational Technology and Learning Theory

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## INTRODUCTION

This overview briefly reviews the history of educational technology and surveys relevant learning theory. In order to understand fully computer-based learning in the United States, one needs to have a more general sense of the history of educational technology (Berg, 2003). Common learning theories that have been applied to computer environments also need close examination because they provide the rationale for specific approaches and learning strategies. In this review, one sees the important influence behavioral and constructivist theoretical models have had on educational-software design in America. Finally, cooperative learning and learning-styles theories are outlined because of their relevance to specific computer-based teaching methods.

Many scholars trace the use of educational technology, broadly defined, to early symbolic systems. According to Paul Saettler (1990), one of the leading historians in the field, educational technology in a broad sense can be traced back to when tribal priests presented systematized knowledge and used early sign writing to pass on knowledge. He points out that the more advanced the culture, the more complex educational technology became. Saettler observes that there is wide disagreement concerning theories in the field of educational technology. However, learning theory is a key to the field because behavioral sciences applied to problems of learning and instruction are fundamental to evolving educational technology. One might trace the beginning of educational technology in America to the use of lantern slides for educational purposes in the American Lyceum and Chautauqua movements, early continuing or extended education programs. Particularly in the Chautauqua educational programs aimed at adults wanting to continue their education, the slides were an integral part of the way programs were presented to large audiences.

Later, what became known as the visual instruction movement promoted visual approaches to teaching to combat what they labeled “verbalism” in the classroom.

One influential figure in this movement was Edgar Dale, who developed a schema he called the “cone of experience,” a notion emphasizing experiential learning over verbal symbols. The visual instruction movement was concerned primarily with the use of specific media, while educational technology is oriented more toward psychological principles and the total teaching-learning process.

In addition to the visual instruction movement, the Lancasterian method of instruction involving systematic instruction around memorization and drill was an early influence on educational technology, particularly behaviorist approaches. Behaviorism emphasized the behavior of the learner and reinforcement, and was first introduced by John B. Watson and then developed most extensively later by B. F. Skinner. Skinner saw curriculum as forming behavioral objectives, or arranging contingencies of reinforcement. In relationship to the progressive and constructivist learning theory, Thorndike was probably the first modern instructional technologist, replaced only later by John Dewey in his broad influence on American education. The Dewey-inspired progressive movement provided the philosophical grounding for what later became constructivism. So we can see that early on there were two main techniques for the use of media in the classroom: one concentrating on behavior, and another focusing on process and experience-based learning.

A pioneer in film technology and an intellectual interested in education, Thomas Edison was one of the first to produce films for classroom use. In addition to Edison, many colleges and universities were involved in educational film production as early as the 1910s with Yale University and the University of Minnesota being large players in this early film production. Demand for training films during World War I led to an increase in educational film production. However, by the late 1920s and early 1930s, educational film companies had financial troubles.

World War II was a turning point for educational film both in terms of number and technique. The use of educational films was part of the official policy

of the war department, and consequently this led to the production of six times more educational films than had been created up to that point. After World War II, additional universities became involved in educational filmmaking including the University of Chicago, USC, Ohio State, University of Wisconsin, NYU, the University of Indiana, University of Minnesota, Iowa State University, University of Michigan, Boston University, and Syracuse University. The first academic research on instructional films was done in 1912. The research on educational use of instructional film is remarkably thin.

The use of recorded and broadcast sound was another important type of educational technology used in the United States. Thomas Edison was also responsible for the invention of the tinfoil phonograph in 1877, which made the first language laboratories possible. After World War I, university-owned radio stations became a common phenomenon, and by 1936 there were 202 such stations across the country. Federal regulation, the rise of commercial radio networks, limitations of the broadcast signal, lack of a target population, and minimal faculty involvement were reasons identified for the failure (Pittman, 1986; Saettler, 1990).

The use of videotapes and broadcast video were also important developments in educational technology. In the research literature, educational television usually refers to programs that have a broad cultural purpose such as *Sesame Street*, while instructional television (ITV) is generally used to describe whole videotaped courses. The University of Iowa started the first instructional television station in 1953. The 1958 National Defense Education Act (NDEA), Title VII, specifically provided for presenting academic subject matter through media and thus encouraged its development. In the 1970s, community colleges in America developed telecourses to deliver course work. Television eventually lost the interest of funders who instead turned in more recent years to the delivery of education through computers.

As early as the 1950s, educational technology began to incorporate the computer. The programmed instruction movement revived individualizing instruction notions and although it declined, its influence lived on past the 1960s. Computer-assisted instruction (CAI) was first used in the 1950s, with much of the early work done at IBM. CAI growth occurred in the mid-1960s, but faded quickly by the late 1960s. The typical CAI program modes were drill and practice and tutorials

with a strong degree of author or instructor, rather than learner, control. Later, intelligent computer-assisted instruction (ICAI) or intelligent tutoring systems (ITS) were developed from a cognitive science approach to educational technology. These computer-based instructional movements were influenced by specific learning theories.

## **LEARNING THEORY: BEHAVIORISM VERSUS CONSTRUCTIVISM**

Both behaviorists and constructivists have sung the praise of technology, and to some extent, probably exaggerated its promise. For constructivists, computers may finally provide the means by which the very labor-intensive educational philosophy of Dewey may be put into practice. In more recent times, those interested in concept mapping, the value of learning computer programming, and full-immersion simulations have all to some degree based their approaches on constructivism. When considering cognitive models, the task of educational technology is to focus on knowledge construction and to understand what cognitive structures users bring to the learning environment. On the other hand, behaviorists have long held sway in the field of computer-based training (CBT), with the tireless repetition and utilization of clear behavioral learning objectives as a key element of these training programs. A brief summary of the behaviorist and the constructivist positions on technology in education and the key theorists is useful for charting future directions for technology-enabled education.

### **Piaget**

Jean Piaget, a primary influence on constructivist theory, developed a theory of learning connected to human development through his observation and study of children. Piaget's background was in science and thus notions of Darwinian evolution in understanding learning in children heavily influenced him. After studying adaptation of organisms to their environment, Piaget reasoned that an organism's intelligence was embodied in structures with latent tendencies for development that could be brought out by appropriate interaction with the environment (Gardner, 1973). The research problem of intelligence for Piaget was to try to discover the different methods or tendencies for think-

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