

Learning Principles and Approaches

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Introduction

Developing effective materials (in any medium) that facilitate learning requires an understanding and appreciation of the principles underlying how people learn. Just as engineering is the application of basic principles from physics and chemistry, and as medicine is the application of basic principles of biology, instruction is the application of basic principles of learning.

However, no universal agreement exists on how learning occurs. How psychologists have viewed the principles of learning has changed significantly throughout the 20th century.

Many ardent behaviorists maintain that both cognitivists and constructivists are "unscientific" because they deal with ideas that cannot really be observed and measured. Many cognitivists, or those who combined elements of both behavioral and cognitive learning psychology, oppose the constructivist approach, criticizing it for being more philosophy than science, for being unprovable, or for not adding anything new to the debate. Radical constructivists argue that educational institutions are in grave danger if they continue to function based on behavioral or cognitive principles and that our educational systems must be redesigned along constructivist principles. In reality, those who cling to a single approach (behavioral, cognitive, or constructivist) are relatively few, and the majority of learning psychologists, educators, and instructional designers prefer to merge various principles of behavioral, cognitive, and constructivist paradigms into one integrated approach.

The following sections describe the primary principles of these three learning paradigms. Understanding these principles is essential to understanding the ongoing debate in the field of education about the best instructional approaches. It is also essential to the debate among instructional designers about how multimedia should be used to design effective educational materials. Following the description of the principles, more about this lively debate and how it is influencing the design and use of educational multimedia is discussed.

Behavioral Psychology Principles

... Ivan Pavlov's research concerned classical conditioning. The basic principle of classical conditioning is that repeatedly pairing a neutral stimulus with a natural stimulus (one that elicits a natural response) causes the neutral stimulus also to elicit the response. The implication is that humans learn many behaviors because of their pairing with basic human needs and responses, such as the need for food, sleep, reproduction, and the like.

Also around the turn of the twentieth century, Thorndike conducted research that is now termed operant conditioning: the use of rewards and punishments to modify behavior. This work was refined and greatly popularized by B. F. Skinner and gave rise to the behavioral school of psychology and learning, the dominant paradigm of learning psychology for much of the 20th century.

Skinner went on to demonstrate that particular patterns of reinforcement or punishment result in different rates of learning and degrees of retention of what is learned.

In addition to his research on operant conditioning, Skinner became a strong proponent of a behavioral philosophy, maintaining that the psychology of learning should restrict itself to the study of observable behaviors and environmental events. He maintained that discussion or research of nonobservable constructs, such as memory, beliefs, or the mind, were detrimental to the study of learning. He also maintained that strict behavioral psychology principles could be used to improve education dramatically.

(Skinner, 1968) and society in general (Skinner, 1948). Many psychologists followed his lead and, through much of the twentieth century, the study of learning in the United States was dominated by behaviorism.

Behavioral psychology and learning theory led to developments, such as programmed textbooks, classrooms based on token economies (Ayllon & Azrin, 1968), and, less directly, to mastery learning programs (Block, 1980) and programs of individually prescribed instruction or IPI (Glaser, 1977).

Cognitive Psychology Principles

Cognitive psychology takes its name from the word cognition, which means the process of knowing. Cognitive psychology places emphasis on unobservable constructs, such as the mind, memory, attitudes, motivation, thinking, reflection, and other presumed internal processes.

Of the different schools of cognitive learning psychology, perhaps the most dominant is based on an information-processing approach. Growing in part out of work in computer science on artificial intelligence, information-processing theories attempt to describe how information in the world enters through our senses, becomes stored in memory, is retained or forgotten, and is used. They claim that information is stored initially in short-term memory and must be used or organized to become stored more permanently in long-term memory. Most information-processing approaches include the notion that memory and thinking have a limited capacity, which accounts for failures in attention and in memory. Also included is the notion of an executive control, which coordinates the learner's perception, memory, processing, and application of information. Underlying the information-processing approach is the assumption that the senses and the brain follow complex but very systematic laws and that we can facilitate learning to the extent we can determine those laws.

Another school or theory of cognitive psychology is semantic networks. This theory attempts to parallel how biologists view the connections of the human brain. ...Remembering, thinking, acting, problem solving, and other cognitive activities consist of information (nodes) being activated via relationships or connections to other information (links to other nodes) that in turn activates other information. This spreading activation of billions of nodes via links accounts for cognitive activity.

Closely related to semantic network theories is Schema Theory, which began with the ideas of Sir Frederick Bartlett (1932). Schemas (or schemata) are highly organized collections of information and their relationships, similar to a semantic network. Schema Theory postulates that our existing knowledge comprises collections of such Schemas. For example, we have a schema for home and the things, people, and activities that take place there. ... Similarly we have schemas for all our knowledge, including transportation, play, politics, religion, and so on. Learning takes place when schemas are modified to incorporate new knowledge. New knowledge may be modified to be assimilated, or schemas may be modified to accommodate the new knowledge, or some of both may occur.

The areas of cognitive theory that are most important to multimedia design are those relating to perception and attention, encoding of information, memory, comprehension, active learning, motivation, locus of control, mental models, metacognition, transfer of learning, and individual differences. These categories reflect most of what is important when designing and evaluating interactive multimedia.

Constructivist Psychology Principles

Just as cognitive learning psychology began replacing the predominant behavioral psychology in the 1970s, constructivist learning psychology is now challenging the currently dominant cognitive approach. Constructivism is also a philosophical view. ...Taking an objectivist world view, instruction or teaching is the process of helping the learner correctly interpret and operate within that real world.

In contrast, constructivism holds that the only reality (or the only one that matters) is our individual interpretation of what we perceive. Constructivist learning theory maintains that knowledge is not received

from outside, but that we construct knowledge in our head. There are different schools of Constructivist thought. For example, according to social constructivism, learning is inherently social. What we learn is a function of social norms and interpretations, and knowledge is not simply constructed by the individual, but by social groups. Moderate constructivism maintains that there is indeed a real world but that our understanding of it is very individual and changing. More radical constructivism holds that we can never really know the exact nature of the real world, so it is only our interpretations that matter.

The important point for instructional designers is that according to the constructivist viewpoint, learning is a process of people actively constructing knowledge. Traditional instructional methods, such as memorizing, demonstrating, and imitating, are considered incompatible with the notion that learning is a process of construction.

Criticisms

Criticisms of Behaviorism

A strict behavioral approach, paying attention only to observable learner behaviors and ways to influence them, is not appropriate for multimedia design. Decades of learning research have demonstrated that classical and operant conditioning principles do not predict all learning outcomes. Theories of motivation, memory, transfer, and the like have promoted instructional methods that behavioral techniques would not, and many of these methods have been successful in improving both achievement and affect.

Having said that, principles from behavioral learning theory are used and should be used in multimedia design. Despite the claims of some constructivist theorists, behaviorism has always emphasized active learning. Learners in a behaviorally designed learning environment or using behaviorally designed materials are almost always actively responding. Their actions are admittedly more reactive than proactive, typically answering questions and solving problems given by the instructor, but they are active.

Criticisms of Cognitivism

Although many psychologists would like to say that the cognitive approach replaced or supplanted the behavioral approach to learning, we believe it was more of a merger.... The cognitive approach, with its increased emphasis on the internal processes of learners, has strayed a bit too far from the importance of active learning. ...Much educational software created during the era of cognitive dominance has been sadly lacking in learner activity and much too dominated by reading, watching, and listening. The cognitive approach has undervalued the powerful principles of reinforcement.

Criticisms of Constructivism

Constructivists, as we claim in the previous section, have created a straw dog of objectivism, incorporating into it all the negatively weighted words in education and claiming all the positively weighted words for themselves. This is somewhat disrespectful of the vast majority of educators who take a much more integrated approach to education and instruction. Almost all educators believe in concepts like autonomy, cooperation, lifelong learning, active learning, personal relevance, transfer, meaningful learning, authentic activities, and communication, even if they are difficult to implement in every educational environment and activity.

Many constructivists believe that instructional methodologies such as tutorial and drill are inappropriate. We disagree. A complete and flexible educational environment includes a combination of media including people, books, computers, and others. The computer software components should include tutorials, drills, hypermedia, Web-based communications and other methods, depending on the subject matter, the learners, the available resources, and the time constraints.

Conclusion

The underlying basis of designing instructional multimedia is the theory of learning. There is considerable difference of opinion as to what conditions and actions most facilitate learning. A goal of this chapter has been to summarize the different approaches to learning theory and the concepts of each. Combining

across the behavioral, cognitive, and constructivist approaches, these include principles of reinforcement, attention, perception, encoding, memory, comprehension, active learning, motivation, locus of control, mental models, metacognition, transfer of learning, individual differences, knowledge construction, situated learning, and collaborative learning.

Lastly, this variety of educational approaches and learning theory concepts presents the designer with many difficult choices. For example, certain types of learner control may increase motivation but decrease achievement. A cooperative learning environment may provide benefits, such as increased interactivity, but also problems, such as less accommodation to individual differences. Instructional design is a series of compromises—a process of balancing multiple, worthwhile, but competing, goals, including achievement and motivation, time and money, learner and instructor satisfaction, initial learning and transfer of learning, and many more. Ultimately good learning environments begin with principles of learning and instruction, but require evaluation, revision, and fine tuning to balance these competing values and ensure that the benefits are accrued for all intended learners.