Learning Theories and Integration Models

Overview of theories

Direct Instruction	Constructivist Instruction
- Learning is transmitted knowledge - Teaching should be teacher-directed and well-structured - Instruction is sufficient	- Learning is constructed knowledge - Teaching should be meaningful - Instruction is student-centered

Overview of Theories
(Needs and Problems Addressed)

Direct Instruction	Constructivist Instruction
- Individual pacing and remediation - Making learning paths more efficient - Performing time consuming and labour-intensive tasks - Providing self-instructional opportunities	- Making skills more relevant to students' backgrounds - Addressing motivation issues through interactive activities - Learning how to work together and problem solve - Using high-level and low-level; skills at the same time

Characteristics of Direct Instruction
- Assure prerequisite skills
- Supply instructional conditions
- Determine the type of learning

Characteristics of Constructivism
- Problem-oriented activities
- Visual formats and mental models
- Collaborative learning
- Learning through exploration
- Authentic assessment

Broadcast Learning	Interactive Learning
• Linear, sequential, serial	Hypermedia
• Instruction	Construction, discovery
• Teacher-Centered	Learner-Centered
• Absorbing Material	Learning how to learn
• School	Life-long
• One-size-fits-all	Customized
• Teacher as transmitter	Teacher as facilitator

Theories of Direct Instruction

- Behavioural Theories
  - B. F. Skinner- Believed that the teacher's job was to modify student behaviour
- Information processing theories
  - Mind = computer
  - Garbage In … Garbage Out (GIGO)
  - Foundational to Artificial Intelligence Applications
- Gagne's Events of Instruction
  - Gaining Attention
  - Informing the learning of the Objective
  - Stimulating recall of prerequisite learning
  - Presenting new material
  - Providing learning guidance
  - Eliciting performance
  - Providing feedback about correctness
  - Assessing performance
  - Enhancing retention and recall

Theories of Constructivism

- John Dewey--- "Social Constructivism"
  - Learning needs to be centered around relevant, meaningful activities
- Lev Vygosky
  - Scaffolding
  - Zone of proximal development

- Jean Piaget's Stages of Development
    - Sensorimotor, preoperational, concrete operational, formal operational
- Jerome Bruner --- Learning as Discovery
    - 3 stages: enactive, iconic and symbolic
- Seymour Papert
    - Microworlds
- John Seely Brown
    - Cognitive Apprenticeships --- Authentic Problem-solving
- Cognition and Technology Group at Vanderbilt University (CTGV)
    - Anchored instruction
- Rand Spiro
    - Cognitive Flexibility
- Howard Gardener --- Multiple Intelligence
    - Linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, and naturalist

Technology Integration Strategies

- Direct Instruction
- Constructivist Instruction
- Hybrid

Latest Idea: Connectivist Perspective
- Cross-discipline relationships

What are Theories and Models?

- What is a theory?
    - A theory provides a general explanation for observations made over time.
    - A theory explains and predicts behavior.
    - A theory can never be established beyond all doubt.
    - A theory may be modified.
    - Theories seldom have to be thrown out completely if thoroughly tested but sometimes a theory may be widely accepted for a long time and later disproved.

  (Dorin, Demmin & Gabel, 1990)

- What is a model?
    - A model is a mental picture that helps us understand something we cannot see or experience directly.

  (Dorin, Demmin & Gabel, 1990)

Behaviorism, Cognitivism and Constructivism - The Basics

Behaviorism: Based on observable changes in behavior. Behaviorism focuses on a new behavioral pattern being repeated until it becomes automatic.

Cognitivism: Based on the thought process behind the behavior. Changes in behavior are observed, and used as indicators as to what is happening inside the learner's mind.

Constructivism: Based on the premise that we all construct our own perspective of the world, through individual experiences and schema. Constructivism focuses on preparing the learner to problem solve in ambiguous situations.

(Schuman, 1996)

The Basics of Behaviorism

Behaviorism, as a learning theory, can be traced back to Aristotle, whose essay "Memory" focused on associations being made between events such as lightning and thunder. Other philosophers that followed Aristotle's thoughts are Hobbs (1650), Hume (1740), Brown (1820), Bain (1855) and Ebbinghause (1885) (Black, 1995).

The theory of behaviorism concentrates on the study of overt behaviors that can be observed and measured (Good & Brophy, 1990). It views the mind as a "black box" in the sense that response to stimulus can be observed quantitatively, totally ignoring the possibility of thought processes occurring in the mind. Some key players in the development of the behaviorist theory were Pavlov, Watson, Thorndike and Skinner.

Pavlov (1849 - 1936)

For most people, the name "Pavlov" rings a bell (pun intended). The Russian physiologist is best known for his work in classical conditioning or stimulus substitution. Pavlov's most famous experiment involved food, a dog and a bell.

Pavlov's Experiment

- Before conditioning, ringing the bell caused no response from the dog. Placing food in front of the dog initiated salivation.
- During conditioning, the bell was rung a few seconds before the dog was presented with food.
- After conditioning, the ringing of the bell alone produced salivation

    (Dembo, 1994).

Stimulus and Response Items of Pavlov's Experiment

Food	Unconditioned Stimulus
Salivation	Unconditioned Response (natural, not learned)
Bell	Conditioned Stimulus
Salivation	Conditioned Response (to bell)

Other Observations Made by Pavlov

- Stimulus Generalization: Once the dog has learned to salivate at the sound of the bell, it will salivate at other similar sounds.
- Extinction: If you stop pairing the bell with the food, salivation will eventually cease in response to the bell.
- Spontaneous Recovery: Extinguished responses can be "recovered" after an elapsed time, but will soon extinguish again if the dog is not presented with food.
- Discrimination: The dog could learn to discriminate between similar bells (stimuli) and discern which bell would result in the presentation of food and which would not.
- Higher-Order Conditioning: Once the dog has been conditioned to associate the bell with food, another unconditioned stimulus, such as a light may be flashed at the same time that the bell is rung. Eventually the dog will salivate at the flash of the light without the sound of the bell.

(What was the name of that dog??)

Thorndike (1874 - 1949)

Edward Thorndike did research in animal behavior before becoming interested in human psychology. He set out to apply "the methods of exact science" to educational problems by emphasizing "accurate quantitative treatment of information". "Anything that exists, exists in a certain quantity and can be measured" (Johcich, as cited in Rizo, 1991). His theory, Connectionism, stated that learning was the formation of a connection between stimulus and response.

- The "law of effect" stated that when a connection between a stimulus and response is positively rewarded it will be strengthened and when it is negatively rewarded it will be weakened. Thorndike later revised this "law" when he found that negative reward, (punishment) did not necessarily weaken bonds, and that

some seemingly pleasurable consequences do not necessarily motivate performance.

- The "law of exercise" held that the more an S-R (stimulus response) bond is practiced the stronger it will become. As with the law of effect, the law of exercise also had to be updated when Thorndike found that practice without feedback does not necessarily enhance performance.
- The "law of readiness" : because of the structure of the nervous system, certain conduction units, in a given situation, are more predisposed to conduct than others.

Thorndike's laws were based on the stimulus-response hypothesis. He believed that a neural bond would be established between the stimulus and response when the response was positive. Learning takes place when the bonds are formed into patterns of behavior (Saettler, 1990).

Watson (1878 - 1958)

John B. Watson was the first American psychologist to use Pavlov's ideas. Like Thorndike, he was originally involved in animal research, but later became involved in the study of human behavior.

Watson believed that humans are born with a few reflexes and the emotional reactions of love and rage. All other behavior is established through stimulus-response associations through conditioning.

Watson's Experiment

Watson demonstrated classical conditioning in an experiment involving a young child (Albert) and a white rat. Originally, Albert was unafraid of the rat; but Watson created a sudden loud noise whenever Albert touched the rat. Because Albert was frightened by the loud noise, he soon became conditioned to fear and avoid the rat. The fear was generalized to other small animals. Watson then "extinguished" the fear by presenting the rat without the loud noise. Some accounts of the study suggest that the conditioned fear was more powerful and permanent than it really was. (Harris, 1979; Samelson, 1980, in Brophy, 1990)

Certainly Watson's research methods would be questioned today; however, his work did demonstrate the role of conditioning in the development of emotional responses to certain stimuli. This may explain certain fears, phobias and prejudices that people develop.

(Watson is credited with coining the term "behaviorism")

Skinner (1904 - 1990)

Like Pavlov, Watson and Thorndike, Skinner believed in the stimulus-response pattern of conditioned behavior. His theory dealt with changes in observable behavior, ignoring the possibility of any processes occurring in the mind. Skinner's 1948 book, *Walden Two* , is about a utopian society based on operant conditioning. He also wrote,*Science and Human Behavior,* (1953) in which he pointed out how the principles of operant conditioning function in social institutions such as government, law, religion, economics and education (Dembo, 1994).

Skinner's work differs from that of his predecessors (classical conditioning), in that he studied operant behavior (voluntary behaviors used in operating on the environment).

Difference between Classical and Operant Conditioning

Classical Conditioning (Pavlov)	Operant (Instrumental) Conditioning (Skinner)
Unconditioned Stimulus ——> Unconditioned Response (food) (salivation)	Response ——> Stimulus (reward) (press lever) (food)
Unconditioned Stimulus ——> Unconditioned Response (food) (salivation) Conditioned Stimulus (bell)	TIME
Conditioned Stimulus ——> Conditioned Response (bell) (salivation)	Conditioned Response ——> ConditionedStimulus (press lever) (Reward)(food)
In classical conditioning, a neutral stimulus becomes associated with a reflex. The bell, a neutral stimulus, becomes associated with the reflex of salivation.	In operant conditioning, the learner "operates" on the environment and receives a reward for certain behavior (operations). Eventually the bond between the operation (pressing the lever) and the reward stimulus (food) is established.

Skinner's Operant Conditioning Mechanisms

- Positive Reinforcement or reward: Responses that are rewarded are likely to be repeated. (Good grades reinforce careful study.)
- Negative Reinforcement: Responses that allow escape from painful or undesirable situations are likely to be repeated. (Being excused from writing a final because of good term work.)
- Extinction or Non-Reinforcement: Responses that are not reinforced are not likely to be repeated. (Ignoring student misbehavior should extinguish that behavior.)
- Punishment: Responses that bring painful or undesirable consequences will be suppressed, but may reappear if reinforcement contingencies change. (Penalizing late students by withdrawing privileges should stop their lateness.)

(Good & Brophy, 1990)

Skinner and Behavioral Shaping

If placed in a cage an animal may take a very long time to figure out that pressing a lever will produce food. To accomplish such behavior successive approximations of the behavior are rewarded until the animal learns the association between the lever and the food reward. To begin shaping, the animal may be rewarded for simply turning in the direction of the lever, then for moving toward the lever, for brushing against the lever, and finally for pawing the lever.

Behavioral chaining occurs when a succession of steps need to be learned. The animal would master each step in sequence until the entire sequence is learned.

Reinforcement Schedules

Once the desired behavioral response is accomplished, reinforcement does not have to be 100%; in fact it can be maintained more successfully through what Skinner referred to as partial reinforcement schedules. Partial reinforcement schedules include interval schedules and ratio schedules.

- Fixed Interval Schedules: the target response is reinforced after a fixed amount of time has passed since the last reinforcement.
- Variable Interval Schedules: similar to fixed interval schedules, but the amount of time that must pass between reinforcement varies.
- Fixed Ratio Schedules: a fixed number of correct responses must occur before reinforcement may recur.
- Variable Ratio Schedules: the number of correct repetitions of the correct response for reinforcement varies.

Variable interval and especially, variable ratio schedules produce steadier and more persistent rates of response because the learners cannot predict when the reinforcement will come although they know that they will eventually succeed.

(Have you checked your Lottery tickets lately?)

The Basics of Cognitivism

As early as the 1920's people began to find limitations in the behaviorist approach to understanding learning. Edward Tolman found that rats used in an experiment appeared to have a mental map of the maze he was using. When he closed off a certain portion of the maze, the rats did not bother to try a certain path because they "knew" that it led to the blocked path. Visually, the rats could not see that the path would result in failure, yet

they chose to take a longer route that they knew would be successful (Operant Conditioning [On-line]).

Behaviorists were unable to explain certain social behaviors. For example, children do not imitate all behavior that has been reinforced. Furthermore, they may model new behavior days or weeks after their first initial observation without having been reinforced for the behavior. Because of these observations, Bandura and Walters departed from the traditional operant conditioning explanation that the child must perform and receive reinforcement before being able to learn. They stated in their 1963 book, *Social Learning and Personality Development*, that an individual could model behavior by observing the behavior of another person. This theory leads to Bandura's Social Cognitive Theory (Dembo, 1994).

What is Cognitivism?

"Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. They also acknowledge the importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivator. However, even while accepting such behavioristic concepts, cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information." (Good and Brophy, 1990, pp. 187).

As with behaviorism, cognitive psychology can be traced back to the ancient Greeks, Plato and Aristotle. The cognitive revolution became evident in American psychology during the 1950's (Saettler, 1990). One of the major players in the development of cognitivism is Jean Piaget, who developed the major aspects of his theory as early as the 1920's. Piaget's ideas did not impact North America until the 1960's after Miller and Bruner founded the Harvard Center for Cognitive studies.

Key Concepts of Cognitive Theory

- Schema - An internal knowledge structure. New information is compared to existing cognitive structures called "schema". Schema may be combined, extended or altered to accommodate new information.
- Three-Stage Information Processing Model - input first enters a sensory register, then is processed in short-term memory, and then is transferred to long-term memory for storage and retrieval.
  - Sensory Register - receives input from senses which lasts from less than a second to four seconds and then disappears through decay or replacement. Much of the information never reaches short term memory but all information is monitored at some level and acted upon if necessary.
  - Short-Term Memory (STM) - sensory input that is important or interesting is transferred from the sensory register to the STM. Memory can be retained here for up to 20 seconds or more if rehearsed repeatedly. Short-

term memory can hold up to 7 plus or minus 2 items. STM capacity can be increased if material is chunked into meaningful parts.

- o Long-Term Memory and Storage (LTM) - stores information from STM for long term use. Long-term memory has unlimited capacity. Some materials are "forced" into LTM by rote memorization and over learning. Deeper levels of processing such as generating linkages between old and new information are much better for successful retention of material.

- Meaningful Effects - Meaningful information is easier to learn and remember. (Cofer, 1971, in Good and Brophy, 1990) If a learner links relatively meaningless information with prior schema it will be easier to retain. (Wittrock, Marks, & Doctorow, 1975, in Good and Brophy, 1990)
- Serial Position Effects - It is easier to remember items from the beginning or end of a list rather than those in the middle of the list, unless that item is distinctly different.
- Practice Effects - Practicing or rehearsing improves retention especially when it is distributed practice. By distributing practices the learner associates the material with many different contexts rather than the one context afforded by mass practice.
- Transfer Effects- The effects of prior learning on learning new tasks or material.
- Interference Effects - Occurs when prior learning interferes with the learning of new material.
- Organization Effects - When a learner categorizes input such as a grocery list, it is easier to remember.
- Levels of Processing Effects - Words may be processed at a low-level sensory analysis of their physical characteristics to high-level semantic analysis of their meaning. (Craik and Lockhart, 1972, in Good and Brophy, 1990) The more deeply a word is process the easier it will be to remember.
- State Dependent Effects - If learning takes place within a certain context it will be easier to remember within that context rather than in a new context.
- Mnemonic Effects - Mnemonics are strategies used by learners to organize relatively meaningless input into more meaningful images or semantic contexts. For example, the notes of a musical scale can be remembered by the rhyme: Every Good Boy Deserves Fruit.
- Schema Effects - If information does not fit a person's schema it may be more difficult for them to remember and what they remember or how they conceive of it may also be affected by their prior schema.
- Advance Organizers - Ausebels advance organizers prepare the learner for the material they are about to learn. They are not simply outlines of the material, but are material that will enable the student to make sense out of the lesson.

The Basics of Constructivism

Bartlett (1932) pioneered what became the constructivist approach (Good & Brophy, 1990). Constructivists believe that "learners construct their own reality or at least

interpret it based upon their perceptions of experiences, so an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events." "What someone knows is grounded in perception of the physical and social experiences which are comprehended by the mind." (Jonasson, 1991).

If each person has his/her view about reality, then how can we as a society communicate and/or coexist? Jonassen, addressing this issue in his article *Thinking Technology: Toward a Constructivist Design Model,* makes the following comments:

- "Perhaps the most common misconception of constructivism is the inference that we each therefore construct a unique reality that reality is only in the mind of the knower, which will doubtlessly lead to intellectual anarchy."
- "A reasonable response to that criticism is the Gibsonian perspective that contends that there exist a physical world that is subject to physical laws that we all know in pretty much the same way because those physical laws are perceivable by humans in pretty much the same way."
- "Constructivists also believe that much of reality is shared through a process of social negotiation..."

If one searches through the many philosophical and psychological theories of the past, the threads of constructivism may be found in the writing of such people as Bruner, Ulrick, Neiser, Goodman, Kant, Kuhn, Dewey and Habermas. The most profound influence was Jean Piaget's work which was interpreted and extended by von Glasserfield (Smorgansbord, 1997).

Realistic vs. Radical Construction

Realistic constructivism - cognition is the process by which learners eventually construct mental structures that correspond to or match external structures located in the environment.

Radical constructivism - cognition serves to organize the learner's experiential world rather than to discover ontological reality

(Cobb, 1996, in Smorgansbord, 1997).

The Assumptions of Constructivism - Merrill

- knowledge is constructed from experience
- learning is a personal interpretation of the world
- learning is an active process in which meaning is developed on the basis of experience
- conceptual growth comes from the negotiation of meaning, the sharing of multiple perspectives and the changing of our internal representations through collaborative learning

- learning should be situated in realistic settings; testing should be integrated with the task and not a separate activity

(Merrill, 1991, in Smorgansbord, 1997)

It Boggles the Mind!

If you are reading about learning theories, you may notice that it is difficult to pin down what theory a certain theorist belongs to. This can confuse you, since, just as you think you have it cased, a name you originally thought was in the behavioral category shows up in a constructivism article.

This problem is often the result of theorists and their ideas evolving over time and changes they make to their original ideas. Davidson includes the following example in an article she wrote:

"Considered by most to be representative of [a] behaviourist learning paradigm, Gagne's theory of learning and events of instruction have evolved progressively to approach a more cognitive theory. His discussion of relating present information and past knowledge (event #3) and the inclusion of learning transfer (event#9) are indicative of this shift toward constructivism." (Davidson, 1998)

Okay? Okay. :-)