Summaries of Learning Theories and Models

Theories and Models of Learning for Educational Research and Practice. This knowledge base features learning theories and models that address how people learn. A resource useful for scholars of various fields, including educational psychology, instructional design, and human-computer interaction. Below is the index of learning theories, grouped into categories. Note that this website is an iterative project and these entries are a work in progress; please leave comments with suggestions, corrections, and additional references.

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Behaviorist Theories:

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- ✓ Classical Conditioning (Pavlov)
- ✓ GOMS Model (Card, Moran, and Newell)
- ✓ Operant Conditioning (Skinner)
- ✓ Social Learning Theory (Bandura)

Behaviorism

Summary: Behaviorism is a worldview that operates on a principle of "stimulus-response." All behavior caused by external stimuli (operant conditioning). All behavior can be explained without the need to consider internal mental states or consciousness.

Originators and important contributors: John B. Watson, Ivan Pavlov, B.F. Skinner, E. L. Thorndike (connectionism), Bandura, Tolman (moving toward cognitivism)

Keywords: Classical conditioning (Pavlov), Operant conditioning (Skinner), Stimulus-response (S-R)

Behaviorism

Behaviorism is a worldview that assumes a learner is essentially passive, responding to environmental stimuli. The learner starts off as a clean slate (i.e. *tabula rasa*) and behavior is shaped through positive reinforcement or negative reinforcement. Both positive reinforcement and negative reinforcement increase the probability that the antecedent behavior will happen again. In contrast, *punishment* (both positive and negative) decreases the likelihood that the antecedent behavior will happen again. Positive indicates the application of a stimulus; Negative indicates the withholding of a stimulus. Learning is therefore defined as a change in behavior in the learner. Lots of (early) behaviorist work was done with animals (e.g. Pavlov's dogs) and generalized to humans.

Behaviorism precedes the cognitivist worldview. It rejects structuralism and is an extension of Logical Positivism.

Radical behaviorism

Developed by BF Skinner, Radical Behaviorism describes a particular school that emerged during the reign of behaviorism. It is distinct from other schools of behaviorism, with major differences in the acceptance of mediating structures, the role of emotions, etc.

Social Learning Theory (Bandura)

Summary: Bandura's Social Learning Theory posits that people learn from one another, via observation, imitation, and modeling. The theory has often been called a bridge between behaviorist and cognitive learning theories because it encompasses attention, memory, and motivation.

Originator: Albert Bandura

Key Terms: Modeling, reciprocal determinism

Classical Conditioning (Pavlov)

Summary: Classical conditioning is a reflexive or automatic type of learning in which a stimulus acquires the capacity to evoke a response that was originally evoked by another stimulus.

Originators and Key Contributors: First described by Ivan Pavlov (1849-1936), Russian physiologist, in 1903, and studied in infants by John B. Watson (1878-1958).

Keywords: stimulus-response, psychic reflexes, unconditioned stimulus, conditioned response, respondent conditioning

Classical Conditioning (Ivan Pavlov)

Several types of learning exist. The most basic form is *associative learning*, i.e., making a new association between events in the environment. There are two forms of associative learning: classical conditioning (made famous by Ivan Pavlov's experiments with dogs) and operant conditioning.

Pavlov's Dogs

In the early twentieth century, Russian physiologist Ivan Pavlov did Nobel prize-winning work on digestion. While studying the role of saliva in dogs' digestive processes, he stumbled upon a phenomenon he labeled "psychic reflexes." While an accidental discovery, he had the foresight to see the importance of it. Pavlov's dogs, restrained in an experimental chamber, were presented with meat powder and they had their saliva collected via a surgically implanted tube in their saliva glands. Over time, he noticed that his dogs who begin salivation before the meat powder was even presented, whether it was by the presence of the handler or merely by a clicking noise produced by the device that distributed the meat powder.

Fascinated by this finding, Pavlov paired the meat powder with various stimuli such as the ringing of a bell. After the meat powder and bell (auditory stimulus) were presented together several times, the bell was used alone. Pavlov's dogs, as predicted, responded by salivating to the sound of the bell (without the food). The bell began as a neutral stimulus (i.e. the bell itself did not produce the dogs' salivation). However, by pairing the bell with the stimulus that did produce the salivation response, the bell was able to acquire the ability to trigger the salivation response. Pavlov therefore demonstrated how stimulus-response bonds (which some consider as the basic building blocks of learning) are formed. He dedicated much of the rest of his career further exploring this finding.

In technical terms, the meat powder is considered an unconditioned stimulus (UCS) and the dog's salivation is the unconditioned response (UCR). The bell is a neutral stimulus until the dog learns to associate the bell with food. Then the bell becomes a conditioned stimulus (CS) which produces the conditioned response (CR) of salivation after repeated pairings between the bell and food.

Пища, съедаемая собакой, не доходит до желудка и выпадает через отверстие в пище- воде. Но желудок — только под влиянием нервного возбуждения — выделяет желудочный сок.

John B. Watson: Early Classical Conditioning with Humans

John B. Watson further extended Pavlov's work and applied it to human beings. In 1921, Watson studied Albert, an 11 month old infant child. The goal of the study was to condition Albert to become afraid of a white rat by pairing the white rat with a very loud, jarring noise (UCS). At first, Albert showed no sign of fear when he was presented with rats, but once the rat was repeatedly paired with the loud noise (UCS), Albert developed a fear of rats. It could be said that the loud noise (UCS) induced fear (UCR). The implications of Watson's experiment suggested that classical conditioning could cause some phobias in humans.

GOMS Model (Card, Moran, and Newell)

Summary: The GOMS Model is a human information processing model that predicts what skilled users will do in seemingly unpredictable situations.

Originators and proponents: Card, Moran and Newell in 1983; Bonnie John et al.

Keywords: Goals, operators, methods, selection rules

GOMS Model (Card, Moran, and Newell)

This model is the general term for a family of human information processing techniques that attempt to model and predict user behavior. Typically used by software designers, a person's behavior is analyzed in terms of four components:

- Goals – something that the person wants to accomplish. Can be high level (e.g. WRITE-PAPER) to low level (e.g. DELETE CHARACTER)

- Operators – basic perceptual, cognitive, or motor actions used to accomplish goals, or actions that the software allows user to make (e.g. PRESS-ENTER-KEY or CLICK-MOUSE)

- Methods – procedures (sequences) of subgoals and operators that can accomplish a goal

- Selection rules – personal rules users follow in deciding what method to use in a circumstance

One of the most validated methods in Human Computer Interaction (HCI), the GOMS model assumes expert user and well-defined tasks. It should be noted that there are various limitations to this technique, e.g.:

1. Task in question must be usefully analyzed in terms of the procedural (how to do it) knowledge.

2. Represents only skilled behavior. Not useful for ill-defined problem solving, exploration, etc. Cognitive walkthrough is useful for exploratory behavior by novices.

3. Need to start with a list of top-level tasks or user goals. List must be provided outside of GOMS.

GOMS is useful for uncovering a frequent goal supported by a very inefficient method thereby informing a design change to include a more efficient method.

Variations include:

- Keystroke Level Model (KLM) by Stuart Card: The first, simplest form of GOMS consisting of the sum of subtasks and required overhead. That is, the sum of the time of P – pointing, H – homing, D – drawing, M – mental operator, R – waiting for system response.

- Card Moran Newell (CMN)-GOMS: A serial stage model of GOMS.

- Critical Path Method (also known as Cognitive Perceptual Motor or CPM-GOMS): A parallel stage model (for users with highest level of skill) critical-path-method or cognitive-perceptual-motor analysis of activity – perceptual, cognitive, motor operators can be performed in parallel as the task demands.

Operant Conditioning (Skinner)

Summary: A behaviorist theory based on the fundamental idea that behaviors that are reinforced will tend to continue, while behaviors that are punished will eventually end.

Originators and Key Contributors: B. F. Skinner, built upon Ivan Pavlov's theories of classical conditioning.

Keywords: response-stimulus, voluntary response, reinforcer

Operant Conditioning (B. F. Skinner)

Operant conditioning can be described as a process that attempts to modify behavior through the use of positive and negative reinforcement. Through operant conditioning, an individual makes an association between a particular behavior and a consequence.

- Example 1: Parents rewarding a child's excellent grades with candy or some other prize.

- Example 2: A schoolteacher awards points to those students who are the most calm and well-behaved. Students eventually realize that when they voluntarily become quieter and better behaved, that they earn more points.

- Example 3: A form of reinforcement (such as food) is given to an animal every time the animal (for example, a hungry lion) presses a lever.

The term "operant conditioning" originated by the behaviorist B. F. Skinner, who believed that one should focus on the external, observable causes of behavior (rather than try to unpack the internal thoughts and motivations)

Reinforcement comes in two forms: positive and negative.

Positive and negative reinforcers

- *Positive reinforcers* are favorable events or outcomes that are given to the individual after the desired behavior. This may come in the form of praise, rewards, etc.

- *Negative reinforcers* typically are characterized by the removal of an undesired or unpleasant outcome after the desired behavior. A response is strengthened as something considered negative is removed.

The goal in both of these cases of reinforcement is for the behavior to increase.

Positive and negative punishment

Punishment, in contrast, is when the increase of something undesirable attempts to cause a decrease in the behavior that follows.

- *Positive punishment* is when unfavorable events or outcomes are given in order to weaken the response that follows.

- *Negative punishment* is characterized by when an favorable event or outcome is removed after a undesired behavior occurs.

The goal in both of these cases of punishment is for a behavior to decrease.

What is the difference between operant conditioning and classical conditioning? In operant conditioning, a voluntary response is then followed by a reinforcing stimulus. In this way, the voluntary response (e.g. studying for an exam) is more likely to be done by the individual. In contrast, classical conditioning is when a stimulus automatically triggers an involuntary response.

Social Learning Theory (Bandura)

People learn through observing others' behavior, attitudes, and outcomes of those behaviors. "Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action." (Bandura). Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

Necessary conditions for effective modeling:

1. Attention — various factors increase or decrease the amount of attention paid. Includes distinctiveness, affective valence, prevalence, complexity, functional value. One's characteristics (e.g. sensory capacities, arousal level, perceptual set, past reinforcement) affect attention.

2. Retention — remembering what you paid attention to. Includes symbolic coding, mental images, cognitive organization, symbolic rehearsal, motor rehearsal

3. Reproduction — reproducing the image. Including physical capabilities, and self-observation of reproduction.

4. Motivation — having a good reason to imitate. Includes motives such asÂ past (i.e. traditional behaviorism), promised (imagined incentives) and vicarious (seeing and recalling the reinforced model)

Bandura believed in "reciprocal determinism", that is, the world and a person's behavior cause each other, while behaviorism essentially states that one's environment causes one's behavior, Bandura, who was studying adolescent aggression, found this too simplistic, and so in addition he suggested that behavior causes environment as well. Later, Bandura soon considered personality as an interaction between three components: the environment, behavior, and one's psychological processes (one's ability to entertain images in minds and language).

Social learning theory has sometimes been called a bridge between behaviorist and cognitive learning theories because it encompasses attention, memory, and motivation. The theory is related to Vygotsky's Social Development Theory and Lave's Situated Learning, which also emphasize the importance of social learning.

Cognitivist Theories:

- ✓ Cognitivism Overview
- ✓ Attribution Theory (Weiner)
- ✓ Cognitive Load Theory (Sweller)
- ✓ Cognitive Theory of Multimedia Learning (Mayer)
- ✓ Elaboration Theory (Reigeluth)
- ✓ Stage Theory of Cognitive Development (Piaget)

Cognitivism

Summary: The cognitivist paradigm essentially argues that the "black box" of the mind should be opened and understood. The learner is viewed as an information processor (like a computer).

Originators and important contributors: Merrill -Component Display Theory (CDT), Reigeluth (Elaboration Theory), Gagne, Briggs, Wager, Bruner (moving toward cognitive constructivism), Schank (scripts), Scandura (structural learning)

Keywords: Schema, schemata, information processing, symbol manipulation, information mapping, mental models

Cognitivism

The cognitivist revolution replaced behaviorism in 1960s as the dominant paradigm. Cognitivism focuses on the inner mental activities – opening the "black box" of the human mind is valuable and necessary for understanding how people learn. Mental processes such as thinking, memory, knowing, and problem-solving need to be explored. Knowledge can be seen as schema or symbolic mental constructions. Learning is defined as change in a learner's schemata.

A response to behaviorism, people are not "programmed animals" that merely respond to environmental stimuli; people are rational beings that require active participation in order to learn, and whose actions are a consequence of thinking. Changes in behavior are observed, but only as an indication of what is occurring in the learner's head. Cognitivism uses the metaphor of the mind as computer: information comes in, is being processed, and leads to certain outcomes.

Attribution Theory (Weiner)

Summary: Attribution Theory attempts to explain the world and to determine the cause of an event or behavior (e.g. why people do what they do).

Originator: Bernard Weiner (1935-)

Key terms: Attribution, locus of control, stability, controllability

Attribution Theory (Weiner)

Weiner developed a theoretical framework that has become very influential in social psychology today. Attribution theory assumes that people try to determine why people do what they do, that is, interpret causes to an event or behavior. A three-stage process underlies an attribution:

1. behavior must be observed/perceived
2. behavior must be determined to be intentional
3. behavior attributed to internal or external causes

Weiner's attribution theory is mainly about achievement. According to him, the most important factors affecting attributions are ability, effort, task difficulty, and luck. Attributions are classified along three causal dimensions:

1. locus of control (two poles: internal vs. external)

2. stability (do causes change over time or not?)

3. controllability (causes one can control such as skills vs. causes one cannot control such as luck, others' actions, etc.)

When one succeeds, one attributes successes internally ("my own skill"). When a rival succeeds, one tends to credit external (e.g. luck). When one fails or makes mistakes, we will more likely use external attribution, attributing causes to situational factors rather than blaming ourselves. When others fail or make mistakes, internal attribution is often used, saying it is due to their internal personality factors.

1. Attribution is a three stage process: (1) behavior is observed, (2) behavior is determined to be deliberate, and (3) behavior is attributed to internal or external causes.

2. Achievement can be attributed to (1) effort, (2) ability, (3) level of task difficulty, or (4) luck.

3. Causal dimensions of behavior are (1) locus of control, (2) stability, and (3) controllability.

Cognitive Load Theory of Multimedia Learning (Sweller)

Summary: A theory that focuses the load on working memory during instruction.

Originators and proponents: John Sweller

Keywords: cognitive load theory, working memory, multimedia learning

Cognitive Load Theory of Multimedia Learning (Sweller)

John Sweller's paper, "Implications of Cognitive Load Theory for Multimedia Learning" describes the human cognitive architecture, and the need to apply sound instructional design principles based on our knowledge of the brain and memory. Sweller first describes the different types of memory, and how both are interrelated, because schemas held in long-term memory, acting as a "central executive", directly affect the manner in which information is synthesized in working memory. Sweller then explains that in the absence of schemas, instructional guidance must provide a substitute for learners to develop either own schemas.

Sweller discusses, in his view, three types of cognitive load:

- extraneous cognitive load
- intrinsic cognitive load
- germane cognitive load

Intrinsic cognitive load

First described by Chandler and Sweller, intrinsic cognitive load is the idea that all instruction has an inherent difficulty associated with it (for instance, calculating 5+5). This inherent difficulty may not be altered by an instructor. However many schemas may be broken into individual "subschemas" and taught in isolation, to be later brought back together and described as a combined whole.

Extraneous cognitive load

Extraneous cognitive load, by contrast, is under the control of instructional designers. This form of cognitive load is generated by the manner in which information is presented to

learners (i.e., the design). To illustrate an example of extraneous cognitive load, assume there are at least two possible ways to describe a geometric shape like a triangle. An instructor could describe a triangle in a verbally, but to show a diagram of a triangle is much better because the learner does not have to deal with extraneous, unnecessary information.

Germane cognitive load

Germane load is a third kind of cognitive load which is encouraged to be promoted. Germane load is the load dedicated to the processing, construction and automation of schemas. While intrinsic load is generally thought to be immutable, instructional designers can manipulate extraneous and germane load. It is suggested that they limit extraneous load and promote germane load.

Extraneous cognitive load and intrinsic cognitive load are not ideal; they result from inappropriate instructional designs and complexity of information. Germane cognitive load is coined as "effective' cognitive load, caused by successful schema construction. Each of the cognitive loads are additive, and instructional design's goal should be to reduce extraneous cognitive load to free up working memory. Throughout the article, Sweller also draws interesting comparisons between human cognition and evolutionary theory.

Cognitive Theory of Multimedia Learning (Mayer)

Summary: A cognitive theory of multimedia learning based on three main assumptions: there are two separate channels (auditory and visual) for processing information; there is limited channel capacity; and that learning is an active process of filtering, selecting, organizing, and integrating information.

Originator: Richard Mayer

Key terms: dual-channel, limited capacity, sensory, working, long-term memory

Cognitive Theory of Multimedia Learning (Mayer)

The principle known as the "multimedia principle" states that "people learn more deeply from words and pictures than from words alone" (Mayer, p. 47). However, simply adding words to pictures is not an effective way to achieve multimedia learning. The goal is to instructional media in the light of how human mind works. This is the basis for Mayer's cognitive theory of multimedia learning. This theory proposes three main assumptions when it comes to learning with multimedia:

1. There are two separate channels (auditory and visual) for processing information (sometimes referred to as Dual-Coding theory);

2. Each channel has a limited (finite) capacity (similar to Sweller's notion of Cognitive Load);

3. Learning is an active process of filtering, selecting, organizing, and integrating information based upon prior knowledge.

Humans can only process a finite amount of information in a channel at a time, and they make sense of incoming information by actively creating mental representations.   Mayer also discusses the role of three memory stores: sensory (which receives stimuli and stores it for a very short time), working (where we actively process information to create mental constructs (or 'schema'), and long-term (the repository of all things learned). Mayer's cognitive theory of multimedia learning presents the idea that the brain does not interpret a multimedia presentation of words, pictures, and auditory information in a mutually exclusive fashion; rather, these elements are selected and organized dynamically to produce logical mental constructs. Futhermore, Mayer underscores the importance of learning (based upon the testing of content and demonstrating the successful transfer of knowledge) when new information is integrated with prior knowledge.

Design principles including providing coherent verbal, pictorial information, guiding the learners to select relevant words and images, and reducing the load for a single processing channel etc. can be entailed from this theory.

Elaboration Theory (Reigeluth)

Summary: Elaboration theory is an instructional design theory that argues that content to be learned should be organized from simple to complex order, while providing a meaningful context in which subsequent ideas can be integrated.

Originators: Charles Reigeluth (Indiana University) and his colleagues in the late 1970s.

Key Terms: conceptual elaboration sequence, theoretical elaboration sequence, simplifying conditions sequence

Elaboration Theory (Reigeluth)

The paradigm shift from teacher-centric instruction to learner-centered instruction has caused "new needs for ways to sequence instruction" (Reigeluth, 1999). Charles Reigeluth of Indiana University posited Elaboration Theory, an instructional design model that aims to help select and sequence content in a way that will optimize attainment of learning goals. Proponents feel the use of motivators, analogies, summaries and syntheses leads to effective learning. While the theory does not address primarily affective content, it is intended for medium to complex kinds of cognitive and psychomotor learning.

According to Reigeluth (1999), Elaboration Theory has the following values:

- It values a sequence of instruction that is as holistic as possible, to foster meaning-making and motivation

- It allows learners to make many scope and sequence decisions on their own during the learning process

- It is an approach that facilitates rapid protolyping in the instructional development process

- It integrates viable approaches to scope and sequence into a coherent design theory

There are three major approaches: (1) Conceptual Elaboration Sequence (used when there are many related concepts to be learned), (2) Theoretical Elaboration Sequence (used when there are many related principles to be learned), and (3) Simplifying Conditions Sequence (used when a task of at least moderate complexity is to be learned).

The simplest version of the concept, principle or task should be taught first. Teach broader, more inclusive concepts, principles, or tasks before the narrower, more detailed ones that elaborate upon them. One should use either a topical or a spiral approach to this elaboration. Teach "supporting" content such as principles, procedures, information, higher-order thinking skills, or attitudes together with the concepts to which they are most closely related. Group concepts, principles, or steps and their supporting content into "learning episodes" of a useful size (not too small or large). Finally, allow students to choose which concepts, principles, or versions of the task to elaborate upon or learn first (or next).

Criticisms

Some scholars have offered various criticisms of Elaboration Theory. For example, there is no prescription for providing "authentic" or "situated" learning. Also, the use of three primary structures (i.e. conceptual, procedural, and theoretical) is a design constraint. As conceptual structures are sequenced from the most general category down to the most detailed subcategory, elaboration theory does not accommodate learners' prior knowledge.

Stage Theory of Cognitive Development (Piaget)

Summary: Piaget's Stage Theory of Cognitive Development is a description of cognitive development as four distinct stages in children: sensorimotor, preoperational, concrete, and formal.

Originator: Jean Piaget (1896-1980)

Key Terms: Sensorimotor, preoperational, concrete, formal, accommodation, assimilation.

Piaget's Stage Theory of Cognitive Development

Swiss biologist and psychologist Jean Piaget (1896-1980) observed his children (and their process of making sense of the world around them) and eventually developed a four-stage model of how the mind processes new information encountered. He posited that children progress through 4 stages and that they all do so in the same order. These four stages are:

- **Sensorimotor stage** (Birth to 2 years old). The infant builds an understanding of himself or herself and reality (and how things work) through interactions with the environment. It is able to differentiate between itself and other objects. Learning takes place via assimilation (the organization of information and absorbing it into existing schema) and accommodation (when an object cannot be assimilated and the schemata have to be modified to include the object.

- **Preoperational stage** (ages 2 to 4). The child is not yet able to conceptualize abstractly and needs concrete physical situations. Objects are classified in simple ways, especially by important features.

- **Concrete operations** (ages 7 to 11). As physical experience accumulates, accomodation is increased. The child begins to think abstractly and conceptualize, creating logical structures that explain his or her physical experiences.

- **Formal operations** (beginning at ages 11 to 15). Cognition reaches its final form. By this stage, the person no longer requires concrete objects to make rational judgements. He or she is capable of deductive and hypothetical reasoning. His or her ability for abstract thinking is very similar to an adult.

Constructivist, Social, and Situational Theories:

- ✓ Constructivism Overview
- ✓ Cognitive Apprenticeship (Collins et al.)
- ✓ Communities of Practice (Lave and Wenger)
- ✓ Discovery Learning (Bruner)
- ✓ Social Development Theory (Vygtosky)
- ✓ Problem-Based Learning (PBL)
- ✓ Situated Learning (Lave)

Constructivism

Summary: Constructivism as a paradigm or worldview posits that learning is an active, constructive process. The learner is an information constructor. People actively construct or create their own subjective representations of objective reality. New information is linked to to prior knowledge, thus mental representations are subjective.

Originators and important contributors: Vygotsky, Piaget, Dewey, Vico, Rorty, Bruner

Keywords: Learning as experience, activity and dialogical process; Problem Based Learning (PBL); Anchored instruction; Vygotsky's Zone of Proximal Development (ZPD); cognitive apprenticeship (scaffolding); inquiry and discovery learning.

Constructivism

A reaction to didactic approaches such as behaviorism and programmed instruction, constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it. Knowledge is constructed based on personal experiences and hypotheses of the environment. Learners continuously test these hypotheses through social negotiation. Each person has a different interpretation and construction of knowledge process. The learner is not a blank slate (*tabula rasa*) but brings past experiences and cultural factors to a situation.

NOTE: A common misunderstanding regarding constructivism is that instructors should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves. This is actually confusing a theory of pedagogy (teaching) with a theory of knowing. Constructivism assumes that all knowledge is constructed from the learner's previous knowledge, regardless of how one is taught. Thus, even listening to a lecture involves active attempts to construct new knowledge.

Cognitive Apprenticeship (Collins et al.)

Summary: Cognitive Apprenticeship is a theory that attempts to bring tacit processes out in the open. It assumes that people learn from one another, through observation, imitation and modeling.

Originator: Collins, Brown and Newman

Key Terms: Modeling, coaching, scaffolding, articulation, reflection

Cognitive Apprenticeship

Around 1987, Collins, Brown, and Newman developed six teaching methods — modeling, coaching, scaffolding, articulation, reflection and exploration. These methods enable students to cognitive and metacognitive strategies for "using, managing, and discovering knowledge"

Modeling

Experts (usually teachers or mentors) demonstrate a task explicitly. New students or novices build a conceptual model of the task at hand. For example, a math teacher might write out explicit steps and work through a problem aloud, demonstrating her heuristics and procedural knowledge.

Coaching

During Coaching, the expert gives feedback and hints to the novice.

Scaffolding

Scaffolding the process of supporting students in their learning. Support structures are put into place. In some instances, the expert may have to help with aspects of the task that the student cannot do yet.

Articulation

McLellan describes articulation as (1) separating component knowledge and skills to learn them more effectively and, (2) more common verbalizing or demonstrating knowledge and thinking processes in order to expose and clarify them.

This process gets students to articulate their knowledge, reasoning, or problem-solving process in a domain" (p. 482). This may include inquiry teaching (Collins & Stevens, 1982), in which teachers ask students a series of questions that allows them to refine and restate their learned knowledge and to form explicit conceptual models. Thinking aloud requires students to articulate their thoughts while solving problems. Students assuming a critical role monitor others in cooperative activities and draw conclusions based on the problem-solving activities.

Reflection

Reflection allows students to "compare their own problem-solving processes with those of an expert, another student, and ultimately, an internal cognitive model of expertise" (p. 483). A technique for reflection could be to examine the past performances of both expert and novice and to highlight similarities and differences. The goal of reflection is for students to look back and analyze their performances with a desire for understanding and improvement towards the behavior of an expert.

Exploration

Exploration involves giving students room to problem solve on their own and teaching students exploration strategies. The former requires the teacher to slowly withdraw the use of supports and scaffolds not only in problem solving methods, but problem setting methods as well. The latter requires the teacher to show students how to explore, research, and develop hypotheses. Exploration allows the student to frame interesting problems within the domain for themselves and then take the initiative to solve these problems.

Communities of Practice (Lave and Wenger)

Summary: Etienne Wenger summarizes Communities of Practice (CoP) as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." This learning that takes place is not necessarily intentional. Three components are required in order to be a CoP: (1) the domain, (2) the community, and (3) the practice.

Originators: Jean Lave and Etienne Wenger in 1991 and further elaborated in 1998.

Key Terms: domain, community, practice, identity, learning

Communities of Practice

The term was first used in 1991 by theorists Jean Lave and Etienne Wenger who discussed the notion of legitimate peripheral participation. In 1998, the theorist Etienne Wenger extended the concept and applied it to other domains, such as organizations. With the flourishing of online communities on the Internet, as well as the increasing need for improved knowledge management, there has been much more interest as of late in communities of practice. People see them as ways of promoting innovation, developing social capital, facilitating and spreading knowledge within a group, spreading existing tacit knowledge, etc.

Communities of Practice can be defined, in part, as a process of social learning that occurs when people who have a common interest in a subject or area collaborate over an extended period of time, sharing ideas and strategies, determine solutions, and build innovations. Wenger gives a simple definition: "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly." Note that this allows for, but does not require intentionality. Learning can be, and often is, an incidental outcome that accompanies these social processes.

One needs to distinguish between what is a CoP and what is not. There are three required components of CoPs:

1. There needs to be *a domain*. A CoP has an identity defined by a shared domain of interest (e.g. radiologists, Star Trek fans, middle school history teachers, Seahawks football fans, etc.); it's not just a network of people or club of friends. Membership implies a commitment to the domain.

2. There needs to be a *community*. A necessary component is that members of a specific domain interact and engage in shared activities, help each other, and share information with each other. They build relationships that enable them to learn from each other. In this way, merely sharing the same job does not necessitate a CoP. A static website on hunting in itself is not a community of practice. There needs to be people who interact and learn together in order for a CoP to be formed. Note that members do not necessarily work together daily, however. Wenger points to the example of Impressionist painters who sometimes met in cafes to discuss their painting styles. He indicates that even though these men normally painted alone, these kinds of interactions were essential to making them a CoP.

3. There needs to be a *practice*: A CoP is not just people who have an interest in something (e.g. sports or agriculture practices). The third requirement for a CoP is that the members are *practitioners*. They develop a shared repertoire of resources which can include stories, helpful tools, experiences, stories, ways of handling typical problems, etc. This kind of interaction needs to be developed over time. A conversation with a random stranger who happens to be an expert on a subject matter that interests you does not in itself make a CoP. Informal conversations held by people of the same profession (e.g. office assistants or graduate students) help people share and develop a set of cases and stories that can become a shared repertoire for their practice, whether they realize it or not.

Communities develop their practice through a variety of methods, including: problem solving, requests for information, seeking the experiences of others, reusing assets, coordination and synergy, discussing developments, visiting other members, mapping knowledge and identifying gaps.

For Etienne Wenger, learning is central to human identity. A primary focus is learning as *social participation* – that is, an individual as an active participant in the practices of social communities, and in the construction of his or her identity through these communities. People continuously create their shared identity through engaging in and contributing to the practices of their communities. The motivation to become a more central participant in a community of practice can provide a powerful incentive for learning. Students will have a desire to develop skills (e.g. literacy skills) if the people they admire have the same skills. That is, they want to join the "literacy club" and will work towards becoming a a member.

Discovery Learning (Bruner)

Summary: Discovery Learning is a method of inquiry-based instruction, discovery learning believes that it is best for learners to discover facts and relationships for themselves.

Originator: Jerome Bruner (1915-)

Keywords: Inquiry-based learning, constructivism

Discovery Learning (Bruner)

Discovery learning is an inquiry-based, constructivist learning theory that takes place in problem solving situations where the learner draws on his or her own past experience and existing knowledge to discover facts and relationships and new truths to be learned. Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments. As a result, students may be more more likely to remember concepts and knowledge discovered on their own (in contrast to a transmissionist model). Models that are based upon discovery learning model include: guided discovery, problem-based learning, simulation-based learning, case-based learning, incidental learning, among others.

Proponents of this theory believe that discovery learning has many advantages, including:

- encourages active engagement
- promotes motivation
- promotes autonomy, responsibility, independence
- the development of creativity and problem solving skills.
- a tailored learning experience

Critics have sometimes cited disadvantages including:

- creation of cognitive overload
- potential misconceptions
- teachers may fail to detect problems and misconceptions

The theory is closely related to work by Jean Piaget and Seymour Papert.

Social Development Theory (Vygotsky)

Summary: Social Development Theory argues that social interaction precedes development; consciousness and cognition are the end product of socialization and social behavior.

Originator: Lev Vygotsky (1896-1934).

Key terms: Zone of Proximal Development (ZPD), More Knowledgeable Other (MKO)

Vygotsky's Social Development Theory

Vygotsky's Social Development Theory is the work of Russian psychologist Lev Vygotsky (1896-1934), who lived during Russian Revolution. Vygotsky's work was largely unkown to the West until it was published in 1962.

Vygotsky's theory is one of the foundations of constructivism. It asserts three major themes:

Major themes:

1. Social interaction plays a fundamental role in the process of cognitive development. In contrast to Jean Piaget's understanding of child development (in which development necessarily precedes learning), Vygotsky felt social learning precedes development. He states: "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)." (Vygotsky, 1978).

2. The More Knowledgeable Other (MKO). The MKO refers to anyone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. The MKO is normally thought of as being a teacher, coach,

or older adult, but the MKO could also be peers, a younger person, or even computers.

3. The Zone of Proximal Development (ZPD). The ZPD is the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability solving the problem independently. According to Vygotsky, learning occurred in this zone.

Vygotsky focused on the connections between people and the sociocultural context in which they act and interact in shared experiences (Crawford, 1996). According to Vygotsky, humans use tools that develop from a culture, such as speech and writing, to mediate their social environments. Initially children develop these tools to serve solely as social functions, ways to communicate needs. Vygotsky believed that the internalization of these tools led to higher thinking skills.

Applications of the Vygotsky's Social Development Theory

Many schools have traditionally held a transmissionist or instructionist model in which a teacher or lecturer 'transmits' information to students. In contrast, Vygotsky's theory promotes learning contexts in which students play an active role in learning. Roles of the teacher and student are therefore shifted, as a teacher should collaborate with his or her students in order to help facilitate meaning construction in students. Learning therefore becomes a reciprocal experience for the students and teacher.

Problem-Based Learning (PBL)

Summary: Problem-Based Learning (PBL) is an instructional method of hands-on, active learning centered on the investigation and resolution of messy, real-world problems.

Originators: Late 1960s at the medical school at McMaster University in Canada.

Key Terms: open-ended problems, self-directed learners, teacher as facilitator, student as problem solver

Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is a pedagogical approach and curriculum design methodology often used in higher education and K-12 settings.

The following are some of the defining characteristics of PBL:

- Learning is driven by challenging, open-ended problems with no one "right" answer
- Problems/cases are context specific
- Students work as self-directed, active investigators and problem-solvers in small collaborative groups (typically of about five students)
- A key problem is identified and a solution is agreed upon and implemented
- Teachers adopt the role as facilitators of learning, guiding the learning process and promoting an environment of inquiry

Rather than having a teacher provide facts and then testing students ability to recall these facts via memorization, PBL attempts to get students to apply knowledge to new situations. Students are faced with contextualized, ill-structured problems and are asked to investigate and discover meaningful solutions.

Proponents of PBL believe that, as a strategy, it:

- develops critical thinking and creative skills
- improves problem-solving skills
- increases motivation

- helps students learn to transfer knowledge to new situations

History

PBL's more recent influence can be traced to the late 1960s at the medical school at McMaster University in Canada. Shortly thereafter, three other medical schools — the University of Limburg at Maastricht (the Netherlands), the University of Newcastle (Australia), and the University of New Mexico (United States) took on the McMaster model of problem-based learning. Various adaptations were made and the model soon found its way to various other disciplines — business, dentistry, health sciences, law, engineering, education, and so on.

Criticisms

One common criticism of PBL is that students cannot really know what might be important for them to learn, especially in areas which they have no prior experience. Therefore teachers, as faciliators, must be careful to assess and account for the prior knowledge that students bring to the classroom.

Another criticism is that a teacher adopting a PBL approach may not be able to cover as much material as a conventional lecture-based course. PBL can be very challenging to implement, as it requires a lot of planning and hard work for the teacher. It can be difficult at first for the teacher to "relinquish control" and become a facilitator, encouraging the students to ask the right questions rather than handing them solutions.

Situated Learning Theory (Lave)

Summary: Situated Learning Theory posits that learning is unintentional and situated within authentic activity, context, and culture.

Originator: Jean Lave

Key Terms: Legitimate Peripheral Participation (LPP), Cognitive Apprenticeship

Situated Learning Theory (Lave)

In contrast with most classroom learning activities that involve abstract knowledge which is and out of context, Lave argues that learning is situated; that is, as it normally occurs, learning is embedded within activity, context and culture. It is also usually unintentional rather than deliberate. Lave and Wenger (1991) call this a process of "legitimate peripheral participation."

Knowledge needs to be presented in authentic contexts — settings and situations that would normally involve that knowledge. Social interaction and collaboration are essential components of situated learning — learners become involved in a "community of practice" which embodies certain beliefs and behaviors to be acquired. As the beginner or novice moves from the periphery of a community to its center, he or she becomes more active and engaged within the culture and eventually assumes the role of an expert.

Other researchers have further developed Situated Learning theory. Brown, Collins & Duguid (1989) emphasize the idea of cognitive apprenticeship: "Cognitive apprenticeship supports learning in a domain by enabling students to acquire, develop and use cognitive tools in authentic domain activity. Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge."

Situated learning is related to Vygotsky's notion of learning through social development.

Motivational and Humanist Theories:

- ✓ Humanism Overview
- ✓ ARCS Model of Motivational Design (Keller)
- ✓ Emotional Intelligence (Goleman)
- ✓ Experiential Learning (Kolb)
- ✓ Maslow's Hierarchy of Needs (Maslow)
- ✓ Self-Determination Theory (Deci and Ryan)

Humanism

Summary: Humanism is a paradigm/philosophy/pedagogical approach that believes learning is viewed as a personal act to fulfil one's potential.

Key proponents: Abraham Maslow, Carl Rogers, Malcolm Knowles

Key terms: self-actualization, teacher as facilitator, affect

Humanism

Humanism, a paradigm that emerged in the 1960s, focuses on the human freedom, dignity, and potential. A central assumption of humanism, according to Huitt (2001), is that people act with intentionality and values. This is in contrast to the behaviorist notion of operant conditioning (which argues that all behavior is the result of the application of consequences) and the cognitive psychologist belief that the discovering knowledge or constructing meaning is central to learning. Humanists also believe that it is necessary to study the person as a whole, especially as an individual grows and develops over the lifespan. It follows that the study of the self, motivation, and goals are areas of particular interest.

Key proponents of humanism include Carl Rogers and Abraham Maslow. A primary purpose of humanism could be described as the development of self-actualized, automomous people. In humanism, learning is student centered and personalized, and the educator's role is that of a facilitator. Affective and cognitive needs are key, and the goal is to develop self-actualized people in a cooperative, supportive environment.

Related theories include: Experiential Learning (Kolb), Maslow's Hierarchy of Needs, and Facilitation Theory (Rogers).

ARCS Model of Motivational Design (Keller)

Summary: According to John Keller's ARCS Model of Motivational Design, there are four steps for promoting and sustaining motivation in the learning process: Attention, Relevance, Confidence, Satisfaction (ARCS).

Originator: John Keller

Key terms: Attention, Relevance, Confidence, Satisfaction (ARCS)

ARCS Model of Motivational Design (Keller)

1. Attention

- Keller attention can be gained in two ways: (1) Perceptual arousal – uses surprise or uncertainly to gain interest. Uses novel, surprising, incongruous, and uncertain events; or (2) Inquiry arousal – stimulates curiosity by posing challenging questions or problems to be solved.

- Methods for grabbing the learners' attention include the use of:

  - Active participation -Adopt strategies such as games, roleplay or other hands-on methods to get learners involved with the material or subject matter.

- Variability – To better reinforce materials and account for individual differences in learning styles, use a variety of methods in presenting material (e.g. use of videos, short lectures, mini-discussion groups).

- Humor -Maintain interest by use a small amount of humor (but not too much to be distracting)

- Incongruity and Conflict – A devil's advocate approach in which statements are posed that go against a learner's past experiences.

- Specific examples – Use a visual stimuli, story, or biography.

- Inquiry – Pose questions or problems for the learners to solve, e.g. brainstorming activities.

2. Relevance

- Establish relevance in order to increase a learner's motivation. To do this, use concrete language and examples with which the learners are familiar. Six major strategies described by Keller include:

  - Experience – Tell the learners how the new learning will use their existing skills. We best learn by building upon our preset knowledge or skills.

  - Present Worth – What will the subject matter do for me today?

  - Future Usefulness – What will the subject matter do for me tomorrow?

  - Needs Matching – Take advantage of the dynamics of achievement, risk taking, power, and affiliation.

  - Modeling – First of all, "be what you want them to do!" Other strategies include guest speakers, videos, and having the learners who finish their work first to serve as tutors.

  - Choice – Allow the learners to use different methods to pursue their work or allowing s choice in how they organize it.

3. Confidence

- Help students understand their likelihood for success. If they feel they cannot meet the objectives or that the cost (time or effort) is too high, their motivation will decrease.

- Provide objectives and prerequisites – Help students estimate the probability of success by presenting performance requirements and evaluation criteria. Ensure the learners are aware of performance requirements and evaluative criteria.

- Allow for success that is meaningful.

- Grow the Learners – Allow for small steps of growth during the learning process.

- Feedback – Provide feedback and support internal attributions for success.

- Learner Control – Learners should feel some degree of control over their learning and assessment. They should believe that their success is a direct result of the amount of effort they have put forth.

4. Satisfaction

- Learning must be rewarding or satisfying in some way, whether it is from a sense of achievement, praise from a higher-up, or mere entertainment.

- Make the learner feel as though the skill is useful or beneficial by providing opportunities to use newly acquired knowledge in a real setting.

- Provide feedback and reinforcement. When learners appreciate the results, they will be motivated to learn. Satisfaction is based upon motivation, which can be intrinsic or extrinsic.

- Do not patronize the learner by over-rewarding easy tasks.

Emotional Intelligence (Goleman)

Summary: Emotional Intelligence (EQ) is defined as the ability to identify, assess, and control one's own emotions, the emotions of others, and that of groups.

Originators: Many, including Howard Gardner (1983) and Daniel Goleman (1995), in a popular 1995 book entitled *Emotional Intelligence*. Several other models and definitions have also been proposed.

Key Terms: conceptual elaboration sequence, theoretical elaboration sequence, simplifying conditions sequence

Emotional Intelligence (EQ)

History

In the 1900s, even though traditional definitions of intelligence emphasized cognitive aspects such as memory and problem-solving, several influential researchers in the intelligence field of study had begun to recognize the importance of going beyond traditional types of intelligence (IQ). As early as 1920, for instance, E.L. Thorndike described "social intelligence" as the skill of understanding and managing others. Howard Gardner in 1983 described the idea of multiple intelligences, in which interpersonal intelligence (the capacity to understand the intentions, motivations and desires of other people) and intrapersonal intelligence (the capacity to understand oneself, to appreciate one's feelings, fears and motivations) helped explain performance outcomes.

The first use of the term "emotional intelligence" is often attributed to A Study of Emotion: Developing Emotional Intelligence from 1985, by Wayne Payne. However, prior to this, the term "emotional intelligence" had appeared in Leuner (1966). Stanley Greenspan (1989) also put forward an EI model, followed by Salovey and Mayer (1990), and Daniel Goleman (1995). A distinction between emotional intelligence as a trait and emotional intelligence as an ability was introduced in 2000.

Daniel Goleman's model (1998) focuses on EI as a wide array of competencies and skills that drive leadership performance, and consists of five areas:

1. Self-awareness – knowing one's emotions, strengths, weaknesses, drives, values and goals and recognize their impact on others while using gut feelings to guide decisions.

2. Self-regulation – managing or redirecting one's disruptive emotions and impulses and adapting to changing circumstances.

3. Social skill – managing other's emotions to move people in the desired direction

4. Empathy – recognizing, understanding, and considering other people's feelings especially when making decisions

5. Motivation – motivating oneself and being driven to achieve for the sake of achievement.

To Golman, emotional competencies are not innate talents, but rather learned capabilities that must be worked on and can be developed to achieve outstanding performance. Goleman believes that individuals are born with a general emotional intelligence that determines their potential for learning emotional competencies.

Emotional Intelligence is not always widely accepted in the research community. Goleman's model of EI, for instance, has been criticized in the research literature as being merely "pop

psychology." However, EI is still considered by many to be a useful framework especially for businesses.

Experiential Learning (Kolb)

Summary: A four-stage cyclical theory of learning, Kolb's experiential learning theory is a holistic perspective that combines experience, perception, cognition, and behavior.

Originators: David A. Kolb (1939-)

Key Terms: Learning cycles, learning styles, concrete experience, reflective observation, abstract conceptualization, active experimentation

Experiential Learning (Kolb)

Building upon earlier work by John Dewey and Kurt Levin, American educational theorist David A. Kolb believes "learning is the process whereby knowledge is created through the transformation of experience" (1984, p. 38). The theory presents a cyclical model of learning, consisting of four stages shown below. One may begin at any stage, but must follow each other in the sequence:

- concrete experience (or "DO")

- reflective observation (or "OBSERVE")

- abstract conceptualization (or "THINK")
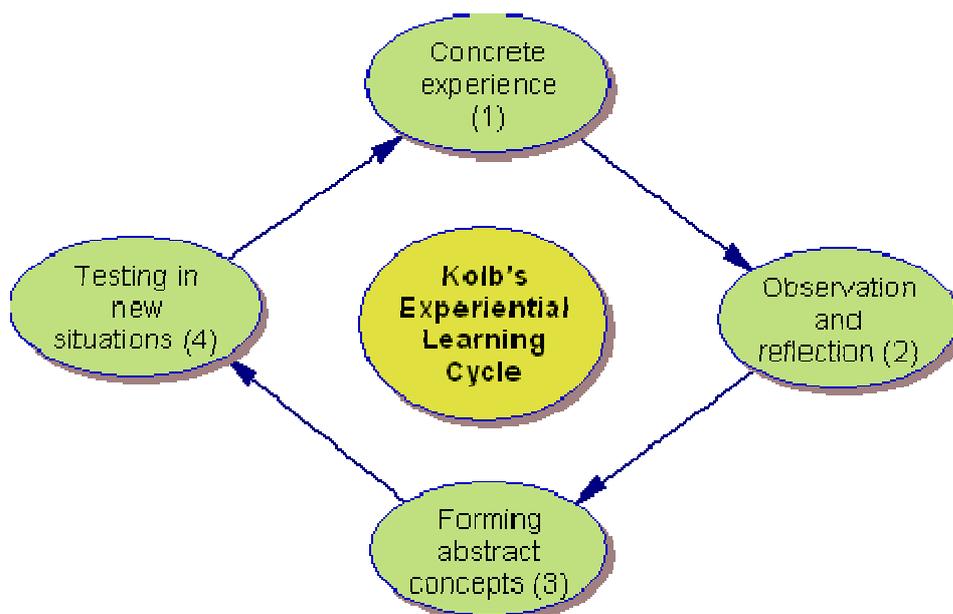
- active experimentation (or "PLAN")

Figure 1. *Kolb's Experiential Learning Cycle*.

Kolb's four-stage learning cycle shows how experience is translated through reflection into concepts, which in turn are used as guides for active experimentation and the choice of new experiences. The first stage, *concrete experience* (CE), is where the learner actively experiences an activity such as a lab session or field work. The second stage, *reflective observation* (RO), is when the learner consciously reflects back on that experience. The third stage, *abstract conceptualization* (AC), is where the learner attempts to conceptualize a theory or model of what is observed. The fourth stage, *active experimentation* (AE), is where the learner is trying to plan how to test a model or theory or plan for a forthcoming experience.

Kolb identified four learning styles which correspond to these stages. The styles highlight conditions under which learners learn better. These styles are:

- assimilators, who learn better when presented with sound logical theories to consider

- convergers, who learn better when provided with practical applications of concepts and theories

- accommodators, who learn better when provided with "hands-on" experiences

- divergers, who learn better when allowed to observe and collect a wide range of information

Maslow's Hierarchy of Needs

Summary: Maslow's Hierarchy of Needs (often represented as a pyramid with five levels of needs) is a motivational theory in psychology that argues that while people aim to meet basic needs, they seek to meet successively higher needs in the form of a hierarchy.

Originator: Abraham Maslow in 1943.

Key terms: deficiency needs, growth needs, physiological, safety, belongingness, esteem, self-actualization

Maslow's Hierarchy of Needs

Abraham H. Maslow felt as though conditioning theories did not adequately acapture the complexity of human behavior. In a 1943 paper called *A Theory of Human Motivation*, Maslow presented the idea that human actions are directed toward goal attainment. Any given behavior could satisfy several functions at the same time; for instance, going to a pub could satisfy one's needs for self-esteem and for social interaction.

Maslow's Hierarchy of Needs has often been represented in a hierarchial pyramid with five levels. The four levels (lower-order needs) are considered *physiological needs,* while the top level is considered *growth needs*. The lower level needs need to be satisfied before higher-order needs can influence behavior. The levels are as follows (see pyramid in Figure 1 below).

- **Self-actualization** – morality, creativity, problem solving, etc.

- **Esteem** – includes confidence, self-esteem, achievement, respect, etc.

- **Belongingness** – includes love, friendship, intimacy, family, etc.

- **Safety** – includes security of environment, employment, resources, health, property, etc.

- **Physiological** – includes air, food, water, sex, sleep, other factors towards homeostasis, etc.
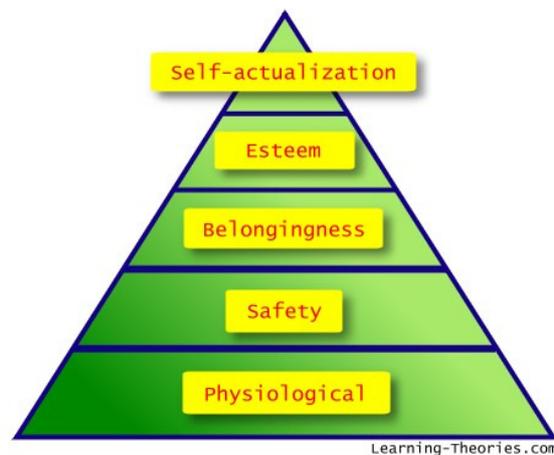

Figure 1. Maslow's Hierarchy of Needs Pyramid.

Information taken from http://www.learning-theories.com/ 21

Deprivation Needs

The first four levels are considered *deficiency* or *deprivation needs* ("D-needs") in that their lack of satisfaction causes a deficiency that motivates people to meet these needs. *Physiological needs*, the lowest level on the hierarchy, include necessities such as air, food, and water. These tend to be satisfied for most people, but they become predominant when unmet. During emergencies, *safety needs* such as health and security rise to the forefront. Once these two levels are met, *belongingness needs,* such as obtaining love and intimate relationships or close friendships, become important. The next level, *esteem needs,* include the need for recognition from others, confidence, achievement, and self-esteem.

Growth Needs

The highest level is *self-actualization*, or the self-fulfillment. Behavior in this case is not driven or motivated by deficiencies but rather one's desire for personal growth and the need to become all the things that a person is capable of becoming (Maslow, 1970).

Criticisms

While a useful guide for generally understanding why students behave the way that they do and in determining how learning may be affected by physiological or safety deficiencies, Maslow's Hierarchy of Needs has its share of criticisms. Some have noted vagueness in what is a "deficiency"; what is a deficiency for one is not necessarily a deficiency for another. Secondly, there seem to be various exceptions that frequently occur. For example, some people often risk their own safety to rescue others from danger.

Self-Determination Theory (Deci and Ryan)

Summary: Self-Determination Theory is a theory of motivation and personality that addresses three universal, innate and psychological needs: competence, autonomy, and psychological relatedness.

Originators: Edward L. Deci and Richard M. Ryan, psychologists at the University of Rochester.

Key Terms: motivation, competence, autonomy, relatedness

Self-Determination Theory (Deci and Ryan)

Self-Determination Theory (SDT) is an important theory of motivation that addresses issues of extrinsic and intrinsic motivation. People have innate psychological needs:

- Competence
- Relatedness
- Autonomy

If these universal needs are met, the theory argues that people will function and grow optimally. To actualize their inherent potential, the social environment needs to nurture these needs.

Competence
Seek to control the outcome and experience mastery.

Relatedness
Is the universal want to interact, be connected to, and experience caring for others.

Autonomy
Is the universal urge to be causal agents of one's own life and act in harmony with one's integrated self; however, Deci and Vansteenkiste note this does not mean to be independent of others

Motivation has often been grouped into two main types: *extrinsic* and *intrinsic*. With *extrinsic* motivation, a person tends to do a task or activity mainly because doing so will yield some kind of reward or benefit upon completion. *Intrinsic* motivation, in contrast, is characterized by doing something purely because of enjoyment or fun.

Deci, Lens and Vansteenkiste (2006) conducted a study that demonstrated intrinsic goal framing (compared to to extrinsic goal framing and no-goal framing) produced deeper engagement in learning activities, better conceptual learning, and higher persistence at learning activities.

Design Theories and Models (Prescriptive):

- ✓ Design-Based Research Overview
- ✓ ADDIE Model of Instructional Design
- ✓ ARCS Model of Motivational Design (Keller)
- ✓ Elaboration Theory (Reigeluth)

Descriptive and Meta Theories:

- ✓ Activity Theory (Vygotsky, Leont'ev, Luria, Engstrom, etc.)
- ✓ Actor-Network Theory (Latour, Callon)
- ✓ Bloom's Taxonomy (Bloom)
- ✓ Distributed Cognition (Hutchins)

Identity Theories:

- ✓ Erikson's Stages of Development (Erikson)
- ✓ Identity Status Theory (Marcia)
- ✓ Self-Theories: Entity and Incremental Theory (Dweck)

Miscellaneous Learning Theories and Models:

- ✓ Affordance Theory (Gibson)
- ✓ Multiple Intelligences Theory (Gardner)