White Paper

Overview of Learning Theories, Theories of Instruction, Learning Strategies, & Learning Activities

Jolly T. Holden, Ed.D
Associate Professor

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Introduction to Learning Theories

Learning theories are conceptual frameworks that describe how information is absorbed, processed, and retained…in other words, how people *learn.* It is the body of principles proposed by psychologists and educators to explain how people acquire skills, knowledge, and attitudes. Learning theory is used in formal instruction to facilitate and accelerate the learning process. When applied to the practice of instruction, learning theories can guide the instructional developer in improving the effectiveness and efficiency of the learning activities of a program.

Relationship to Instructional Systems Design (ISD)

Learning theory impacts instructional systems development in several ways. Many of the products specifically called for in the ISD phases are derived from behavioral learning theory. In the 1950s, behaviorists developed procedures for designing "programmed" instruction that included:

- Analyzing and breaking down content into specific behavioral objectives
- Determining procedures needed to achieve the objectives
- Trying out and revising the steps
- Validating the program against the objectives.

This approach was incorporated into the early ISD procedures. Instructional developers apply learning theory to select instructional strategies for the type of learning required. To the extent that there are real differences in the types of learning, e.g., intellectual skills, motor skills, or attitudes, cognitive strategies, different instructional techniques may be needed. Instructional developers look to learning theory to explain how individuals differ in the ways they learn. Understanding different learning styles, in order to target methods and materials to individual students, may become the most important theoretical area for enhancing learning.

The three most prevalent learning theories are *behaviorism, cognitivism, and constructivism* (Table 1).

Behaviorism

Behaviorism is a learning theory that only focuses on objectively observable behaviors and discounts any independent activities of the mind.

- In a behavioral model of instruction the mind is viewed as a “black box” in the sense that response to stimuli that can be observed and anything that exists, exists in a certain quantity and can be measured.
- Through the use of reinforcement in a predominantly individualized system of instruction, behaviorists seek to increase the number or strength of correct student responses.
- The modes of instruction may vary from Thorndike’s “trial and error” to Skinner’s “teaching machines” but involve a system of chaining where each response alters the environment, and this altered condition serves as a stimulus for the next response.
- Behavior theorists define learning as nothing more than the acquisition of new behavior based on environmental conditions.

Behavioral theory is mostly concerned with observable output and does not place any emphasis on the social context of learning. Behavior theorists define learning as nothing more than the acquisition of new behavior based on environmental conditions.

- Behaviorists identify conditioning as a universal learning process of which there are two different types of conditioning:
- Classic conditioning occurs when a natural reflex responds to a stimulus. We are biologically "wired" so that a certain stimulus will produce a specific response. One of the more common examples of classical conditioning in the educational environment is in situations where students exhibit irrational fears and anxieties like fear of failure, fear of public speaking and general school phobia.
- Behavioral or operant conditioning occurs when a response to a stimulus is reinforced. Basically, operant conditioning is a simple feedback system: If a reward or reinforcement follows the response to a stimulus, then the response becomes more probable in the future. For example, leading behaviorist B.F. Skinner used reinforcement techniques to teach pigeons to dance and bowl a ball in a mini-alley.

Cognitivism

Cognitive learning comes from the perspective that students actively process information and that learning takes place through the efforts of the student as they organize, store, and then find relationships between information, linking old to new knowledge.

Cognitive theorists believe that learning occurs with associations through contiguity and repetition and acknowledges the importance of reinforcement. Also, they believe that human beings need to acquire and reorganize information into cognitive structures that are understandable. Cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which human's process and store information.

One of the forms of cognitive learning is discovery learning. Discovery Learning is an approach to instruction through which students interact with their environment by exploring and manipulating objects, rather than passively receiving knowledge.

Constructivism

Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in.

The term constructivism refers to the idea that learners construct knowledge for themselves, each learner individually (and socially) constructs meaning as he or she learns. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences.

Constructivism applies both to learning theory (how people learn) and epistemology (the nature of knowledge) and largely depends on the student's prior knowledge when entering the classroom. Constructivists concentrate on learning instead of teaching where the learners'

independence and resourcefulness are not only accepted but should be supported by teachers.

On the whole, constructivist teaching encourages students to take responsibility for their own learning, to be autonomous thinkers, to develop integrated understandings of concepts, and to pose—and seek to answer—important questions.

- The purpose of learning is for an individual to construct his or her own meaning, not just memorize the "right" answers and regurgitate someone else's meaning.
- Since education is inherently interdisciplinary, the only valuable way to measure learning is to make the assessment part of the learning process, ensuring it provides students with information on the quality of their learning.

Table 1: Key Elements in Behaviorism, Cognitivism, & Constructivism Learning Theories

Behaviorism	Cognitivism	Constructivism
Learning happens when a correct response is demonstrated following the presentation of a specific environmental stimulus	Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner.	Learners build personal interpretation of the world based on experiences and interactions
Emphasis on producing observable and measurable outcomes	Emphasis is on interaction, reflection, and collaboration in group work	Knowledge is embedded in the context in which it is used (authentic tasks in meaningful realistic settings)
Sequenced knowledge and skills presented in logical limited steps	Concerned with setting, and interaction driving new knowledge acquisition	Create novel and situation specific understandings by assembling knowledge from diverse sources appropriate to the problem at hand (flexible use of knowledge)
Instruction is to elicit the desired response from the learner who is presented with a target stimulus	Learner is viewed as an active participant in the learning process	
Instruction utilizes consequences and reinforcement of learned behaviors	Emphasis on structuring, organizing and sequencing information to facilitate optimal processing	

Theoretical Approaches to Learning

Distributed Cognition

Distributed cognition recognizes the complexity of learning environments where cognition is distributed among people and devices. Distributed cognition refers to the idea that individual reason cannot be viewed in isolation but as inherently interwoven with its social and cultural surroundings. When creating a learning environment that uses the distributed cognition

framework it is important to analyze the various contributions of the environment in which work activities take place, the representational media, the interactions of individuals with each other and their interactional use of artifacts. The distributed cognitive model takes the sole burden for learning and interpretation off the individual learner and acknowledges the myriad of ways that knowledge can be constructed (Salomon, 1997).

Situated Cognition

Situated cognition emphasizes the role of context in learning and asserts that learning is dependent upon the context in which it occurs, and can be described as learning that takes place via active participation in a community of practice (Driscoll, 2005).

According to situated cognition, learning only makes sense within particular situations. Learning and knowing are integrally and inherently situated in the everyday world of human activity where learning is seen as a social, dialogical process in which communities of practitioners socially negotiate the meaning of phenomena.

Situated cognition theory asserts that learning is dependent upon the context in which it occurs; therefore, learning events must address the social, cultural, and political context of the student and provides for meaningful learning and the transfer of knowledge to real life situations. It is a method in which learners use generalizations to translate knowledge from one situation to another. This theory allows students to restore information when needed.

Situated Cognition is a way to "address difficulties students have in retention and generalization". In situated cognition, generalizations are used to help transfer knowledge from one situation to another. This enriches the learning process by providing practical experiences of real situations. Learning is an individual and internal mental process in which knowledge is acquired and stored for use at will in any circumstance.

Key Concepts:

- *Content* is the specific concept that is acquired by the learner. Activities in concept and situations are essential to the learning process. The learning has to be in a concept where the learner will be able to apply the knowledge to real life situations.
- *Context* is the environment and the setting in which the learning takes place. Due to the learners' personal experiences, a variety of methods are worked on through situations. The learners are able to use meaningful resources and purposeful activities that promote problem solving and transfer the learning to real life situations.
- *Facilitation* allows the learners to utilize internal information. It is a way to help the learner with abilities, monitoring, and skills.
- *Assessment* is the growth of the learner is reviewed in order to evaluate the learning process.
- Knowledge is subjective, contextualized, and relative situated in the activity, context, and culture of the event

Socially Shared Cognition

Social Learning Theory takes place in a social context; we learn by other's behaviors and often model those behaviors. This occurs through group discussions, and live sessions. Social Learning can be constraining because there is a physical absence of others. Interacting with others promotes modeled behavior if it is activity that is valued and if the model holds admired status. Social learning theory suggests that most human behavior is learned observationally from others. The key processes implicated in this model focuses on the potency of immediate interaction, reciprocal influence processed between individuals and groups, goal-directed behavior, negotiated processing of information and ideas, and the maintenance and enhancement of social identity. Observation and modeling of behavior, attitudes, and emotional reactions of others is the basis of social learning (Bruning, Schraw, Norby, & Ronning, 2004).

Self Regulation

The goal of self-regulation theory is to create self-directed learners. Self-directed learning focuses on the process by which adults take control of their own learning, in particular how they set their own learning goals, locate appropriate resources, decide on which learning methods to use and evaluate their progress. More specifically, learners who self-regulate set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior guided and constrained by their goals and the contextual features f the environment. In other words, the self-regulated student uses motivational, attitudinal, strategic, and metacognitive components in learning situations (Schunk, 2004).

Students will use self-regulation theory to *self-monitor* their own needs. If a student already knows about what they are learning they may not choose to read the book or use other available materials. However, if the learner is just beginning they may need to use all the materials as well as look for more outside information. As well as monitoring their needs this also shows the use of *self-efficacy*, per se, students decide their own ability to successfully complete an assignment.

Outcome expectation is important to self-regulation. How a student perceives a subject and their own knowledge on the subject, leads to their expected outcomes. The student's view of attribution for outcomes (internal or external) will influence their ability to self-regulate their behavior towards this subject

One aspect of self-regulated learning theory applicable to adult learners is that it focuses on the process by which adults take control of the own learning, in particular how they set their own learning goals, locate appropriate resources, decide on which methods to use, and evaluate their progress.

Motivation Theory

Motivation is a powerful force that can be used to sustain goal-directed behavior. Simply stated, is the ability to set and maintain goals. Motivational theory identifies four major dimensions of motivation (Driscoll, 2005):

Interest. Interest refers to whether the learner's curiosity is aroused and whether that arousal is sustained over time

Relevance. Relevance is the perception of the learner as to whether the instruction satisfies personal needs or goals.

Expectancy. Expectancy refers to the learner's perceived likelihood of success and how much in control of that success the learner is.

Satisfaction. Satisfaction refers to intrinsic motivations and reactions to extrinsic rewards.

Learner motivation is also impacted by:

Attitude – quality instruction, evidence that effort makes a difference, immediate feedback, amount and quality of effort directly related to success

Need – fosters sharing, feedback, and collaboration

Stimulation – provide a variety of methods and materials

Affect – identify with material, involve emotions in learning process

Competence – immediate feedback, instructor comments, build self-confidence

Reinforcement – extrinsic reinforces given immediately

Theories of Instruction

Gagne's Conditions of Learning

Learning theorists have categorized human activity into types of learned behavior. Robert Gagné categories of learning types are the most inclusive. Gagné's theory should be classified as *instructional theory* as opposed to a learning theory. While learning theory consists of a set of propositions and constructs that account for how changes in human performance abilities come about, an instructional theory seeks to describe the conditions under which one can intentionally arrange for the learning of specific performance outcomes (Gagné, 1985).

Gagné believed that different internal conditions are necessary for each type of learning. A learning event contains a learner, a stimulus situation and an action or response. Each external event must satisfy a specific cognitive process necessary for learning to take place internally in the learner. The sequence of these events should create the foundation to instructional design.

Gagné's learning types include intellectual skills, verbal information, cognitive strategies, motor skills, and attitudes (Driscoll, 2005). Gagné suggests that each type of learning requires different internal conditions for processing to occur. Internal conditions may be cued or prompted by external conditions present in the learning environment. In Gagné 's view, effective instruction must reach beyond traditional learning theories (behaviorism, cognitivism, and constructivism) and provide support to transition from simple to complex skills, thus using an hierarchical model for learning.

Intellectual Skills. Intellectual skills are the foundation for all higher learning. They consist of discrimination, concepts and rule-using. Cognitive strategies are often called a higher-order type of intellectual skill. Intellectual skills are hierarchical in nature. For example, in order to

learn a higher-order skill, the learner should possess the prerequisites and have already learned the lower-order skills such as discriminations, concrete concepts, defined concepts, and rule learning.

Discriminations. Discriminations are skills related to seeing differences between stimuli. Most adult problems in discrimination come from physical disabilities like color blindness, hearing loss, or some injury that affects sensory perception.

Concrete Concepts. Concrete concepts are skills related to categorizing physical objects into one or more classes based on their physical attributes. Identifying resistors from among other electrical components is an example of concrete concept learning.

Defined Concepts. Defined concepts are skills related to classifying symbolic objects into one or more classes based on a definition. The definition is actually a rule for classification. For example, classifying a verbal statement from an officer as a command is an example of a learned defined concept.

Rule Learning. Rule learning skills relate to applying principles or procedures to solve problems. Problem solving is the ability to recall relevant rules and use them to solve a novel problem. The product of problem solving is not only a solution to the problem, but also learning a new rule or procedure to be used if a similar situation should arise in the future.

Verbal Information. Verbal information is the learning of names and labels that can be verbalized. It is also called declarative knowledge. Verbal information learning requires some basic language skills. In addition, verbal information is more readily retained when it is learned within a larger context of meaningful information. Gagné described verbal information as *declarative knowledge* ("knowing what") and intellectual skills as procedural *knowledge* ("knowing how"). Declarative knowledge includes remembering and using concepts and facts. Procedural knowledge includes remembering and applying procedures and processes (Driscoll, 2005).

Cognitive Strategies. The basic premise of an information processing model is that individuals mentally process their environment. This process consists of a number of stages in which the stimuli become information, which is given meaning by previous knowledge and current expectations. Cognitive strategies are employed to maintain the knowledge in short-term memory and translate it to a structure that enters long-term memory as a type of knowledge in the form of propositions, productions or schemas. Cognitive strategies are thought of as executive control mechanisms for learning. Monitoring the use of strategies is "metacognition." Cognitive strategies used in metacognition are called metacognitive strategies.

Motor skills. Motor skills are learned behaviors that involve the smooth coordinated use of muscles. Motor skills most often involve a sequence of activities that may be described verbally as an "executive subroutine." This verbal information is learned to provide guidance for learning the execution of the motor skill. When the learner has acquired the motor skill, the verbal routine is no longer needed and the skill is performed in a smooth and continuous manner. Motor skills require practice and kinesthetic (natural) feedback. Verbal feedback from an observer also helps the learner make corrections in performance. Much of the instruction is aimed at getting the student to recognize the feel of the motor performance when it is executed correctly.

Attitudes and Motivation. The acquiring of particular attitudes may require the prior learning of intellectual skills or particular sets of information. For example, if a positive attitude toward safety is to be acquired, the learner should have (1) intellectual skills (concepts and procedures) associated with safety, and (2) a variety of verbal information about the advantages of following safety procedures or the consequences of not following them. Attitudes have mutually supportive relationships. An individual generally tries to maintain consistency with regard to choice behaviors. However, attitudes are based on perceptions of reality. These perceptions are colored by misinformation or critical experiences. Attitudes are learned or influenced by observing others and viewing the consequences of their behavior. This type of learning (vicarious) is a distinct principle of social learning. External conditions for learning attitudes include a human model. Experiences play a major role in the formulation of attitudes. Motivation plays a significant role in learning.

Gagné's Nine Events of Instruction

Gagné's created a nine-step process referred to as *The Events of Instruction* (Gagné, 1985). The events of instruction of instruction are related to the learning process in that it supports the internal processes of learning.

Information undergoes a series of transformation as it passes through the stages of memory. Processes thought to be responsible for these transformations include attention, pattern recognition, retrieval, rehearsal, encoding, retention, and so on. Modifying the information flow, as well as setting processing priorities, are executive control processes (Driscoll, 2005). Because learning takes place only when these processes are activated, the goal of instruction, according to Gagné, should be to facilitate this activation through his nine-step process.

The Nine Events of Instruction:

- Gain attention
- Inform learner of objectives
- Stimulate recall of prior learning
- Present stimulus material
- Provide learner guidance
- Elicit performance Provide feedback
- Assess performance
- Enhance retention and transfer

Keller's Motivation Model

John Keller developed a general model integrating the various sources of motivation for learning. Keller's model assumes that students' motives, combined with their expectances, will influence the degree of attention of effort they will supply to a learning task. In considering the instructional applications of his model, Keller proposed for conditions of motivation that must be met to have a motivated learner (Driscoll, 2005). The four conditions are Attention, Relevance, Confidence, and Satisfaction (ARCS)

Attention involves grabbing the learner's interest at the beginning of instruction and maintaining that interest throughout the lesson and course. *Attention* is achieved by the students need to do well in the class (either for their degree or for knowledge needed in a work environment)

Relevance is the personal significance and value to the learner of mastering the learning objectives. *Relevance* is established by applying the assignments to real life situations that could be used in the student's lives

Confidence relates to the learner's expectancy of success. *Confidence* is gained when the student uses the classroom materials to practice the skills in the unit in an environment that is non-threatening and self-correcting

Satisfaction comes from achieving performance goals. *Satisfaction* is achieved when the student receives their grade in a timely manner with comments so the learner will know they achieve.

Learning Strategies

Transfer of learning means that something learned in one situation can be applied in another. Since transfer is the primary goal of instruction, it is imperative one must design for transfer. To that end, transfer is facilitated by the development of instructional strategies.

Scholars have identified learning to be primarily a social, dialogical process. Social learning theory suggests that most learning takes place in a social context where learner behavior is modeled by others. This modeling can occur through lecture, guided discussion, role-playing, case study, and other instructional strategies.

When articulating an instructional strategy, you must clearly relate the instructional strategy with the corresponding learning theory. For example, in each phase of learning activity, you would define and identify the key elements of the applicable learning theory and the appropriate instructional strategy (see Table 5 for examples) that characterizes the specific learning theory. The student activities are the product of an instructional strategy that facilitates the attainment of the instructional objectives.

Table 2: Examples of Theory-based Learning Strategies

Behavioral	Cognitive	Constructivism
Instructional cues	Interactivity	Modeling
Practice paired with stimuli	Illustrative examples	Collaborative Learning
Reinforcement	Corrective feedback	Coaching
Discrimination	Mnemonics	Scaffolding
Association	Chunking	Fading
Building fluency	Concept Mapping	Problem-Based Learning
Drill and practice	Advanced Organizers	Authentic Learning
Generalization (defining and illustrating concepts)	Analogies/Metaphor	Anchored Instruction
	Scaffolding	Cognitive Flexibility
Associations (applying explanations)	Active retrieval (linking to	Object-based Learning

Chaining (automatically performing a specified procedure)	prior knowledge)	

Note: For a glossary of instructional strategies, click this link: http://glossary.plasmalink.com/glossary.html

Instructional Strategies vis-à-vis Cognitive Strategies

Instructional strategies focus on the transmission of knowledge and describe the general components of a set of procedures used to enable student mastery of learning outcomes, while cognitive learning strategies are methods used to help learners link new information to prior knowledge. To that end, cognitive strategies focus on how the learner processes knowledge and provides a structure for learning through mental strategies, and these are used to facilitate the activation and retention of prior knowledge by integrating active and exploratory learning techniques into the design process.

Some examples of instructional strategies are:

Imagery

- Mental visualization of objects, events, and arrays
- Enabling internalized visual images that relate to information to be learned
- Creating or recreating an experience in your mind
- Imagery involves the primary learning modalities: visual and aural

Simulation replicates or mimics a real event and allows for continual observation. A simulation creates a realistic model of an actual situation or environment

- Illustration depicts abstract concepts with evocative, palpable real-world examples
- Modeling is a contrived, simplified version of an object or concept that encapsulates its salient features.

Drill & Practice. Repetition of a task or behavior until the desired learning outcome is achieved. Allows for transfer of knowledge from working memory to long-term memory.

Cognitive Learning Strategies

Cognitive learning strategies are methods used to help learners link new information to prior knowledge in facilitating the transfer of learning through the systematic design of instruction (Driscoll, 2005). Cognitive learning strategies focuses on how the learner processes the knowledge and supports the learner as they develop internal procedures that enable them to perform tasks that are complex, and can increase the efficiency with which the learner approaches a learning task.

Cognitive learning strategies primarily focuses on how the learner processes the knowledge, provides a structure for learning when a task cannot be completed through a series of steps (*scaffolding*).

Scaffolding is a technique to increase the effectiveness of the instruction in that specialized instructional supports need to be in place in order to best facilitate learning when students

are first introduced to a new subject. Scaffolding techniques can be classified into three major groups (Bruning, et al., 2004):

- *Verbal* scaffolding (e.g., paraphrasing, think-alouds, contextualizing)
- *Procedural* scaffolding (e.g., modeling, group instruction, peer assisted activities)
- *Instructional* scaffolding (e.g., using graphic organizers to help learners build background and organize text content).

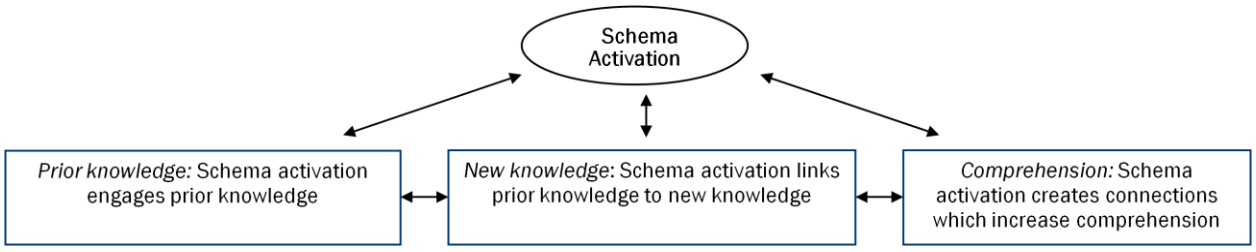
The utility of cognitive learning strategies can be employed by faculty to facilitate the activation and retention of prior knowledge by focusing on *knowledge construction*.

Knowledge construction is a methodological approach which assumes that knowledge needs to be constructed. It occurs when learners explore issues, take positions, discuss positions in an argumentative format, and reflect and evaluate their positions. Knowledge construction involves active learning through participation and discourse, the opportunity to critically analyze information, dialogue with others about its meaning, reflect upon how the information fits within one's personal belief and value systems (*schema*), and arrives at a meaningful understanding of that information. In this process, information becomes transformed into knowledge.

Schema. The contents of long term memory are sophisticated structures that permit us to perceive, think, and solve problems, rather than a group of rote learned facts. These structures are known as schemas (a mental framework for understanding and remembering information) and permit us to treat multiple elements as a single element. Schemas are the cognitive structures that make up our knowledge base and assist us in knowledge construction, and can be "activated" through the use of cognitive learning strategies.

> *Schema activation* refers to an array of activities designed to activate relevant knowledge in students' memory prior to encountering new information. Schema activation is the process of engaging prior knowledge, which is organized in the brain in schemata. Schema activation is an important scaffolding tool where learning depends upon the activation of old knowledge to provide an appropriate schema into which new knowledge can be incorporated (Driscoll, 2005, Schunk, 2004, & Bruning, et al., 2004).

Figure 1: Schema Activation



Types of Cognitive Learning Strategies

Cognitive learning strategies can be *represented* based on the information presented, and is used as tools to construct knowledge in new concepts (Driscoll, 2005, Schunk, 2004, Bruning, et al., 2004). Representative models include:

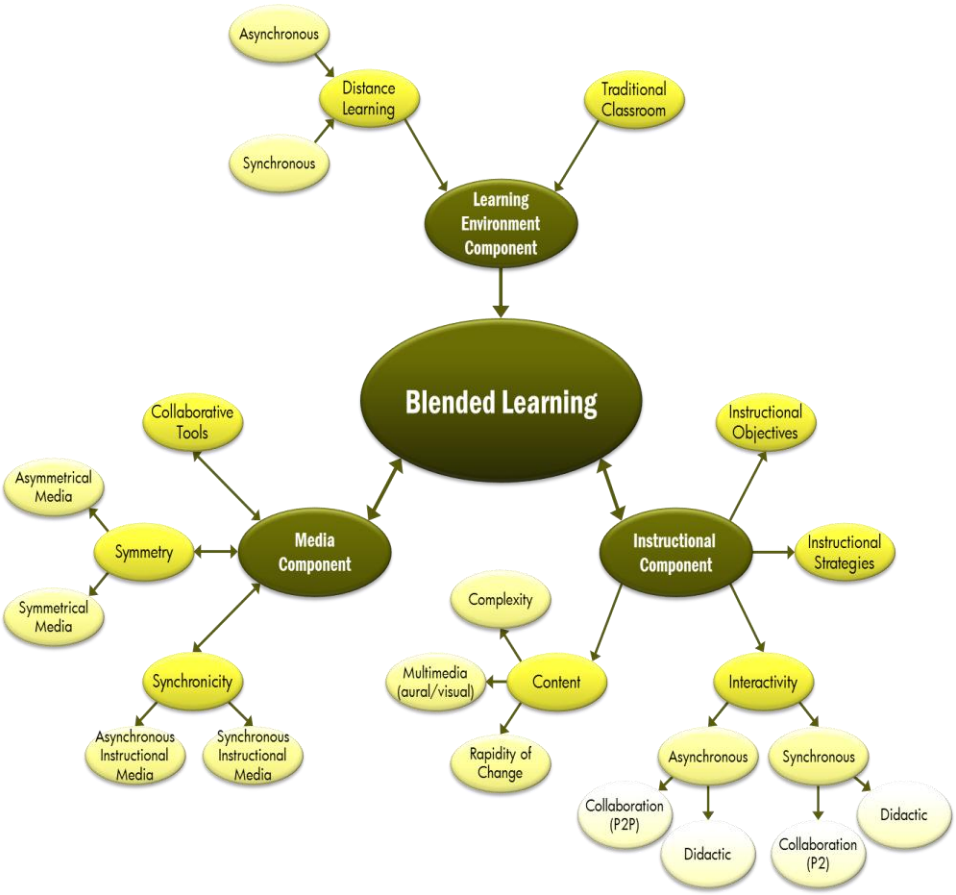
Organizing strategies are not memorable strategies in that they must be supplemented by more powerful strategies, such as framing or concept mapping. However, chunking strategies are good preparation for other strategies (West, Farmer, & Wolff, 1999).

Chunking. Organization of information into meaningful units; makes it easier to use, store, and recall information; multiple chunks of information can be linked together; helps in overcoming working memory limitations; limits on the capacity of immediate memory affects the amount of information that we are able to receive, process, and remember.

Spatial strategies are an array of information organized by location in space and time. They assist in the recall of concrete arrays of information by using visual displays (grids, matrix, framework) of substantial amounts of information, and provide a big picture by which learners can use to assimilate information.

Concept Maps. Concept mapping is a way of graphically displaying concepts and relationships between or among concepts (Figure 2). It allows a visual aid in which to view thoughts and ideas and can aid a student in tying ideas together or relationships between ideas. Concept mapping consists of extracting concepts and their relationships from text or other content. They are useful because they can visually depict new information and relationships which can greatly assist in understanding a body of knowledge and problem solving.

Figure 2: Concept Map Example



Frames Type 1.Frames are a visual display of substantial amounts of information; allows text easier to understand; knowledge is organized around the representation in frames and allows a uniform representation of knowledge; main ideas are represented as slots of some concept that describes properties of that concept (Figure 3).

Figure 3: Frame Type 1 Example

Types of Rocks	Formation	Composition	Types	Uses
Igneous				
Sedimentary				
Metamorphic				

Frames Type 2. These are represented as matrices or grids that allows for organizing large numbers of facts, concepts or ideas (Figure 4). They are driven by a general principle or statement, elicits personal knowledge from memory, and relationships are recognized and understood by logical inference. They allow the learner to elaborate and enrich complex information through active learning. Frames Type 2 also provides schema activation, improves comprehension, and allows for deeper levels of processing. They are useful by providing the big picture and helps students recall prior learning. Frames Type 2 can be combined frames type one, and can be combined with other cognitive strategies such as imagery, rehearsal and mnemonics, although they do not require as much supplementation as other cognitive strategies.

Figure 4: Frame Type 2 Example

Indians	Tools	Food	Clothing	Shelter	Environment
Coast					
Desert					
Plains					

Bridging strategies helps learners to recall what they know and to transfer knowledge to new topics. It should be brief, abstract, and introduction of the new material and a restatement of prior knowledge. They provide learners with a structure of new information and encourage transfer and application by relating incoming information to concepts and ideas already in memory in such a way that new material is more memorable (West, et al., 1999).

Advance Organizer. A [bridging] strategy for metacognition in that it provides a "bridge" for students to transfer pre-existing knowledge to a new topic. Advance organizers can be used to link new with something already known, an introduction of a new lesson, unit or course, an abstract outline of new information and re-statement of prior knowledge, a structure for students of the new information, and an encouragement for students to transfer or apply what they know.

Metaphor. A figure of speech in which an expression is used to refer to something that it does not literally denote in order to suggest a similarity. A metaphor can be *comparative* in that it is an implicit statement that two apparently dissimilar objects do have in common features; it can be *interactive*, per se, similarities in the mind of the student between the vehicle and topic; or *relational*, per se, based on abstract connections of a logical or natural character; or an *attribute*, based on physical or perceptual similarities.

Analogy. Involves taking into consideration resemblances, between objects, situations or ideas which are similar. The intent is to transfer prior knowledge from a familiar situation to a new situation, per se, use of a familiar idea or concept to introduce or define a new idea or concept.

Simile. A figure of speech in which two unlike things are compared and share one common factor. This form of a cognitive strategy is essential because its ability to influence learning and memory. When using a simile the relationship is expressed using "is like" or "is similar to" or "as". A simile can use imagery as a bridge connecting the concept and the understanding, display better memory performance, e valuate their learning preference from the different formats the information is introduced, and imagine the concept, store and recall the image, and relate it to the subject.

General Purpose Strategies*.* Representative models include (West, et al., 1999):

Rehearsal. Allows for mastery of manageable chunks; enhances retention of modeled events; maintains information in short-term memory indefinitely and improve recall; represents miscellaneous ways of study; activities which help put material into short term memory by keeping it active so it can be more deeply processed for recall over long periods; reviewing, asking/answering questions, summarizing.

Maintenance rehearsal is effective for short term retention and consists of using some memory strategy that keeps or maintains information in short-term memory. Elaborative rehearsal relates new information to previously known information. It is more of an active process that involves elaborating on new incoming information in some way and consists of information that one already knows.

Imagery. Mental visualization of objects, events, and arrays. Enabling internalized visual images that relate to information to be learned. Creating or recreating an experience in your mind .Imagery involves the primary learning modalities: visual and aural.

Mnemonics. Artificial aids to memory and meaningful practice which involves familiarizing oneself with a list. They act as a holding pattern while links are found to retain the information permanently. Repetition and association are two essential components to any memory technique. New knowledge is more effectively stored in the long term memory

when it is associated with anything that is familiar. Demand active participation and a constant repetition of the material to be memorized.

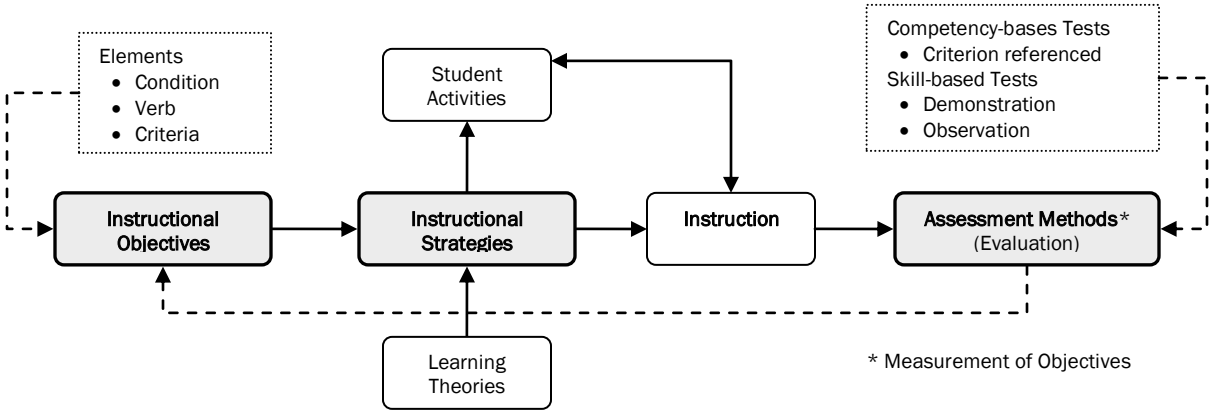
Instructional Learning Strategies

Instructional strategies focus on the delivery of knowledge, while cognitive strategies focus on how the learner processes the knowledge. Instructional strategies describe the general components of a set of procedures used to enable students' mastery of learning outcomes (Dick, Carey, L. & Carey, J., 2009). Instructional strategies are developed in support of the instructional goal and specific learning (instructional) objectives

Designing Learning Activities

The utility of cognitive learning strategies can be employed by teachers/instructional designers to facilitate the activation and retention of prior knowledge by integrating active and exploratory learning techniques into the design process (Figure 5).

Figure 5: Learning Activity Design Model



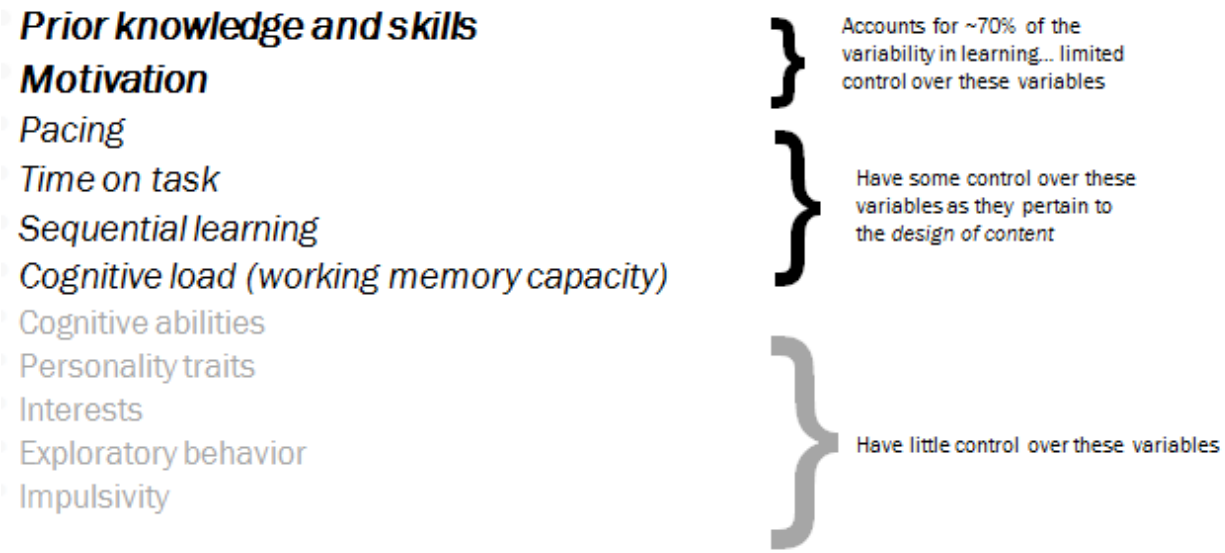
While active learning involves activity, exploratory learning requires exploration on the part of the learner.

When translating learning theory into the design of content, integrating multimedia components can lead to effective learning. Continued research into neuroscience is discovering how the brain processes information and has revealed that significant increases in learning can be accomplished through the informed use of visual and verbal multimodal learning. Our brain is constantly searching its memory for context based on prior knowledge/experience. In the absence of visual cues, the brain creates "mental pictures" based upon one's schema to add context to what is printed/spoken.

Note: With respect to working memory, verbal/text memory and visual/spatial memory work together, without interference, into a framework (or *schema*) of understanding. Consequently, the development of schemata requires students to learn topics in ways that are relevant and meaningful to them, regardless of the modality.

The human dynamics of learning is a complex process that encompasses elements of behaviorist, cognitive and social learning theories. The variables that affect learning outcomes (Figure 6) are so pervasive that no single variable can account for variations in individual learning. Continued research into neuroscience is discovering how the brain processes information acquired through our primary learning modalities: visual, aural, and tactile. However, the challenge for instructional designers is to move information from short term memory to long term memory for recall [and application].

Figure 6: Factors Affecting the Variability in Learning



Structuring Learning Environments to Support Active Learning

Active and exploratory learning requires a deep commitment to learning that is specifically tailored to active and exploratory approaches. A crucial determinate in employing active and exploratory learning is a change in paradigm from more traditional teaching methods (Schunk, 2004).

Exploratory and active learning activities allow for:

- Flexibility-providing multiple opportunities for exploration and active learning
- Structuring activities to meet higher taxonomic levels
- Encouraging critical thinking tasks
- Incorporating group work and social interaction
- Keeping a focus on student-centered instruction
- Breaking lectures into short segments and have students perform a task after each segment (answer a question, solve a problem, etc)
- Ask thought questions instead of factual questions
- Encourage brainstorming
- Integrate cooperative learning
- Include role-playing, drama, debates, simulations, and games
- Use peer teaching

Active Learning

Active learning derives from two basic assumptions: Learning is by nature an active endeavor, and different people learn in different ways. Active learning strategies incorporate these principles:

- Students are actively involved
- Instruction is activity-based
- Curriculum is student-centered

Active learning strategies create an environment that engages students who might not otherwise be engaged in their own learning in meaningful ways. Active learning environments incorporate:

- Collaborative learning
- Cooperative learning
- Team learning
- Problem-based learning

Exploratory Learning

An exploratory environment is left completely to the user.

- Learners who are activating knowledge in an exploratory or active environment must realize some control over their environment.
- The heart of exploratory learning: the environment must be rich and must provide learning opportunities when active exploration occurs

In exploratory learning, students explore their surrounding environment and construct learning from their discoveries. Exploratory learning is environment-rich and depends upon the availability of appropriate materials and resources. Exploratory learning strategies incorporate these principles:

- Environment is rich
- Learners self-explore
- Learners create own meaning

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