

Chapter 5

Using Learning Theory and Brain Science to Guide Training



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Abstract Learning theories guide how training is designed, developed, and evaluated. Using learning theories to direct training design results in improved learning and training outcomes. As science has advanced, new learning theories have emerged as it is now possible to view the brain during the learning process. This chapter will review recent research that can help learning professionals identify precision-training methods that can produce the best learning outcomes.

Keywords Brain science · Cognitivism · Behaviorism · Social learning theory · Humanism · Constructivism · Andragogy · Learning styles

Learning Objectives

1. Evaluate the relationship between learning theories and HIT training
2. Discuss evidence and training best practices from neuroscience
3. Identify evidence from learning science and how it applies to specific training needs
4. Discuss the difference between learning styles and learning preferences

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The Use of Learning Theory in Training Design

John needed to create some eLearning to teach nurses how to use a new order entry function that was being added to the EHR. He remembered hearing that people may have one of four different learning styles and that training should be designed to meet the needs of all of these different types of learners. John recalled that the four learning styles included (1) people who like to see images and videos to help their learning, (2) those who like to hear narration, (3) those who learn best by reading or writing down information, and (4) those who absorb new knowledge through hands-on activities.

Within the eLearning module, John planned to include both written text and an accompanying voice-over to speak the written words. He felt that this training design approach would address two of the four learning styles. Next, John pondered about how to include the learning needs for those who like to read and write, and those who need hands-on activities to learn. After some thought, John decided that the new eLearning module would include sections where the learner would need to enter information after reading a question or case study. This approach would address the learning needs for those who prefer to read and write to learn. Finally, John included activity in the eLearning module by creating a requirement for the learner to click an arrow to move from screen to screen. He additionally included a few quizzes that functioned by requiring the learner to move text on the screen from one location to another to match with the correct answers. How do you think this eLearning module was received by the learning audience? Do you think that people can only learn if training is presented using their learning style?

Introduction

Learning theory might seem a bit intimidating, but learning theories are simply the published end-result of observations and research on how people best learn. Each researcher approaches learning in a slightly different way, resulting in many unique theories about how people intake and process information. In reality, many learning professionals have a favorite learning theory that they use frequently, but there is no single learning theory that will provide optimal learning outcomes in every learning situation. Therefore, it is important to understand each of the most commonly used learning theories because the selected learning theory will influence and guide how training is designed, developed, and evaluated [1]. Some of the earliest learning theories were developed before we had multiple ways to view and evaluate learning [2]. With the advent of modern technology, the science of brain-based learning provides new insight into how people learn, and modern technology can help researchers actually view the brain during the learning process [3].

In addition to guiding the design and development of training, learning theories can also serve to frame the evaluation of training. For example, if training is based on

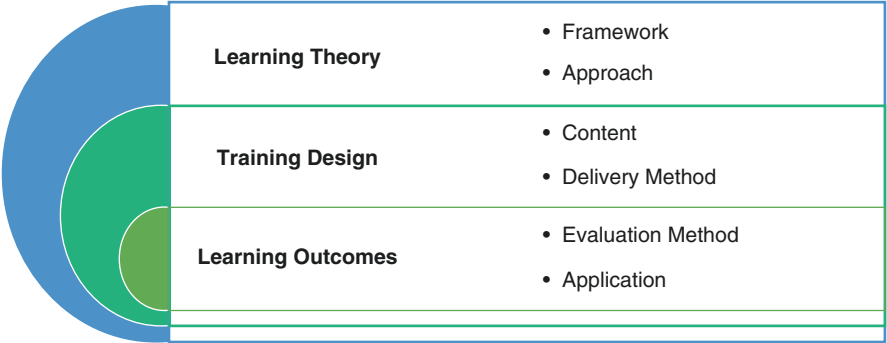


Fig. 5.1 Relationship of learning theory to design and outcomes

a particular learning theory, training that uses that theoretical approach should produce a certain the expected response from the learner (Fig. 5.1). The expected response forms the basis for evaluation of the training design, and the skill of the designer and instructor will be used a certain way when a particular learning theory guides training. There are many books and resources that go into great detail about each of the learning theories, but the purpose of this chapter is to provide a general overview of the most commonly used learning theories used for training design and development.

Learning Theories and Frameworks

Behaviorism

Behaviorism is one of the older learning theories, developed over the late 19th and early twentieth century. At that time, the ultimate output of learning was a change in performance, therefore behaviorism focused on changing the behavior of the learner [4]. Many are familiar with the story of Pavlov and his experimental approach that caused dogs to salivate each time they heard a bell ring. This conditioned response occurred because initially the dogs were given meat powder at the same time that they heard a bell ring. Over time, just the sound of the bell triggered the salivatory response even when there was no meat powder reward. From this early experimental research came the concept of classical conditioning, which is defined as a direct transfer of the response towards one stimulus, the meat powder, to that of another stimulus, the sound of a bell.

Building on the early work of Pavlov, the concept of operant conditioning expanded on classical conditioning by introducing positive and negative rewards to reinforce performance of the desired behavior. From an educational perspective, the instruction determines the desired behavior of the learner and institutes positive or negative rewards to reinforce the behavior. Positive reinforcement is the introduction of something positive to reinforce repetition of the desired behavior. Examples

of positive reinforcement include grades and skills exercises. Negative reinforcement is not providing punishment, but rather involves removal of an unpleasant stimulus such as canceling the additional homework that was assigned due to poor performance, seeing improved grades, or receiving increasingly positive feedback about behavior. Although behaviorism is one of the theories that has fallen from frequent use, elements of the theory can be seen in learning activities that include skills exercises and repetitive drills.

Health information training that is based on behaviorism may include such elements as graded quizzes, repetition of skills exercises, prizes or treats for demonstrating desired behaviors, and the training will include clear learning objectives and outcomes. Training based on behaviorism will often provide strong and frequent encouragement and praise when movement in the right direction is observed, or when goals are achieved to further motivate the learner. One of the pitfalls of behaviorism is that when praise is not provided for accomplished goals, the learner may not experience reinforcement of the desired behavior, which can negate learning [5].

Cognitivism

While behaviorism focused on changed behavior as evidence of learning, many questions about how people learn were left unanswered. Cognitivism emerged in the mid-twentieth century as a way to explain the process of how people learn. The theory of cognitivism proposed that learning not only changes behavior but involves how information is organized in the brain [4]. Cognitivism focuses on the mechanics of memory, proposing that information is encoded in the brain when stimulus in the environment reaches the attention of the brain. From there, the large amount of encoded information taken into the brain is filtered so that irrelevant information is removed, and then the newly encoded information is stored in short term memory. New information stored in short-term memory will only remain for 20-30 seconds unless transferred to long term memory. Additionally, information can only be integrated into short term memory in small pieces, which is why telephone numbers and social security numbers were developed to be only seven to ten digits long.

An easy way to visualize cognitivism is to picture the brain as a large filing cabinet. In this mental filing cabinet, new information must be coded and filed with like information so that it is placed into context and can be retrieved at a later time. To move new information into long-term memory, the information in short-term memory is encoded a second time to group it with like information so that it can be retrieved at a later time, based on each person's unique mental labels and internal brain filing systems. Using a foundation of cognitive learning, in 1965 Gagne proposed nine events of instruction that must be present for new knowledge to be encoded and moved into long-term memory [6]. The nine events of instruction include (1) gaining the attention of the learner through a stimulus, (2) providing the objective of the learning, (3) connecting new knowledge with previously acquired knowledge, (4) presenting material in a way that is clear and memorable, (5)

directing learning that is to occur, (6) allowing for performance of the new knowledge, (7) presenting feedback on the learning process, (8) assessing use of the new knowledge with additional feedback, and (9) allowing for practice to promote the ability for future retrieval of the new knowledge. The steps within Gagne's nine events of learning allow for encoding and retrieval of new knowledge.

Health information training that is designed using cognitive learning theory might include techniques that help the learners remember new information by creating strong connections with existing knowledge. Training techniques may include repetition of concepts, using mnemonics, imagery, and unusual associations that help the learner to recall information because it is tied to something unusual or unexpected.

Social Cognitivism

Around the same time that behaviorism was emerging, theorists were starting to examine how learning occurred within a cultural and social context. Researchers noted that learners were influenced by their language and culture when learning, and that the interplay of teachers and peers helped learners to test new ideas. The goal of social cognitivism is to help the learner grow from dependence to independence when learning new information by using the influence of the teacher and peers to support the learning and growth process [7].

Health information technology training that is developed using the foundation of social cognitive theory may include the opportunity for students to identify their goals for learning. And included in the training should be time for peer interaction and discussion about what has been learned, and opportunities to practice new skills that help to establish and maintain independence.

Social Learning Theory

Social learning theory emerged in the early twentieth century and was developed in recognition of the importance of the environment on learning. The ability to observe, imitate, and learn a new behavior contributes to the learning process. For social learning to occur, the student must be able to observe or pay attention, process and retain what is learned in memory, and possess the motivation to observe and imitate another's behavior [8].

When social learning is the foundation of health information technology training, the class may be structured as a flipped classroom where the learners are given pre-work. The prework includes information that is later discussed with peers in the classroom. Training using the social learning model will have minimal instructor activity and a large amount of learner interactivity. Social learning can also occur when a learner imitates the behavior and processes of a preceptor in the real-world environment.

Humanism

The learning theory of humanism emerged at the same time that psychology was developing theories about self-esteem and human potential, including Maslow's hierarchy of needs theory. Training that is designed using humanism presupposes that learning is a personal decision made to help one achieve their full potential. Humanism uses five principles to guide education that include (1) self-direction and independence, (2) assuming responsibility for what is learned, (3) growth of creativity, (4) curiosity, and (5) inclusion of the arts. Humanism forms some of the core elements of adult learning theory, which will be presented later in this chapter [1].

When humanism is the foundation for health information technology training, there will be an emphasis on the benefits of obtaining training including professional growth and the relationship between training and optimal patient care. Additionally, training using humanism as an approach may offer options for the learner to select when their training occurs as well as the methods for obtaining training. Emphasis will also be placed on linking the outcomes of learning to the benefits of new knowledge and professional responsibility.

Constructivism

The theory of constructivism proposes that learning occurs not when information is provided to the learner, but when the learner reflects on the new information and tests that new information by interacting with others. The knowledge gained is shaped by the learner's own past experiences and attitudes, and the input of peers helps to validate or test new learning. As constructivism gained acceptance, later theorists proposed an experiential learning model that progresses from concrete experiences to reflection on the experience, development of additional concepts based on the reflection, and finally testing of the new concepts developed in the learner's environment [5]. Constructivism is primarily used as underpinning for adult learning because the learner must have a certain level of experience and context to process and reflect on new information.

When the learning theory of constructivism is used for health information technology training, the learning event may include activities that promote reflection on new information such as questions and answers about new information, practice time in the classroom, opportunities for independent practice in a safe *sandbox* environment, and the ability to interact with experienced users of the new technology.

Brain-Based Learning

Scientists and researchers are now able to view how the brain functions during the learning process. Hart initially proposed the theory of brain-based learning in 1983 [3]. The theory of brain-based learning proposes that the brain changes as learning

occurs by forming new neurons and synapses between neurons. Interestingly, the newly formed connections and neurons help the learner to organize new information within the neural networks. Another term used for the growth and changes seen in the brain during learning is neuroplasticity. Through technology, researchers have seen that learning engages certain areas of the brain, and not all areas of the brain are engaged in learning. When learning is occurring, the brain produces adrenaline and serotonin to facilitate the work and growth of neurons. In addition to facilitating learning, these neurotransmitters may also produce a change in mood or emotion as learning occurs.

The brain learns best when certain elements are incorporated into the training such as practice and engagement with the emotions of the learner. However, negative emotions such as fear of failure or punishment and social humiliation can inhibit learning and create a fight or flight response to training. Learning occurs when emotions are carefully balanced to provide a learning challenge without excess frustration [3]. Instructors should be alert for learners that appear overwhelmed during the learning event and intervene with a later or different training opportunity if needed.

Training that is based on brain-based learning may include pre-training communication and information that helps to inform, excite and reduce stress for learners. Classrooms will be engaging but non-judgmental, with plenty of positive feedback. Instructors may monitor learner stress levels and provide breaks and methods for reducing stress such as games or social interaction opportunities.

Adult Learning Theory

Although referred to as a theory, adult learning theory is more of a framework that arose from an exploration of many learning theories applied specifically to adult learners. In contrast to the adult learning framework, the science of teaching children is called pedagogy. Pedagogy is primarily focused on providing foundational new information and knowledge to children, usually through a unidirectional flow of information from teacher to learner. Andragogy, or adult learning, is based on the idea that adults have a lifetime of learning and experience and must be participants in their own learning [9]. Andragogy is based on six premises, and Table 5.1 provides a comparison of pedagogy versus andragogy.

While andragogy does not explain how people learn, it does provide insight into creating the conditions that allow adults to best learn. Although it is tempting to utilize andragogy for all adult learning, there are appropriate times and situations where a pedagogical approach or a mixed approach may be the best model for delivering training, especially when presenting new information that is not yet aligned with a life or work context.

Health information technology training that is based on andragogy may include the following elements. The need for training and the purpose of training is clearly communicated early and often. During the training event, learners are presented

Table 5.1 Pedagogy versus andragogy

Pedagogy	Andragogy
The learner needs knowledge, but only what is needed to reach a defined competency such as to pass a test	The learner wants to know why learning is necessary before investing the time and energy into pursuing learning
The teacher views the learner as a dependent learner, and the teacher must provide the information that is to be learned	Adults have life experiences and are accustomed to being responsible for their own decisions. Adults tend to resist learning that they perceive is forced upon them.
The instruction does not relate to, nor consider the learner’s past experiences. The final authority is the textbook or other authoritative source of information.	Adults have a great volume of life experience and appreciate learning experiences that acknowledge the value of their past experiences.
The learner will learn only that which the teacher tells them they must learn in order to achieve a goal or competency.	Adults seek to learn those things that will prepare them for situations or tasks that are imminent; and seek learning that will help them progress in life or accomplish tasks more readily.
Learning is ordered and grouped by subject and therefore has little relation to the logic of life experiences	Adults learn best when information is presented or aligned with the context of life or life situations
Learners are motivated to learn by extrinsic forces such as teacher approval or grades	The greatest motivator for adult learning is intrinsic rather than extrinsic.

with information about why the training is important and how it aligns with organizational strategy and enhances personal development and growth. Instructors may take the time to relate new concepts such as documenting vital signs in the EHR to prior experiences of documenting vital signs within a paper chart. Learners may also be given the choice of when to attend a learning event and possibly to select different learning delivery methods such as eLearning versus a classroom learning session.

Learning Styles

In the early 1990s the concept of learning styles overtook the education and training world. The premise of learning styles was that people learn best when they receive instruction through their own learning style [10]. The four learning styles of visual, aural, read/write, and kinesthetic were embedded into classrooms, and training experts were sometimes tasked with developing four different training programs to meet the needs of each type of learner. However, ongoing research has shown that student learning is not impacted either way when learning is presented using their learning style versus another learning style.

The latest research indicates that people may have a preferred way of learning, so that if they like words more than images, or hearing better than reading, learning outcomes are not influenced by how the learning is presented but the learner may

prefer a certain method of presentation. Although incorporating different learning approaches to meet every learning style is not necessary for improved learning, using variation in training delivery methods may help to stimulate and maintain engagement with a learning event. Although it has been demonstrated that learners can learn through methods other than their favorite or preferred learning style, training that is designed to engage learners through many different methods such as listening, viewing, reading, and doing aligns with the need for the brain to frequently shift focus, and will engage each learner more deeply when their learning preference is presented. To incorporate learning preferences into training, learning professionals can provide a break for the human brain about every twenty minutes by seamlessly switching the delivery method, a technique that may help learners remain engaged.

The Science of Instruction

Research has been conducted on the science of instruction for eLearning, which is often the delivery method for health information technology training. Researchers have focused on best practices for training design when eLearning is the delivery method. Some of the principles developed by Clark R and Mayer R [11] directly impact how eLearning should be designed through the use of evidence and best practices.

Some of the key findings from this research include the greater learning impact of using words and images rather than words alone, and making sure that the words are placed close to the visual graphics to minimize eye movement can also facilitate better learning. Another important discovery for eLearning developers is that information is received through either the eyes or the ears, but the brain cannot use both pathways at the same time. Looking back at John's training design at the beginning of this chapter, this means that John was actually creating cognitive overload and brain fatigue by narrating word for word the same words shown on the screen. By adding arrows that needed to be clicked to move forward in the eLearning, John also included extraneous actions that detract from learning. Any extraneous images included in the eLearning created by John will also detract from learning. Images must be relevant and associated with the content.

E-learning for HIT training that is based on the science of instruction should avoid the use of extraneous motion or images that do not relate to the content. Fatiguing eye motion should be reduced by placing explanatory text near images, and screens should contain either text or narration, but avoid word for word narration of the text. Screens should be designed to avoid clutter and also include plenty of white space to reduce brain fatigue. The focus of the science of instruction is to minimize brain fatigue and cognitive overload by reducing unnecessary eye movements and decreasing the need for the brain to process irrelevant information.

Summary

Learning theories were developed to help explain how to change behavior and to explain how people learn, thus providing the ability to create the conditions that facilitate optimal learning. While no single learning theory perfectly addresses the process of learning, each theory contains elements that can be used to support successful training design and effective learning. In addition, the use of a particular learning theory can guide the approach to learning evaluation and management.

The process of training can be highly impactful to both an organization and to a learner. When training is not designed using the evidence that can produce the best outcomes, the time spent in learning may create negative outcomes or waste organizational resources. In today's environment, health care workers have many options for their employment and careers. Effective training can not only support and develop a successful professional career, but can create a positive attitude towards change and the use of health information technology in the provision of health care.

Discussion Questions and Answers

1. Using the cognitive learning theory, list some ways to help learners encode information to move it into short term memory.
 - (a) Use mnemonics to help learners associate a concept with another word
 - (b) Use images to encode new concepts for short-term memory
 - (c) Make sure that information is not too long to be retained in short-term memory
 - (d) Relate new information to existing knowledge
 - (e) Use repetition
2. Which learning theory(s) fit best with HIT training and why?
 - (a) Learners can select their own preferences here
3. What types of activities would you include in a class that is based on social cognitivism?
 - (a) Have students identify learning goals
 - (b) Allow time for peer interaction and discussion
 - (c) Provide time for learners to practice new skills
4. How would you structure the design of content when using the adult learning framework?
 - (a) Allow for learners to select their preferred class time for learning
 - (b) Communicate the reason for training
 - (c) Relate new concepts to existing experience
 - (d) Provide learners the choice of learning delivery method
5. What are three differences between pedagogy and andragogy?

Pedagogy	Andragogy
The learner needs knowledge, but only what is needed to reach a defined competency such as to pass a test	The learner wants to know why learning is necessary before investing the time and energy into pursuing learning
The teacher views the learner as a dependent learner, and the teacher must provide the information that is to be learned.	Adults have life experiences and are accustomed to being responsible for their own decisions. Adults tend to resist learning that they perceive is forced upon them.
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