

Learning in the Context of Technologies

2

Chapter Outline

- Behaviorism
- Cognitivism
- Constructivism
- Other learning theories
- Technology-enhanced learning.

By the End of This Chapter, You Should Be Able To

- Clarify the background and main ideas of different learning theories
- State the relationship of technology and learning theories
- Describe the impact of learning theories on teaching, including behaviorism, cognitivism, constructivism, connectivism and humanism

Main Learning Activities

1. Think about what is learning and the advantages and disadvantages of program instruction and discuss with your peers.
2. Think about the characteristics and functions of sensory memory, short-term memory, and long-term memory as well as the implications of information processing theory for instruction. More specifically, how would you characterize your response to the discussions of behaviorism and cognitivism? Were you passive as a reader or were you processing what you read and creating ideas or cognitive structures?
3. Think about what are the differences between individual/cognitive constructivism and social constructivism? In addition, think about the implications of constructivism for teaching.

4. Think about the implications of connectivism for teaching. Suppose you want to learn more about climate change, who might you ask to gain a better understanding? Is there a group you might join to follow up on your interest?
5. Think about the integration of technology and education and how the learning theories evolved over time. Do you find a connection between specific technologies and learning theories? Can you describe a couple of examples?
6. Work with your group members or peers, to create a concept map to show how learning theories and technologies are related to each other. Modify the concept map based on your discussion in the group.

2.1 Introduction

Learning is a process that brings together personal and environmental experiences and influences for acquiring, enriching or modifying one's knowledge, skills, values, attitudes, behaviors, and worldviews. Learning theories develop hypotheses that describe how this process takes place. The scientific study of learning started in earnest at the dawn of the twentieth century. Behaviorism, cognitivism, socio-constructivism, and other views have been proposed as the emphasis has been placed on cognitive style and emerging educational technologies. These theories will be discussed in subsequent sections.

In this chapter, firstly the definition of learning in the context of technologies will be described. Then, learning theories, including behaviorism, cognitivism, constructivism, and other views, will be discussed. Finally, technology-enhanced learning will be described briefly and elaborated in subsequent chapters.

2.2 Learning Theories

Learning happens everywhere and everyday for everybody, but what is learning? Most people have the intuition that learning implies the ability to do something that the learner could not do before or know something that the learner did not know before.

In most psychological theories, learning is defined as a persistent change in human performance or performance potential (Lohr & Chang, 2005). According to Spector (2016), the changes could include one's abilities, attitudes, beliefs, knowledge, and skills. However, the major concepts and principles of learning vary with learning theories in different ages. Learning theories are conceptual frameworks describing how knowledge is absorbed, processed, and retained during learning (Simandan, 2013). In the process of designing and developing instructional

systems, learning environments and learning activities relevant learning theories and psychological perspectives include behaviorism, cognitivism, constructivism, connectivism, and humanism.

2.2.1 Behaviorism

Behaviorism was elaborated by Watson, among others. Watson was an American psychologist whose research was published in the early part of the twentieth century. Behaviorism was dominant in American psychology for half a century from the 1920s to the 1960s and remains one of the most important schools of American psychology. The main representatives of behaviorism include John B. Watson (1878–1958), Burrhus F. Skinner (1904–1990), and Edward L. Thorndike (1874–1949).

Main ideas

Behaviorism is a perspective that focuses almost exclusively on directly observable things to explain learning (Spector, 2016). That which is directly observed and believed most relevant to learning are the immediate things in the learner's environment, and most closely contiguous in time and place to the targeted learning—the so-called *stimulus* conditions for learning. The *response* of the learner to the stimulus is also directly observable and serves as an indicator of learning (Spector, 2016).

The major idea of behaviorism includes the following:

- The learning process is a gradual **attempt and error** until the consistent success is attained.
- The key to learning success depends on **reinforcement**.
- Learning involves a **stimulus–response sequence**.

Edward L. Thorndike (1905) developed an stimulus–response (S-R) theory of learning. In stimulus–response theory, knowledge is defined as a learner's collection of specific responses to stimuli that are represented in behavioral objectives (Koehler & colleagues, 2014). Edward L. Thorndike noted that responses (or behavior) were strengthened or weakened by the consequences of behavior: (1) a response to a stimulus is reinforced when followed by a positive rewarding effect, and (2) a response to a stimulus becomes stronger by exercise and repetition. Different reinforcement patterns (i.e., continuous or intermittent) have been shown to have a different impact on learning outcomes (Ferster & Skinner, 1957).

Behaviorism puts emphasis on the importance of the environment during individual learning. According to behaviorism theory, teaching is to control the learning

environment to achieve the desired results, and the main method of controlling learning behavior is to strengthen the correct response. Behaviorism pioneer, Watson (1930) said,

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I will guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. I am going beyond my facts and I admit it, but so have the advocates of the contrary and they have been doing it for many thousands of years (Watson, 1930, p. 82).

The impact on teaching

Burrhus F. Skinner (1953) proposed *operant conditioning*. Operant conditioning is a type of learning in which the strength of a behavior is modified by the behavior's consequences, such as reward or punishment. In operant conditioning, stimuli are present when a behavior is rewarded or punished to control that behavior. For example, a child may learn to open a box to get the candy inside, or learn to avoid touching a hot stove; the box and the stove are discriminative stimuli.

According to operant conditioning, the probability of the behavior occurring in this scenario is enhanced by the reinforcement. Learning is understood as the step-by-step or successive approximation of the intended partial behaviors by the use of reward and punishment.

Programmed instruction is based on Skinner's operant conditioning. It is a method of presenting new subject matters for students in a graded sequence of controlled steps.

- According to programmed instruction, the textbooks are divided into small frames and small steps, and each frame has its own goals. Learners could achieve their goals through certain learning procedures.
- Students work through the programmed material by themselves at their own speed. After each step, we can test their comprehension by answering an examination question or filling in a diagram. They are then immediately shown the correct answer or given additional information (The Columbia Encyclopedia, 2001).
- Instruction is self-paced, and learners are required to be active by completing exercises and tests and proceeding based on feedback from the instruction.

The learning essence of behaviorism is the change of the external behavior caused by the environment. Impacts on teaching are that the desired results could be achieved through controlling the learning environments, while the main measures of control learning include present stimulus, provide practice, feedback and reinforcement, such as strengthening the correct response.

Extended reading

A **Skinner box**, also known as operant conditioning chamber, is an enclosed apparatus that contains a bar or key that an animal can press or manipulate in order to obtain food or water as a type of reinforcement. Developed by B. F. Skinner, this box also had a device that recorded each response provided by the animal as well as the unique schedule of reinforcement that the animal was assigned.

When put into the box, the cat would show evident signs of discomfort and impulse to escape from confinement. It tries to squeeze through any opening; it claws and bites at the wire; it thrusts its paws out through any opening and claws at everything it reaches.... It does not pay very much attention to the food outside but seems simply to strive instinctively to escape from confinement. The cat that is clawing all over the box in her impulsive struggle will probably claw the string or loop or button so as to open the door. And gradually all the other unsuccessful impulses will be stamped out and the particular impulse leading to the successful act will be stamped in by the resulting pleasure, until, after many trials, the cat will, when put in the box, immediately claw the button or loop in a definite way (Thorndike, 1898, p. 13).

2.2.2 Cognitivism

Cognitivism psychology was initiated in the late 1950s and became dominant in the late 1970s and the early 1980s. The main representatives include Jean Piaget (1896–1980), Jerome S. Bruner (1915–2016), David P. Ausubel (1918–2008), and Robert M. Gagné (1916–2002), among others.

Cognitivism arose within psychology as behaviorism was proved to be insufficient to explain complex human learning, such as language learning. In order to explain some human behaviors, psychologists turned to investigate the information processing in the mind which is considered as unobservable black box by behaviorists (Spector, 2016). People are no longer viewed as collections of responses to external stimuli as understood by behaviorists, but as information processors.

Main ideas

In cognitive psychology, learning is conceptualized as the acquisition of knowledge: The learner is an information processor who absorbs information, undertakes cognitive operations on it, and stocks it in memory.

According to cognitivism, learning is not a stimulus–response sequence, but the formation of cognitive structures. The learners do not simply receive stimuli mechanically and react passively, but, rather, learners process stimuli and determine appropriate responses.

Cognitivism has its roots in cognitive psychology and information processing theory. The best way to introduce cognitivism is through Anderson's (1983)

ACT-R model of information processing (see <http://act-r.psy.cmu.edu/publication/>). Information processing theory involves how people receive, store, integrate, retrieve, and use information. The basic idea of the information processing theory is that the human mind is like a computer or information processor.

This model proposes that information is processed and stored in three stages: sensory memory, short-term memory, and long-term memory. They are assumed to receive information from environment and transform it for storage and use in memory and performance (Huitt, 2003).

- A learner's environment activates the receptors (sense), and information is then transmitted through the sensory memory to short-term memory in selected and recognizable patterns (7 plus or minus 2 chunks of information). The information is held in short-term memory for about 20–30 s (unless rehearsed), and then, the information to be acquired is transformed by a process known as semantic encoding to a form that enters long-term memory (Cognitivism and Gagne's Model of Learning, 1970). With sensory memory, learners perceive organized patterns in the environment and begin the process of recognizing and coding these patterns.
- Short-term memory (working memory) permits the learner to hold information briefly in mind to make further sense of it and to connect it with other information that is already in long-term memory.
- Long-term memory enables the learner to remember and apply information long after it was originally learned.

Impact on teaching

As a cognitive psychologist, Gagné (1985) proposed **nine events of instruction** and conditions of learning as effective means to activate and support the processes of information processing. Table 2.1 shows these instructional events in the left column and the associated internal mental process in the right column.

The impact on teaching from cognitivism is as the following:

- (1) In the design of computer-aided instruction, people began to pay attention to the internal psychological process of learners and then began to study and emphasize the learners' psychological characteristics and cognitive structures.
- (2) Educators no longer regard learning as the learner's passive response to external stimuli, but consider learning as involving attitudes, needs, interests, hobbies, and cognitive structures.
- (3) The teacher's task is to try to arouse the learners' interest and motivation and then combine the current teaching content with the original knowledge and experience of the learners.

Table 2.1 Instructional events and internal mental process (Gagné, Wager, Golas, & Keller, 2005)

Instructional events	Internal mental process
1. Gain attention	Stimuli activate receptors
2. Inform learners of objectives	Creates level of expectation for learning
3. Stimulate recall of prior knowledge	Retrieval and activation of short-term memory
4. Present the content	Selective perception of content
5. Provide guidance for learning	Semantic encoding for storage long-term memory
6. Elicit performance “practice”	Responds to questions to enhance encoding and verification
7. Provide informative feedback	Reinforcement and assessment of correct performance
8. Assess performance test, if the lesson has been learned	Retrieval and reinforcement of content as final evaluation
9. Enhance retention and transfer	Retrieval and generalization of learned skill to new situation

Extended Reading:

- **Jean Piaget: Cognitive developmental theory**

Piaget’s basic outlook is that as a person matures, he or she adapts to the world in different ways. The two basic processes of adaptation are assimilation and accommodation, and they cannot be separated. Assimilation was to describe the learning process through which a child picks up new concepts and ideas and absorbs them into the existing concepts and ideas. Accommodation is different from assimilation. It is the process of reorganization and changes in a child’s cognitive structures caused by the inability to assimilate the information in existing structures.

- **David P. Ausubel: Cognitive Assimilation Theory**

Ausubel was influenced by the teachings of Jean Piaget. He puts forward cognitive assimilation theory, which focuses on what he describes as meaningful learning. It is a process where new information is related to an existing relevant aspect of the individual’s knowledge structure. According to the cognitive assimilation theory, whether students can learn new knowledge meaningfully depends on the existing concepts in their cognitive structure. These concepts can be used to connect the knowledge with the existing knowledge for the learner, and find or form relevant concepts in the original cognitive structure. The meaning of new knowledge is needed to incorporate into their own cognitive structure and form their own understanding, while some changes have taken place in the original cognitive structure.

2.2.3 Constructivism

Constructivism emerged in the 1970s and 1980s as an extension of cognitivism that included an emphasis on internal mental constructions and the influence of others on an individual's learning. The main ideas are based on the works of John Dewey (1859–1952) and Lev Vygotsky (1896–1934).

Main ideas

Constructivism holds that learning is the process of constructing internal psychological representation in the process of the interaction with the environment. Helping learners involves helping them to understand the nature, regularity, and the inner connections among things (Chen & Liu, 2011). The basic elements of constructivism include context, collaboration, conversation, and meaning-making.

From constructivism, learning could be understood in the following ways.

- (1) Learning is or should be learner-centered.
- (2) Learning is the process by which learners construct internal psychological representation actively.
- (3) The learning process consists of two aspects: the reorganization and reconstruction of old knowledge and the meaningful construction of new knowledge.
- (4) Learning is not only an individualized behavior, but also a social and language-centered behavior; learning requires communication and cooperation.
- (5) Learning involves emphasizing the situation of learning and attaching importance to the creation of meaningful situations to support learning.
- (6) Effective learning requires appropriate resources to support meaning construction.

The impact on teaching

According to constructivism, teachers should not teach in the traditional way, but should encourage students to cooperate or interact with peers. Students should process information and construct meaning of knowledge actively, rather than listen to teachers passively. The impact of constructivism on teaching is as follows:

- (1) Pay attention to the design of learning scenario. The teacher should design multi-dimensional learning scenarios, so that learners can understand the concept of principles from various aspects, and then develop problem-solving, decision-making, and innovation capabilities.
- (2) Emphasize the learner's active role. Focus on cultivating students' self-management skills to stimulate the necessary psychological state and prior knowledge for learning.
- (3) Pay attention to the contribution of error concept to learning. Situated cognition theory treats the aim and process as unity. Therefore, even the erroneous concept being produced in the process of learning, it also has a positive contribution to the construction of the whole knowledge structure.

Extended Reading:

Fish Is Fish (Lionni, 1970) describes a fish who is keenly interested in learning about what happens on land, but the fish cannot explore land because it can only live in water. It befriends a tadpole who grows into a frog and eventually goes out onto the land. The frog returns to the pond a few weeks later and reports on what he has seen. The frog describes all kinds of things like birds, cows, and people. The book shows pictures of the fish's representations of each of these descriptions: Each is a fishlike form that is slightly adapted to accommodate the frog's descriptions—people are imagined to be fish who walk on their tailfins, birds are fish with wings, and cows are fish with udders. This tale illustrates both the creative opportunities and dangers inherent in the fact that people construct new knowledge based on their current knowledge. (Go to the Web site for the image. <https://www.ectaveo.ch/Mediathek/2012/07/FroescheundFische.jpg>)

Social constructivism

Constructivism can be viewed simply as individual/cognitive constructivism, whereas social constructivism recognizes the role of language and others in learning. The main idea is that learning is a meaning construction process. The individual constructivism is mainly developed on the basis of Piaget's thoughts. According to Piaget's theory of cognitive development, learning is the process by which learners form, enrich, and adjust their cognitive structures through the interaction of new and old knowledge and experiences. The two main cognitive processes involved are assimilation (using an existing mental construct or schema in a new situation) and accommodation (altering an existing schema or creating a new one based on a new situation).

Social constructivism focuses on the social and cultural mechanisms behind the construction of learning and knowledge. The basic view is that learning is a process of cultural participation, and learners participate in a community's practical activities to learn the related knowledge through the support of certain culture. Knowledge is not only constructed during the interaction between individual and physical environment, but also the interaction of social culture (Chen & Liu, 2011).

The main representative of social constructivism is Lev Vygotsky. Vygotsky's social constructivist theory highlights the following aspects:

- (1) Social and cultural interactions play a very important role in the learning process.
- (2) Knowledge is co-constructed and that individuals can learn from one another.
- (3) The learner must be engaged in the learning process. Learning happens with the assistance of other people.

Based on the research of the socio-constructivism, Vygotsky (1987) puts forward the Zone of Proximal Development (ZPD). This is a “range of tasks that are too difficult for an individual to master alone, but can be mastered with the assistance or guidance of adults or more-skilled peers (Vygotsky, 1987).” Another part of this theory is scaffolding, which emphasizes to give the learner the right amount of assistance at the right time. If the learner can perform a task with some assistance, then he or she is closer to mastering it. These theories have an important influence and enlightenment on teaching, and some new teaching methods have formed, such as anchored instruction, cooperative learning, and reciprocal instruction.

Extended reading:

- **Anchored instruction**

Refers to instruction in which the material to be learned is presented in the context of an authentic event that serves to anchor or situate the material and, further, allows it to be examined from multiple perspectives. (Bransford et al., 1990, p. 5)

- **Collaborative learning**

Collaborative learning involves working together as a group to accomplish shared goals to maximize the learning of each individual. (Huang & Liu, 2001)

- **Reciprocal instruction**

Reciprocal instruction is an instructional activity that takes the form of a dialogue between teachers and students regarding segments of text for the purpose of constructing the meaning of text. (Palincsar & Brown, 1986)

2.2.4 Other Learning Theories

Besides behaviorism, cognitivism, and constructivism, there are many other learning theories, which play an important role in guiding teaching and learning activities, such as connectivism and humanism.

2.2.4.1 Connectivism

Over the last twenty years, technology has changed how we live, how we communicate, and how we learn. With the development of the information technology, such as social networking and cloud computing, connectivism has been put forward and gained increasing attention. The main representatives include George Siemens and Stephen Downes.

Main ideas

Connectivism is a hypothesis of learning which emphasizes the role of social and cultural context. It is the integration of principles from chaos, network, and complexity and self-organization theories. The central aspect of connectivism is the metaphor of a network with nodes and connections (Siemens, 2005). In this metaphor, a node is anything that can be connected to another node such as an organization, information, data, feelings, and images. In this sense, connectivism proposes to see knowledge's structure as a network and learning as a process of pattern recognition (AIDahdouh, Osório, Caires & Susana, 2015).

According to connectivism, learning is creating networks (Fig. 2.1). Nodes are external entities, which can be used to form a network. The nodes may be people, organizations, libraries, Web sites, books, database, or any other source of information. The act of learning is creating an external network of nodes, where we connect information and knowledge sources. The learning that happens in our heads is an internal network (neural). Learning networks can then be perceived as structures that we create in order to stay current and continually acquire experience, create, and connect new knowledge (external). Learning networks can be perceived as structures that exist within our minds (internal) in connecting and creating patterns of understanding (Siemens, 2006).

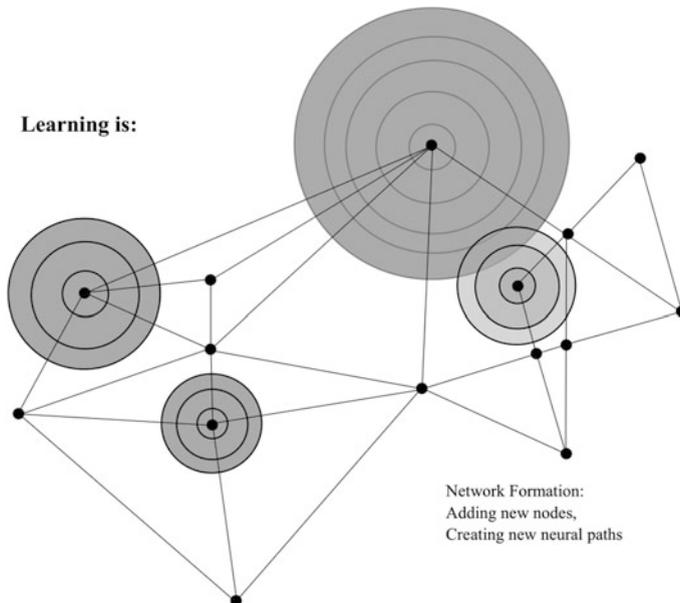


Fig. 2.1 Learning as network formation. Adapted from Siemens (2006)

2.2.4.2 Humanism

Humanism emerged in the 1950s and became popular after the 1960s. Humanistic psychologists believe that the school should integrate the concept and practice of moral education into various teaching activities and help the students to develop a sound personality. The main representative includes Abraham Maslow (1908–1970) and Carl Rogers (1902–1987).

Main ideas

Humanism is a perspective that focuses on the value of the individual and personal freedom. According to humanism, each person has the ability to develop his or her own potential and motivation. Individuals can freely choose their own development direction and value. Humanism focuses on human's overall development, emphasizes human dignity and value, and pays attention to the health and integrity of people. Humanism investigates mainly how to create a good environment for learners to perceive the world from their point of view and develop an understanding of the world, aiming to achieve the highest level of self-realization.

2.3 Technology-Enhanced Learning

Learning theories and technologies are connected and intertwined by information processing and knowledge acquisition (Spector & colleagues, 2014). In order to understand the technology-enhanced learning, it is useful to look at the technologies used in different periods of history when the different learning theories emerged and became popularity (Fig. 2.2).

(1) From the 1920s to the 1960s, behaviorism was proposed and came to be dominant. Some technologies were adopted in the process of teaching, such as the automatic teaching machine, chemo-card, etc.

In 1924, the psychologist Sidney L. Pressey designed the first teaching machine, which is suitable for rote-and-drill learning (Fig. 2.2). It was mainly used for automated testing of students. It also includes the principle of allowing students to set their own pace, positive response, and timely feedback. The automatic teaching machine includes two modes of operation: quiz and learning. He believes that “teaching machines are unique among instructional aids, in that the student not merely passively listen, watches, or reads but actively responds. In addition, students could find out whether his response is correct or not, and a record may be kept which aids in improving the materials.”

Extended Reading: Teaching Machines (Benjamin, 1988)

B. F. Skinner was also interested in a teaching machine. He conceptualized a teaching machine for the classroom for use by individual students. In 1954, B. F. Skinner published “The Science of Learning and the Art of Teaching”

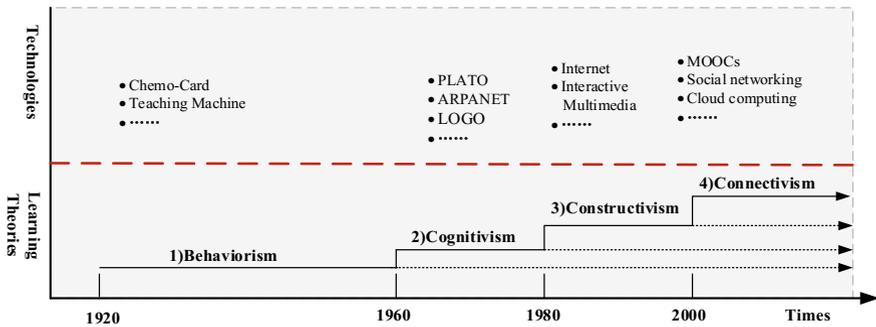


Fig. 2.2 Timeline of learning theories and technologies

which is suggested that the use of **teaching machines** can solve many teaching problems and promote the development of program teaching movement at that time. He designed teaching machine and program teaching according to the theory of operational conditioning and positive reinforcement.

If you want to read more concerning the teaching machine, please read *A History of Teaching Machine* (Benjamin, 1988).

In 1930, J. Peterson designed chemo-card which can support automatic scoring and timely feedback.

(2) Cognitivism became dominant in the 1970s and 1980s. Many early educational technology developments occurred in university settings, and these were often associated with various computer technologies, such as PLATO (Programmed Logic for Automated Teaching Operations) and Logo.

PLATO (see <https://chip.web.ischool.illinois.edu/people/projects/timeline/1960won.html>) was the first generalized computer-assisted instruction system developed in the 1960s at the University of Illinois. It developed many tools to support the design, development, and deployment of learning environments. Many modern concepts in multi-user computing were developed in PLATO, including forums, message boards, online testing, e-mail, chat rooms, picture languages, instant messaging, remote screen sharing, and multi-player games.

In the 1970s, the Logo programming language was introduced to support many instructional activities, and some people thought it would revolutionize teaching and learning in schools (Spector, 2016). In 1980, Seymour Papert introduced Logo. It was the first language specifically designed to enable children to learn by discovery.

(3) From the 1980s, constructivism started to become dominant. Interactive multimedia, Internet, and other modern technologies were applied in teaching and learning. In the technology-supported learning environments, learners could construct their knowledge actively in interaction with the environment and through the reorganization of their mental structures.

(4) With the rapid development of information technology, MOOCs, social networking, cloud computing, etc., are widely used in teaching and learning. The connection between people and people, people and knowledge, knowledge and knowledge changed from ideal to reality. MOOCs are used in distance education which were first introduced in 2006 and emerged as a popular mode of learning in 2012 (Lewin, 2013). It is an online course aimed at unlimited participation and open access via the Web (Kaplan & Haenlein, 2016). Learning analytics is the use of intelligent data, learner-produced data, and analysis models to discover information and social connections for predicting and advising people's learning (Siemens, 2010).

Information technology has become an important tool of education, and it is not only rich in information resources, but also can extend human capacity and expand the social environment of supporting learning. The history of technology and learning theory's development reflects an evolution from individual toward community learning, from content-driven learning toward process-driven approaches, from isolated media toward integrated use, from presentation media toward interactive media, from learning settings dependent on place and time toward ubiquitous learning, and from fixed tools toward handheld devices.

In the future, with the development of information technology, learning theories will be improved and developed further. The theories of instructional design will be more mature and more scientific. The practice of educational technology will promote the continuous development of the learning theory and will promote each other.

Key Points in This Chapter

1. Learning theories are conceptual frameworks describing how knowledge is absorbed, processed, and retained during learning. In the process of designing and developing instructional systems, learning environments and learning activities relevant to learning theories and psychological perspectives include behaviorism, cognitivism, constructivism, connectivism, and humanism.
2. The major idea of behaviorism includes: (1) The learning process is a gradual attempt and error until the consistent success is attained. (2) The key to learning success depends on reinforcement. (3) Learning involves a stimulus–response sequence.
3. The nine instructional events include: gain attention, inform learners of objectives, stimulate recall of prior knowledge, present the content, provide guidance for learning, elicit performance “practice,” provide informative feedback, assess performance test, and enhance retention and transfer.

4. Constructivism believes that learning is the process of constructing internal psychological representation in the process of the interaction with the environment. The constructivism emphasizes learner-centered, situational, collaborative, and meaningful construction.
5. The technology and learning theory have interactions. Learning theories and technologies are connected and intertwined by information processing and knowledge acquisition. With the rapid development of information technology, MOOCs, social networking, cloud computing, etc., are widely used in teaching and learning.

Learning resources

- Behaviorism could not explain how children acquire a natural language; also, about the time, mainframe computers were spreading a model of cognitive architecture which was developed with the mind being analogous to a computer processor—see <http://act-r.psy.cmu.edu/>, Anderson (1983), and the ACT-R Web site at Carnegie Mellon University located at <http://act-r.psy.cmu.edu/>
- A timeline figure of learning theories can be added with time on the x-axis from about 1913 (John Watson’s “Psychology as the Behaviorist Views it) to 2020 and depth and breadth of coverage on the y-axis—and okay to include behaviorism, cognitivism, socio-constructivism, organizational learning, and machine learning and perhaps a few other prominent learning theories; see <http://www.unesco.org/new/en/education/themes/strengthening-education-systems/quality-framework/technical-notes/influential-theories-of-learning/>
- Timeline slides:
 - (1) <http://www.slideshare.net/TicsUmg/history-ofeducationaltechnologytimeline>
 - (2) <http://webspace.ship.edu/hliu/etextbook/history/Edu%20Tech%20Past%20Present%20Future.pdf>
 - (3) <http://people.ischool.illinois.edu/~chip/projects/timeline.shtml>
 - (4) <http://www.eds-resources.com/educationhistorytimeline.html#1900>
 - (5) <http://www.timerime.com/en/timeline/232616/History+of+Educational+Technology/>
 - (6) https://en.wikipedia.org/wiki/Educational_technology

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