Learning theories describe how people learn, often by reference to a particular model of human cognition or development. Depending on the learning theory, different requirements arise regarding the learning process, e.g., how to structure it, what questions to ask the learner, etc.

Learning theories can be divided into *descriptive* and *prescriptive* theories [162, page 137]. Descriptive learning theories make statements about how learning occurs and devise models that can be used to explain and predict learning results. When describing different descriptive theories of learning below, I will follow the common categorization that distinguishes between *behaviorist*, *cognitive*, and *constructivist* learning theories [151, 162].

Prescriptive learning theories are concerned with guidelines that describe what to do in order to achieve specific outcomes. They are often based on descriptive theories; sometimes they are derived from experience. *Instructional design* is the umbrella which assembles prescriptive theories. I will describe instructional design in Section 3.4.

### 3.1 Behaviorism

Behaviorism explains human behavior based on observable stimulus-response associations, without referring to mental processes. Behavioristic theories were developed in the beginning of the 19th century as a reaction to the then predominantly used psychological methods of introspection and subjectivity, which behavioral theorists such as John B. Watson qualified as non-scientific [206].

Learning is viewed as the forging of the desired condition-action pairs. Positive reactions have to be reinforced, undesired ones avoided. Behaviorists such as Burrhus F. Skinner applied their research results to technology-supported learning. Skinner [169] provided principles for *programmed instruction*, which is characterized by leading the learner through the learning material in gradual steps, providing immediate feedback, and continuous positive reinforcement.
In the sixties, the US government, especially the Department of Defense invested considerable amounts of money in the development of programmed instruction, with the hope of reducing the costs for civil and military training. One prominent system developed at that time was Plato whose trademark is still used today. Yet, evaluation results of programmed instruction were mixed, and the authoring costs were extremely high, so that educational systems based on pure behavioristic principles became rare.

### 3.2 Cognitivism

Cognitive psychology makes mental processes the primary object of study. Experiments involving mental operations are designed such that they allow conclusions on the cognitive structures used in the mind during problem solving. These experiments are reproducible, in contrast to the former introspective and subjective experiments.

Learning is viewed as transferring the cognitive structures in long-term memory and being able to use them, when necessary. Learning takes place through organizing, storing and linking the new structures to old knowledge.

Based on cognitive theories, one can devise principles for instruction. In the 1960ties, Gagné [44] published his principles of instruction, an effort to collect the existing theories and to put them into a common framework. He distinguishes nine cognitive processes and assigns specific instructional events to the objectives, e.g., the process “retrieval”, with the instructional event “stimulating recall of prior learning”.

In technology-supported learning, the research in cognitive psychology led to the new field of Intelligent Tutoring Systems (ITS). ITS were designed to support the learner during problem solving in his creation of the appropriate cognitive structures. One of the most prominent ITS, the PACT-tutors were originally based on Anderson’s ACT-* theory [3, 4, 5].

### 3.3 Constructivism

Constructivism is based on the premise that knowledge can not be transmitted but has to be constructed by the individual. Therefore, learning is an active process of integrating information with pre-existing knowledge.

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1. The ratio between military and civilian investment in education is astonishing: “within government agencies, the military spends seven dollars for every civilian dollar spent on educational technology research. Each year, for example, the military spends as much on educational technology research and development as the Department … of Education has spent in a quarter century” [132].

2. [http://www.plato.com](http://www.plato.com) [145].