

Constructivism refers to a number of related ideas in learning theory that share the notion that individuals must develop (or construct) understanding based on their prior experiences and personal interaction with objects and ideas and with other individuals. Constructivism has a number of distinct meanings so care must be taken when using this term (Woolfolk, 2011; Matthews, 1998).

Constructivism as Learning Theory emphasizes the active role of the learners during the processes of constructing their own understanding (Woolfolk, 2011) based on experiences and reflections of those experiences. Constructivism implies personal knowledge construction as opposed to simple knowledge transmission (Applefield et al., 2001).

To understand the idea of constructivism and the power of pre-existing knowledge, consider trying to convince a child who believes the Earth is flat (this is called a misconception or alternative conception) that it is actually round. The child immediately visualizes a flat but round pancake-shaped Earth. When told the Earth is spherical, the child may visualize a sphere with their flat pancake shaped Earth on top of it and with people standing on top of that. In order to help the child to overcome these misconceptions and begin to develop an accurate sense of a spherical Earth, the child's misconceptions must first be recognized (both by the teacher and the child) and then addressed appropriately (Bransford et al., 2000).

Although there is no single constructivist theory of learning, most constructivists agree on two core ideas: that learners are active in constructing their own knowledge and that social interactions are an important part in the construction of knowledge (Woolfolk, 2011). In a classroom guided by constructivist learning theory, students are responsible for tackling problems and making sense of experiences, they share ideas with their peers and teacher, and the teacher performs a vital role in the learning process by interacting with students in scaffolding their thinking and providing information when needed. Teachers also must be aware of students' prior knowledge and use this information in designing lessons and asking questions of students (Gordon, 2009).

While most science educators find some value in the use of constructivism in the classroom, Matthews (1998) rejects pedagogy based on constructivist learning theory. He asks, "Why must learners construct for themselves the ideas of potential energy, mutation, linear velocity ... Why not explain these ideas in such a way that students understand them?" (p.9). However, because learners will use their prior understanding to make sense of teachers' explanation, teachers must acknowledge that it is the learners who must make meaning for themselves.

Conceptual Change Teaching is instruction based on the idea that students' pre-existing knowledge can either support or interfere with future understanding. There is no single model called "conceptual change teaching" but several of the learning cycle models (see also) are based on constructivist principles since they give students (and teachers) an opportunity to think about what students already know (Tabachnick & Zeichner, 1999).

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The idea behind conceptual change teaching is the basic recognition on the part of the teacher that students' prior ideas play a role in future understanding. If the prior concepts held by students are not accurate they are called misconceptions or alternative conceptions (see also). Such misconceptions therefore must be used in the classroom and changed through instruction. Therefore, the name "conceptual change" relates to the expectation that students already have concepts (perhaps inaccurate) that must be changed or replaced by ideas that are more scientifically appropriate (Duit & Tregust, 2003). Teaching for conceptual understanding (see also) is related to conceptual change teaching since the goal of school science instruction is that students will fully understand the concept or idea not just know it at a shallow level.

Even though this book focused on the vocabulary of education, there is a form of philosophical constructivism that often enters the conversation and, therefore, demands a place here.

Radical Constructivism is an extreme form of constructivism suggesting that there is no reality or truth in the world. Therefore, "truth" is deemed as that which an individual perceives and believes (Woolfolk, 2011). Such a view implies an "anything goes" form of instruction (Gordon, 2009) and that students should have opportunities to direct their own learning, follow their own interests, ask the questions they want answers to, and pursue their own meanings. Few educators would agree with the use of radical constructivism as a rationale for teaching and learning; learners could argue that whatever they learn is exactly what they wanted and needed to learn and hence they should not be guided by standards designed by nor should they be evaluated by assessments prepared by others. (PW/WM)

- Applefield, J. M., Huber, M., & Moallem, M. (2001). Constructivism in theory and practice: Toward a better understanding. *The High School Journal*, 84(2), 35-53.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Duit, R., & Tregust, D. F. (2003). Conceptual change: A powerful framework for improving science teaching and learning. *International journal of science education*, 25(6), 671-688.
- Gordon, M. (2009). Toward a pragmatic discourse of constructivism: Reflections on lessons from practice. *Educational Studies*, 45(1), 39-58.
- Matthews, M. (Ed.). (1998). *Constructivism in science education: A philosophical approach*. Dordrecht, The Netherlands: Kluwer Academic.
- Tabachnick, B. R., & Zeichner, K. M. (1999). Idea and action: Action research and the development of conceptual change teaching of science. *Science education*, 83(3), 309-322.
- Woolfolk, A. (2011). *Educational psychology* (11th ed.). Boston, MA: Pearson.