Learning in Education

Article · January 2003

1 author:

1-1-2003

Learning in Education

Stanton Wortham

University of Pennsylvania, stantonw@gse.upenn.edu

Learning in Education

Abstract

Learning takes place in many settings, but educational institutions foster both breadth and depth of learning. Different types of teaching make very different assumptions about what learning is.

Keywords

cognitive mediation, social context, teaching, schools, human nature

Disciplines

Education

Encyclopedia of Cognitive Science

Article 563: Learning in Education

Stanton Wortham
Associate Professor and Chair
Educational Leadership Division
Graduate School of Education
University of Pennsylvania

3700 Walnut Street
Philadelphia, PA 19104-6216
USA
215 898 6307; FAX 215 898 4399
stantonw@gse.upenn.edu

Learning in Education

Learning takes place in many settings, but educational institutions foster both breadth and depth of learning. Different types of teaching make very different assumptions about what learning is.

Introduction

Theories of learning have been applied most often in educational institutions. The relationship between cognitive science and education has benefited both scientists and practitioners. Scientists have used educational settings to develop and test their theories, and practitioners have used new knowledge about learning to design more effective education.

Broadly conceived, education is the process of continuing the human species. All humans are born immature, without the knowledge and skills they will need to function—without language, without knowing how to use complex tools, etc. The species continues because adults communicate knowledge and skills to the next generation. This intergenerational transfer allows future generations to build on prior accomplishments.

Thus all humans teach. Whether they realize it or not, all teachers act as if some theory of learning is true. Particular ways of teaching make assumptions about what learning is. Furthermore, theories of learning themselves rest on conceptions of human nature. Different accounts of how people learn assume different things about what people are essentially like.

This chapter describes three broad theories of learning—together with the conceptions of human nature underlying these theories—and the types of educational practice that have been built on these theories. The chapter has two purposes. First, it is important to recognize the theories of learning and conceptions of human nature that underlie various types of schooling. The chapter describes how typical teacher and student behavior makes assumptions about how learning happens. Second, as theories of learning have developed, we have learned that earlier theories were too simple. The chapter describes how more complex accounts of learning and human nature are needed to guide educational practice.

Behavior

Theories of learning that focus on behavior are called "behaviorist." Behaviorists argue that humans should not consider themselves special. Copernicus showed that the earth was not the center of the solar system, and Darwin showed that humans were not qualitatively different from animals. Behaviorists further puncture our sense of superiority, arguing that humans do not have free will to act as they choose. "A person does not act upon the world," B. F. Skinner said, "the world acts upon him." On this theory, the environment shapes people's behavior through reinforcement. Just as Darwin

showed that organisms appear designed by a creator to fit their niche, even though

adaptation is in fact a result of random variation and natural selection over time,

behaviorists show that humans appear to reflect and choose their actions, while in fact

their behavior has been shaped by reinforcement.

To learn, then, is to change one's behavior in response to reinforcement. This

account of learning contains three central elements: behaviors by the organism,

conditions present in the environment, and consequences that follow from various

behaviors. People, like other animals, will generate various behaviors in a new situation.

Some of these behaviors will result in positive consequences, while others will not.

People learn to respond more often with behaviors that were reinforced positively in a

given situation.

Behaviorist education

On a behaviorist account, teaching is the systematic shaping of a student's

behavior. The teacher has control and students are raw material to be shaped. Teachers

arrange reinforcements so that students come to behave as teachers want them to.

Scientists have successfully taught pigeons to play ping pong, for instance, by designing

a long series of intermediate skills that lead from natural pigeon behavior to ping pong.

They reinforce the pigeons for doing each of these intermediate skills, in turn, until the

pigeons produce the target behavior. Similarly, teachers of human students should define

the target behaviors, design a path of intermediate behaviors from what students can

already do, then reinforce students at each step until they produce the target behavior.

Behaviorists have designed "teaching machines" that dispense rewards as students accomplish pre-specified tasks. One famous picture shows a small boy playing a piano, with a candy dispenser on top. Although these pictures now look outdated, many practices in today's schools presuppose a behaviorist account of learning. Discipline systems almost always rely on rewards and punishments to shape students' behavior. Grades are used as reinforcers. And many classroom practices, from worksheets to testing, involve teachers rewarding students for producing desired behavior.

Research in cognitive science over the last fifty years has shown that behaviorism is not an adequate theory of learning. People often act because they value activities intrinsically, not for external reinforcement. As described in the next section, people also develop complex representations of the world and reflect on their actions in a way that behaviorists denied. Why, then, do students and teachers so often act as if behaviorism were true?

Because it works. If you have control over effective reinforcers, you can shape people's behavior. Behaviorism is not false. It is true, but it is not the whole truth. Under certain circumstances, people do learn just like animals. The question is whether we should create more circumstances that encourage people to learn this way. Cognitive scientists claim that we should not, because humans have the potential to learn in non-behaviorist ways, and because students can develop deeper knowledge when encouraged to learn differently.

Mind

Theories of learning that focus on mental representations are called "cognitivist." Cognitive approaches to learning see humans as actively making sense of the environment. People develop mental models of the world and act on the basis of these models, not simply in response to reinforcements. When people encounter a new situation, they assimilate it to their own pre-existing models of the world. Learning involves expanding those mental models, in order to make them more accurate.

This account of learning distinguishes between genuine understanding and merely producing the right behavior. People often just parrot the right answer without understanding it, just as pigeons can play ping pong without understanding what they are doing. True learning involves a deeper grasp of the subject matter, such that people's mental models line up with the world. Furthermore, people cannot be forced to learn. True learning requires a change in people's internal models, and learners must change these models themselves.

Cognitive scientists have described various structures and processes that underlie learning. There seem to be some universal constraints, which presuppose people to certain broad types of mental models. Particular domains of knowledge are also organized in distinct ways, to facilitate learning. And individuals sometimes vary in the types of structures that they operate most effectively with. For instance, there are different learning styles—some people learn most effectively through verbal explanations, while others learn more effectively through visual diagrams, and so on.

Cognitivist education

From this perspective, learners need to develop deeper understandings, not just produce the right behaviors. Deeper understandings cannot be imposed on students, because they must construct their own mental models. So teachers do not shape students, nor do they deliver correct answers. Teachers should develop educational environments that push students to broaden and deepen their own models, thus opening up areas of the world that students have not thought about. After teachers have set up rich educational environments, ones that contain puzzles designed to provoke students to reflect, then they must allow students to explore. Teachers can challenge students, by pointing out contradictions in their beliefs, but students themselves must recognize the puzzles and work to solve them. Teachers can explain, but if students can only repeat a teacher's explanation then they have not truly learned. Students themselves must integrate new experience with their own developing mental models.

Assessment is a bigger challenge for cognitivist educators than behaviorist ones. Behaviorists pre-define the educational objective, and they assess whether students produce the desired behavior. Genuine cognitive learning, in contrast, takes place internally. Teachers can infer about students' understandings, but they do not want to encourage rote learning by using simple tests. Instead of assessing whether students get the right answers, cognitivist educators try to assess underlying thought processes by examining how students reached certain answers.

Cognitivist theories of learning are more widely accepted than behaviorist ones. Nonetheless, there is less cognitivist teaching than behaviorist teaching in our schools. This happens partly because cognitivist education is difficult for both teachers and

students. Because they are responsible for students' learning, it is hard for teachers to let students pursue their own ideas much of the time. Students also find it easier to write down what the teacher says, instead of developing their own accounts. This sort of resistance can be overcome, and many teachers do successfully encourage students to develop their own deeper understandings. But behaviorist practice has been harder to overcome than behaviorist theory.

Society

Theories of learning that go beyond mental representations to include social practices are called "social cognitivist." Cognitivist learners are autonomous, developing models themselves to make sense of the environment. Recent theories present the learner, instead, as a participant in social activities. Learning, on this account, is a transformation of participation in activity, not primarily the creation of mental models. Instead of simply developing their own representations, people become increasingly competent participants in the intellectual lives of those around them.

From this point of view, people learn as they more competently use tools to facilitate thought and action. Adults incorporate learners into their activity by teaching them how to use certain cognitive tools. Some of these tools are mental, like mnemonic devices. Others are objects, like maps. But learners do not have to construct them alone, because these tools have already been developed and can be borrowed from others.

Any theory of learning presupposes a "unit of analysis." This is the smallest unit that preserves essential behavior of the whole. In order to study the behavior of water, for example, one must understand the molecular level. Studying hydrogen and oxygen

atoms separately will not allow one fully to understand the behavior of water. Similarly, one cannot fully understand learning solely by studying individuals' mental representations. Individual cognitions are essential, as hydrogen atoms are essential to water, but learning itself depends on a larger unit: a social activity, which includes individuals' mental representations, various cognitive tools, and others' knowledge and skill, all of which together allow learning.

Unlike behaviorists, and like cognitivists, social cognitivists describe how cognitive structures and processes mediate between the environment and people's actions. But social cognitivists emphasize that these mediating structures go beyond individuals' mental models to include tools and other aspects of social activities. Although some activities (like conventional tests) do require individuals to think in isolation with limited tools, a full account of learning must analyze social activities in addition to mental representations.

Social cognitivist education

In a social cognitivist approach, both teacher and student are active. Instead of relying primarily on students' own exploration and model-building, the teacher acts as a competent practitioner of the activity being taught and brings tools for students to use. Teachers guide students as they begin to participate in the activity. This guidance allows students to do tasks that they would not be able to perform on their own. Students act like apprentices, at first doing minor parts of the task while observing others, then taking on increasing responsibility.

Teachers should design more naturalistic or "authentic" activities for students to participate in, where the goal is competent participation in real activity. Many medical schools, for instance, now use "problem-based learning"—in which groups of beginning students are given real, complex cases and asked to diagnose the problem. They must consult more expert practitioners, do research on relevant topics, and develop alternative diagnoses to present in class. Students thus learn how to participate in the practice of medical diagnosis, and they learn the relevant facts along the way.

From this perspective, testing is unnatural. If students must learn to participate competently in real activities, teachers should not test whether they can solve problems by themselves out of context. And because learning most often involves participating with others to accomplish a task, students should not be tested alone. Students should instead be asked to exhibit their mastery by participating competently in naturalistic activities.

Like behaviorism, pure cognitivism is only partly true. Just as people are often manipulated by reinforcements, people often rely primarily on their own mental models to understand the environment. But if our educational goal is to help young people build on the knowledge and skills that have been developed by previous generations, we should treat them neither as animals to be shaped nor as lone thinkers. We must help them grow into and expand the activities that make us human. This will require educational practices based on more complex accounts of learning.

Further Reading

Anderson J, Reder L, and Simon H (1996) Situated Learning and Education. *Educational Researcher*, *25*, 5-11.

Duckworth E. (1987) "*The Having of Wonderful Ideas" and Other Essays on Teaching and Learning*. New York: Teachers College Press.

Engeström Y, Miettinen R, and Puramäki R (1999) *Perspectives on Activity Theory.* Cambridge: Cambridge University Press.

Gardner H (1999) *Intelligence Reframed*. New York: Basic Books.

Greeno J (1997) On Claims that Answer the Wrong Questions. *Educational Researcher*, *26*, 5-17.

Hutchins E (1995) *Cognition in the Wild*. Cambridge, MA: MIT Press.

Lave J, and Wenger E (1991) *Situated Learning*. Cambridge: Cambridge University Press.

McGilly K (1994) *Classroom Lessons*. Cambridge, MA: MIT Press.

Piaget J. (1967) *Six Psychological Studies*. New York: Random House.

Renninger K (1998) Developmental Psychology and Instruction. In I Siegel and K Renninger *Child Psychology and Practice*. New York: John Wiley and Sons.

Rogoff B, Turkanis C, and Bartlett L (2001) *Learning Together*. Oxford: Oxford University Press.

Schwartz B (1985) *The Battle for Human Nature*. New York: Norton.

Skinner, BF (1968) *The Technology of Teaching*. New York: Appleton Century Crofts.

Vygotsky L (1978) *Mind in Society*. Cambridge, MA: Harvard University Press.

Wertsch J (1998) *Mind as Action*. Oxford: Oxford University Press.

Glossary

Authentic assessment—Assessing students' knowledge while they participate in more naturalistic activities, instead of tests.

Cognitive mediation—The process in which people's models of the world shape their understandings of and reactions to it.

Cognitive tools—Objects like maps, words, or mnemoric devices that people rely on to facilitate thinking.

Genuine understanding—When a learner goes beyond getting the right answer and develops a representation that more accurately reflects the world.

Operant conditioning—Shaping a learner's behavior by selectively reinforcing his or her responses to particular situations.

Situated cognition—The dependence of cognitive accomplishments on non-mental components like cognitive tools and other aspects of social activity.