

Book Review

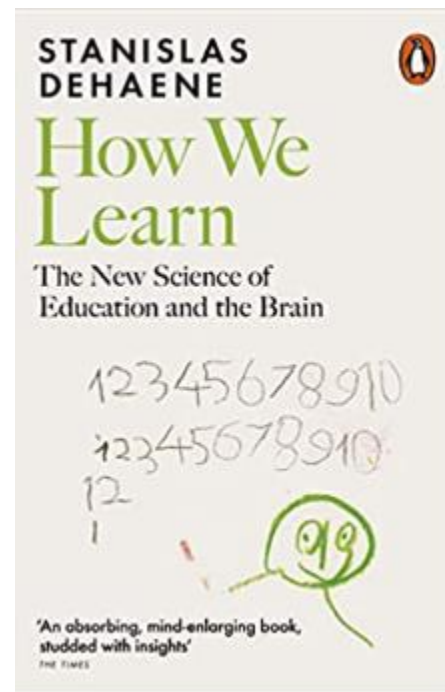


How We Learn: The New Science of Education and the Brain **By Stanislas Dehaene, Penguin Books (353 pages)**

As reviewed by Curt Adams

Most educators have strong beliefs about how to improve and transform education. I know I do. These beliefs often become the dominant lens that we use to make sense of experiences, define reality, and inform actions. Given the weight we attach to our perspectives, it is valuable to consider how well our assumptions measure up to relevant evidence. Research evidence from neuroscience and cognitive science is arguably underutilized in testing our beliefs about how effective education systems work. If you are serious about reconciling your educational beliefs with the science of learning, Stanislas Dehaene's book *How we learn: The new science of education and the brain* is a must-read. The book stresses the importance of the science of learning when considering education policies, practices, and conditions.

Dehaene begins with a simple question: "What is learning?" He asserts that our familiarity with the word "learning" often obscures or ignores the existing knowledge about neurological and cognitive structures regulating our brain. He further contends that learning should not be conflated with concepts and metrics used to evaluate what a student has or has not "learned." Learning is



not a finite outcome. Instead, it is a dynamic process in which the brain tests millions of synapses in search of the correct neuronal network to represent the object being studied or the action being performed. The process is active, fluid, and driven by numerous errors as the brain adjusts knowledge structures to align them with information and observations. Dehaene asserts that to learn is to form an internal mental model of the external world. He likens the learning brain to a scientist who derives hypotheses from existing knowledge, who compares these hypotheses to incoming information, and who adapts these hypotheses to match observations. What takes scientists considerable time, the brain accomplishes in milliseconds and repeatedly for the thousands of sensory responses it receives.

In part two of the book, Dehaene wades into the nature-nurture relationship of brain development. He unpacks several common misconceptions and reassembles them according to neuroscience evidence. I highlight a few here.

- ***A baby is born with a blank mental state free of knowledge structures.*** Dehaene says that this belief is not accurate because we are born with existing neural networks and knowledge structures. A baby enters the world with mental models of objects, numbers, spatial awareness, people, probabilities, and language. Simply put, we are born with a rich language of thought and complex knowledge structures that regulate learning.
- ***Brains are sponges that absorb information.*** Our brains take in information, encode it, process it, and then send signals out to the mind and body. However, brains are NOT sponges that simply absorb information from the environment. We learn when our brains are actively engaged, adequately nourished, and regularly used to test hypotheses. Learning is not a passive reception of information. It is a dynamic activity of projecting, testing, adjusting, and encoding.
- ***Each brain has its own unique learning style.*** There are no different styles. Dehaene notes that while individual differences are real, these

differences exist on top of a common architecture. All human brains function and learn in the same way with some exceptions for developmental disorders (e.g. dyslexia, dyscalculia, and other developmental syndromes like autism and schizophrenia).

- ***Brains slow down and stop learning as we age.*** It is true that early childhood years, beginning at birth, are the most sensitive periods for learning and when the greatest development occurs. However, brain plasticity extends into childhood, adolescence, and adulthood. What happens as we age is that neuropathways formed in our younger years get recycled as we experience and learn new things. This is why formal education, together with rich environments outside of school, are important for continued brain development. Enriching environments build better brains and help us to recycle neuropathways so that we can continue to learn as we age.
- ***Errors are the mark of poor achievement.*** Not true. Mistakes are how the brain learns. The brain learns by refining and adapting mental models based on errors.
- ***Certain children are born with stronger abilities.*** Yes, children are different, but all children have the same brain structures. All babies are born as potential physicists, mathematicians, and linguists. Families, communities, and schools must enrich the environment to nurture the innate learning potential in every child.

In part three, Dehaene describes the “four pillars of learning.” These pillars have the most practical application for organizing schools to maximize student learning.

Pillar I. Attention. Attention amplifies information that comes into the brain. Without attention to specific features of the environment, information remains mere background noise that the brain processes weakly or not at all. Dehaene uses the well-known gorilla experiment to describe the importance of attention. In the experiment, people are asked to watch a basketball game

and count the number of passes one team makes. A person in a gorilla costume enters the video during the game and people paying attention to counting passes frequently miss seeing the dancing gorilla, even when their eyes are focused on it. Unfortunately, students frequently miss the “gorillas” they should be seeing in the classroom. Teachers can teach, but without attention, students will not learn to their potential. Good teaching requires awareness of what we want students to attend to and how well they are attending to the material.

Pillar II. Active engagement. By active engagement, Dehaene refers to the brain being attentive, focused, and active in forming mental models and testing mental models against added information. For Dehaene, the word active refers to the brain engaged in deeper processing, as opposed to devices used to keep students moving in class. Active engagement requires piquing students’ natural curiosity. Curiosity ignites inner motivation to explore ideas, process information, and persist in learning activities. Curiosity aligns with memory. The more curious you are about something, the more likely you are to remember it. Curiosity is the best trigger for learning.

Pillar III. Error feedback. Error is how the brain learns, which explains why feedback matters for student learning. Tests and grades used to sort, rank, motivate, punish, and judge students do not qualify as useful error feedback. Feedback needs to be accurate, rapid, explanatory, and specific to errors students make. Testing is one of the most effective ways to stimulate learning if tests engage students in deep processing of errors. Tests, for the most part, are often not designed to stimulate learning.

Pillar IV. Consolidation. Consolidation is an efficient function. The brain consolidates knowledge structures to create space for more information. Consolidation results in automaticity of brain responses. For example, once individuals learn to ride a bike, they do not have to think about how to do it. A critical support for consolidation is sleep. The brain remains active during sleep as it replays events of the day and consolidates what has been experienced.

Dehaene's book raises critical questions about how schools might be organized differently. How might we work with families and communities to construct mutually supportive learning contexts? How might college of education professors like me prepare educators steeped in the science of learning. Perhaps what stands out most from Dehaene's book is just how much energy we spend debating policies, resources, and practices without paying any attention to the science of learning. It seems to me that we have somehow missed the dancing gorilla in our midst.

Curt Adams is a Professor of Educational Leadership and Policy Studies at the University of Oklahoma.



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