

Getting the Brain in Gear

The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning

by James E. Zull
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Reviewed by Donald R. Stoll

For senior teachers who hoped to make it to retirement without mastering more than basic word-processing skills, the rate of change in the educational environment is daunting. No one would dismiss all the talk about teaching and how students learn as “mumbo jumbo,” but the teacher who keeps up with the research by glancing at NEA professional journals is struck and maybe even overwhelmed by the range of theories and the often seemingly contradictory conclusions.

What’s a fellow or a gal to do? If there were only *something* concrete, sure, grounded in cold scientific research that is also accessible to the informed but rusty scholar—that might be worth considering. Well, James Zull, author of *The Art of Changing the Brain*, is seeking to provide that *something*.

In the 1970s considerable research was conducted in the neurosciences. New technologies made it possible to chart neural activity in various locations in the brain and to start drawing more physiologically based conclusion on how the brain works. Gradually these findings began making their way into other academic disciplines and a plethora of cognition-based approaches to teaching popped up at various professional conferences. Soon, however, the differences began to outnumber the commonalities and the dilettante teacher got left behind. Zull’s book is aimed at that conscientious amateur scholar/professional teacher looking for that *something*, by seeking to make this brain research more accessible to those of us involved in the business of learning and teaching.

Zull was involved in a biochemistry laboratory at Case Western

Reserve—where he is on the biology faculty—doing research on cell-cell communication, protein folding cell membranes, and biosensor research until the lab closed in 1998. Four years earlier, he had taken his years as a university biology teacher and researcher to the world of faculty development, taking on leadership of the University Center for Innovation in Teaching and Education. Here he worked with university professors struggling with their teaching and their students' learning and fell under the influence of his Case Western colleague David Kolb, author of *Experiential Learning*. The link he forged between the two areas of his research blossomed into this book.

The author's thesis is that learning occurs when the neurological pathways in the brain are changed and that using the whole brain is the best way to accomplish this change. What he brings to this conversation is his insight that the functions the brain performs—getting information (for which the brain relies on the sensory cortex), making meaning of information (relying on the back integrative cortex), creating new ideas from these meanings (using the front integrative cortex), and acting on those ideas (which requires the motor cortex)—parallel what he calls “the four pillars of human learning: gathering, analyzing, creating, and acting.” Change (learning) occurs during what he describes as the “learning cycle”; concrete experience leads to reflective observation and this leads to abstract hypothesis that, in turn, leads to active testing, which becomes a new concrete experience, and the cycle continues.

His next insight revolves around the relation of emotions to learning. He points out that the thinking brain is physiologically built upon the emotion and feeling brain; therefore because of the physical structure of the brain, teaching involves dealing with how students feel. Uncomfortable, frightened students struggle, while assured, confident students learn. Of course, experienced teachers know this—but Zull explains why it is so and how important it is. He dwells on the biological difference between intrinsic rewards—the good feeling that comes with learning things that are naturally interesting and rewarding—and extrinsic rewards—grades—and makes a strong physiologically based case for focusing on intrinsic rewards.

Zull the teacher effectively identifies warning signs teachers will recognize that appear when students are not engaging the whole brain. Several of his chapters profile students who exhibit incomplete learning skills. He attributes their struggle to over-reliance on certain parts of the brain to the exclusion of other parts. The characters in these scenarios are easily recognizable and the book smoothly morphs into a teaching manual rather than a chronicle of brain research.

After pointing out that, biologically, all learning begins with existing networks of neurons, he paints a compelling picture of learning—con-

structing new understanding—as the process of “attaching the new to the old.” Teachers surely know students do not enter the classroom as blank slates. The successful teacher builds lessons not on his or her image of what the knowledge looks like but on the image the student brings to the lesson. Zull tells us, “we often carry childhood beliefs with us for a lifetime, even when we know that they are technically incorrect.” For the student to learn, the connection must be made to that prior knowledge.

In fact, “The Art of Changing the Brain” is the art of helping students find connections with their past beliefs and experiences and building upon these. There are two elements to accomplishing this. First, the teacher must seek to understand the student—the better we understand the student’s thinking and prior experiences, the better insight we can have into how the student can build on existing neuronal connections. These include what the student has been told about the topic as well as the feelings this topic raises. This is hard. We all too seldom have any real idea of what a student has actually been told about a topic because teachers so seldom talk to each other about what they teach. It’s also hard because few teachers realize the importance of the emotional state of students when they learn something.

Second the successful teacher needs to be flexible, to identify and use what works, even if seems wrong. Teaching, like learning, is utilitarian—if knowledge becomes understanding, even if the process used violates the teacher’s aesthetics, it’s good. If mnemonic devices help someone learn how to spell *separate*, why not use them to memorize the periodic table. My college roommate memorized the complex formulas in his organic chemistry course by assigning each of them to one of the starting offensive linemen on the Chicago Bears.

The pedagogical idea here is one of building on what exists rather than trying to eliminate things that bother us. As Zull notes, “the art is the skill of finding the parts of existing networks that are ‘right’ and helping the student attach new things to them which generate more complete understanding. This approach suggests that much of what we consider ‘wrong’ is just incomplete. We can add to it if we have the ‘Art.’”

Don’t expect a comprehensive book on brain research. Although there are plenty of sources cited and summarized, this is principally a book on teaching. On one hand it validates much of what teachers intuitively discover as they grow in experience. On the other, it provides a theoretical underpinning for these intuitive discoveries. And it does this while demystifying the complexities of brain biology and teaching/learning theories by way of a clear writer’s voice.

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