Neuroscience in School Design

By Irene Nigaglioni

Recent research on the relationship between the physical environment of educational facilities and its impact on students has shown that design can definitely affect learning. Different design features, such as daylight, temperature, acoustics and color have the most influence on students, and when designed correctly can positively impact the learning process. However, little has been published on the effect architectural design can have on learning, by studying how it affects our brain. This is now changing as neuroscientists have found that the moment we walk into a space, our brain is engaged and activated, sending electrical currents to thousands of brain cells. Given that learning activities rely on engagement, using a building's architecture to activate learning can further enhance the learning experience in schools.

Emotional arousal helps the brain learn, according to John Medina, author of "Brain Rules." Medina adds that we "absorb information about an event through our senses, translate it into electrical signals, disperse those signals to separate parts of the brain, then reconstruct what happened, eventually perceiving the event as a whole." Architectural elements such as light, sound, texture and shape can affect us immediately, triggering an emotional reaction that can affect how we retain information. These attributes provide external stimulation that can activate certain brain areas, making it more receptive to learning. The opposite is true if these attributes are neglected during design. A windowless classroom with rows of front-facing desks can actually turn off a student's interest in the material being discussed.

When designing learning environments, architects and designers should strive to achieve a design that can help activate the brain. Continued research by neuroscientists is being conducted in this arena, but we can arrive at certain designs based on what we know of how the brain absorbs information. Our senses are essential to how we perceive information, so building environments that activate our senses is a good start. We are also aware that in order to design successful learning environments, we need to know the users, and understand that we all learn differently, so it is imperative that the learning environment be personalized. Lastly, creating environments that are safe and comfortable allows the brain to be engaged and activated in learning activities, instead of distracted by feelings of danger and discomfort.

Activate the Senses

Humans have five basic senses: smell, hearing, touch, taste and vision. Some of the senses are better at triggering old memories, like the sense of smell. Medina writes that our senses "have evolved to work together, which means that we learn best if we stimulate several senses at once." However, according to neuroscientist Eric Kandel, the brain prioritizes vision, and "half of the sensory information going to the brain is visual."

Woodard Elementary School responds to humans' neural preference for curves with a pathway that is engaging and non-threatening.

Understanding this, as architects we must design sensory-rich environments that first appeal to our vision and then activate our other senses. One way of accomplishing this is by carefully using light, color, texture and shapes. The traditional factory model classroom neglects these by creating a repetitive, rectilinear pattern that results in hallways with a very institutional feel that can be sensed as negative and impersonal. Humans have a bias towards curves, and curvilinear spaces and objects have been associated with positive emotions and a sense of safety, according to a study conducted in 2013 by psychologist Oshin Vartanian.

For example, Woodard Elementary School in Cypress, Texas responds to our neural preference for curves, creating an engaging, non-threatening pathway through the building. The space is further activated by the use of natural light and color on the glass, which triggers and activates our sense of vision. The different materials in the space, from the smooth walls, to a textured stone column bring together all the senses to create a sensory stimulating environment. Another example is Valley Oaks Elementary School in Houston. In this case, our senses are engaged with the use of graphics that assist with wayfinding, and introduce circular shapes into an otherwise rectilinear space.

Personalize Environments

Every student and teacher that enters a school building experiences it differently, due to differences in backgrounds and prior experiences. Older schools have largely failed to take these differences into consideration, and the learning environment is reflective of a one size fits all mentality. However, in order to engage the brain to receive information, each student's background and prior experiences have to be considered. Architects and planners need to design spaces that are varied in size and diverse in setting. This allows for each learner to experience the settings in their own way, finding the space that allows them to feel comfortable and receptive to learning.

Recently, several articles have been published regarding studies by neuroscientists questioning the concept of learning styles as not having any scientific base. They question the truth behind visual, tactile or auditory learners, when they know our strongest sense is vision, and question the benefit of single modality instruction to respond to a particular learning style. They strongly suggest the need for multi-modal instruction in order to stimulate the brain. When designing with neuroscience in mind, designers need to take this into account.

According to Judy Willis' book, "Brain Friendly Strategies for the Inclusion Classroom," there are strategies that help build strong neuronal circuits and sustained memory storage. She writes: "Manipulation and application of new information correlates with increased brain stimulation, hence direct lecturing and memorization alone are inadequate. Multisensory exposure to information, student centered activities, discovery and hands-on-learning experiences" are best for students. The learning environment needs to be designed to allow for makerspaces that allow students the opportunity to tinker and participate in their learning.

The new North Richland Middle School in North Richland Hills, Texas highlights one such space, which anchors the school's learning hub. These spaces need to be designed with transparency, so other students can see and hear the activities taking place within. They also need to be designed with large surfaces for writing, as well as with water and power to allow for experimentation and the use of tools. They should also include flexible furniture that allows students to sit or stand as they work. These types of spaces should be provided in different sizes, with a variety of features, and should be found throughout the building.

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Valley Oaks Elementary School uses graphics that assist with wayfinding and introduce circular shapes into an otherwise rectilinear space.

Neuroscience is one of the newest research fields trying to understand the relationship between the physical environment of school facilities and its impact on student achievement. As we continue to understand the way our brain works, we can develop exciting new school designs that will help students thrive. Master sculptor Constantin Brancusi described the human reaction to art as immediately giving the observer "...at once, the shock of life, the sensation of breathing." We should strive to design school facilities that motivate, stimulate and energize many generations of students, and that are a radical departure from the factory-style schools of our past.

Irene Nigaglioni, AIA, ALEP, LEED AP BD+C, joined PBK, where she serves as a partner and national educational planning director, in 1993. She has served in leadership roles for national associations dedicated to educational environments, including serving as chair of the A4LE.