Brain and Learning

Joseph William Gilkey Jr[1]

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ABSTRACT

Think back to when you were a young child or even when you were the parent of a young child, the time when a very young person begins to seek meanings for almost everything that pops up in the surrounding environment in and out of the home. As young children broaden their experience, they ask ever-increasing numbers of questions about the world they see and experience. Initially, these questions focus on the simplest things, and then over time they gradually begin to expand and broaden to complex matters, events, and issues that even challenge the most well reasoned understanding of adults. These questions help children shape their formative view of the world. This quest for knowledge becomes the most fundamental aspect of the educator's mission in cultivating and nourishing the young person's intellectual curiosity.

Introduction

Think back to when you were a young child or even when you were the parent of a young child, the time when a very young person begins to seek meanings for almost everything that pops up in the surrounding environment in and out of the home. As young children broaden their experience, they ask ever-increasing numbers of questions about the world they see and experience. Initially, these questions focus on the simplest things, and then over time they gradually begin to expand and broaden to complex matters, events, and issues that even challenge the most well reasoned understanding of adults. These questions help children shape their formative view of the world. This quest for knowledge becomes the most fundamental aspect of the educator's mission in cultivating and nourishing the young person's intellectual curiosity

Even adults remember that "aha" moment of clarity and discovery when a new concept is encountered and its cognitive impact and emotional gasp. For educators, it is our job to orchestrate those experiences for students so that they are engaged to participate in that discovery process. The key to affective learning is getting the students to engage freely and confidently and to generate answers. The engagement must be genuinely focused to encourage students in being creatively involved to help find the answers to their question, as opposed to traditional ways of forced memorization of isolated facts and rote practice of skills. The brain has the capability to perceive patterns and adapt quickly in solving problems and selecting appropriate methodologies. However, to enable this process, the elements of engagement and self-generation must be present. To reach peak performance in the human brain, the individual should feel comfortable in being aware of the unlimited capacities to make connections, and to understand what conditions help maximize this process. In principle, students learn from their holistic experience in both the world around their peers and inside the classroom. The content and context of this process are difficult to separate. Each event, whether it is complex or not, embeds some kind of information in the brain to be stored and eventually recalled later. The brain then engages it capabilities to associate that content experienced with the information now being learned. With educators, their primary focus then should be to expand the quality and quantity of ways in which the students are exposed to content. The effectiveness, for example, can be increased by enhancing the context in which the content is delivered. Educators come to grips with the fact that brain-based education therefore, involves, one, creating and arranging, elevating, and appropriate experiences for learners, and, two, ensuring that students receive materials that provide a way to process their experience that increases the attraction of meaning – that is, by relating material to already learned experiences.

Early on in school, students are told to read, take notes and to memorize the materials for the central reason of passing tests. But this approach fails to prepare students for a world that is not test-friendly neat and

[1] St John's University, United States

straightforward. Unfortunately, these test-focused processes do not provide students the relevant skills and attributes that require a far more comprehensive breadth and depth of perspective in a tighter, global environment. The world's marketplace is multi-faceted in its dynamic nature and requires the ability to adapt quickly and specifically to any situation that arises at hand. Furthermore, using a teaching method that requires memorizing provides the student with the inappropriate and unsuitable skill sets because they fail to engage and to take advantage of the brain's truly expansive capacity to learn.

A healthy brain – irrespective of the person's sex, age, race, ethnicity, or nationality – has the aptitude to do the following general common functions:

1. Capacity to detect and understand patterns.
2. An extraordinary capacity for memory,
3. The capability to learn from experiences and the subsequently ability to analyze the data and the results of that experience;
4. A tremendous ability to create.

Studies have shown that rather than spoon-feeding students by laying everything out for their students, educators should push students to generate answers on their own. One simple way to start is to encourage teachers to pause occasionally and to ask questions encouraging the students to develop answers. This would aid in developing the student's capacity to generate answers and solutions. Even a short pause for only a few seconds can greatly enhance the learning experience. It may also be beneficial for the whole class even if one student answers aloud, as Metcalfe and Kornell have demonstrated. In their study, the results indicated that if students are posed a mixed condition question as part of the pausing tactic, eventually every student in the class will start generating answers, and their memory will be greatly improved. It was clear from their work that getting the student to generate the answers on their own improves the learning process (Metcalfe and Kornell).

The learning process commonly witnessed in U.S. schools during the last 20 to 30 years has been shown, both anecdotally and in empirical studies, to be variably inappropriate with regard to preparing students for long-term learning. In many respects, the educational process has come to resemble a factory approach, which requires students to memorize material with little or no interaction. This method, in particular, has shown to be inappropriate in providing lasting relevant skills. At the same time this type of teaching method also has failed to develop students to be fluid and dynamic in their thinking, as an effective, productive business environment requires in the marketplace. The business environment is no longer as stable and predictable as some have experienced in the past. The need for dynamic thinking – especially to the point of accepting failure in a specific moment as an essential step toward realizing truly successful innovation and original enterprise – is more critical than ever before, given the increasingly shrinking global marketplace.
New definitions of the interrelationship between one's behavioral environment and personal factors also have emerged, providing a framework for distilling the interactions integral to learning psychology. The field of study is known as SCT (Social Cognitive Theory), which is based on understanding an individual's reality constraint. Current teaching methods have behaviorism incorporated into the lesson's pedagogical rationale and is largely based on the notions of reward and punishment. Something as small as a "smiley" sticker, for example, could be much bigger than a more tangible reward for a single act. The use of that "smiley" sticker might influence the expectations, preferences, and behaviors having a greater impact lasting far beyond that single event. Thus, a single teacher's behavior may have passed along, yet virtually invisible, consequences, which could stay with the student for years later.

Social Cognitive Theory is gaining increasing salience as schools become more heavily invested in online learning and educational programs. For example, videos incorporating similar points of views or perspectives on problems and issues enhance the impact of observational or vicarious learning. Some online learning modules encourage students to generate practice questions or situations that target the value of reiteration, reinforcement, and reproduction of concept learning. Likewise, repetitive mastering of certain types of skills – e.g., learning to drive a car – reinforces the student's sense of self-efficacy and confidence in the ability to perform. Likewise, certain practice situations can emphasize a student's skills of distinguishing appropriate and inappropriate approaches for coping emotionally in particular types of problem or stress situations. Furthermore, the emphasis is on strengthening the student's self-regulatory capabilities, which means, as the student's ability deepens and broadens, the feedback from a teacher also becomes more detailed and sophisticated. This interactive feedback underscores the capacity of the student to improve continuously in mastering the objectives of the lesson and achieving the most desirable outcomes.

One of the many problems with the behavioral risk approach is that it does not provide a way to giving knowledge about those consequences. Things such as rewards and punishments, when these items are directed by others, is when most people would be most influenced, and by looking to others for direction and answers, in turn, affects the quality of the learning process. In fact, we now see how recent entire generations have been working exclusively for the grade or the rewards of an immediate and tangible nature. The impact has led to consequences in which students lose motivation for a more engaged yet less immediately tangible experience of learning and comprehension. Regarding lectures and the ways in which questions are poised, I would challenge the static design of lectures where all goals and outcomes are predetermined, leaving little or no room for symmetrical interaction with students. For a skill to be highly mastered, a person must have substantive opportunities to generate some of their own answers and organize their skills – a process that further primes the brain's physiological properties for these cognitive processes. The most effective possible way is to offer significant, diverse channels for creative opportunity so that students can comfortably generate their answers. When all students have these options, they potentially stand to actually thrive with the opportunity to do some things that emerge as innovative and creative – all immensely satisfying for the student who seeks to become more independent as they move through their schooling.

Meanwhile, the result of continuous input without realistic engagement can impact negatively the learning process by not relating the learning to other meaningful contexts essential to one's formative life experiences. In interactive experiences, one comes to terms with the superficial information and has doors opened to become aware and appreciate the deeper sense of how the information connects to larger contexts – such as ecological issues, a global economy, the quality of life, or the broadening circle of multicultural, socially diverse contacts and networks of friends and peers. Some research (Caine & Caine, 1991, 2003) set the groundwork for the approach known as brain-based learning. Twelve principles comprise this approach with fundamental assumptions that the brain is unique, that the brain is a parallel processor, that learning engages the individual's whole physiology, and the brain processes wholes and parts simultaneously. Likewise, the approach accepts the principles that the search for meaning is innate and that it comes through patterning. Similarly, emotions are critical to patterning. Learning involves both focused attention and peripheral perception and it always involves both conscious and unconscious processes (Janet Metcalfe). The approach also acknowledges two types of memory: spatial memory system and a set of systems for rote learning (Caine R. N., 1990). Finally, it acknowledges that we understand and remember best when facts and skills are embedded in natural, spatial memory, and that learning is enhanced by challenge and inhibited by threat (Saleh, 2012).

Sometimes learning is passed along to long-term memory (LTM) rather than being lost in its short-term counterpart (STM). When information is learned, it can simply be something memorized so then that item can be passed along to the long-term memory area. The ability to pass along the information is accomplished by frequent rehearsing. The only problem with this is that memorized information can often be poorly labeled and stored in isolated areas of the brain that can be difficult to locate later for immediately accessible retrieval. When the information is stored the pathways to the storage areas are narrow and singular in nature, which are called taxon memory. The taxon memory systems are relatively isolated and resistant to change. Through the course of numerous sequential studies, basic features of taxon memory have been elucidated. (Tassell, 1999, 2000, 2001, 2002, 2003, 2004). They include the acknowledgment that the information placed in taxon memories is placed accordingly through practice and rehearsal. Taxon memory is linked to extrinsic motivation and is powerfully motivated by external incentives and punishment. Other features include being aware that taxon memories are physiologically "set' in a way that makes them quite resistant to change, as anyone who has tried to change a habit knows. Further clarification is required to contextualize the concept of taxon systems being relatively isolated. The items are only relatively isolated because they can be highly organized and do interact with other items stored in memory so that they can be called on readily as needed during an ongoing event, situation or experience. While many of the items that we store by way of taxon systems are not initially meaningful, the research indicates that what is most important to us is that the information can be found and recalled in the matter of skills that can be used on demand, regardless of the meaning.

O'Keefe and Nadel(1978) point out that everything that happens to us occurs in spatial contexts. This is such a fundamental point that we easily overlook it, and it should be more apparent in our self-awareness. The concept means, in part, that we always operate in a rich physical context. For example, we do not simply select a furniture store. Instead, we select specific furniture in specific stores within specific walls and so on, all of which surround us and are in a precise yet ever-changing relationship to us. We can substitute any action for selecting furniture in the store, such as attending a concert or reading a book, and the same spatial context principle still would hold. We do this by constantly creating and testing spatial maps that give us information about our surroundings. Maps are constructed within what we call the locale memory system, which relies heavily on the hippocampus, part of the limbic system, and located in the brain's medial temporal lobe.

We rely on spatial maps to guide our movements and interactions within our surroundings. However, the locale memory system is not adequately represented by the information processing model of memory. In particular, it is clear that we continuously monitor a great deal of sensory data and information, and much more than to what we can be specifically attend. We automatically form long-term memories of events and places without liberally attempting to memorize them. Think of the challenge of recollecting the sensory memory from the previous night's dinner. This assigns credibility to the complex informational processing tasks that should be acknowledged more extensively in the instructional approaches we use in our educational programs.

The Brain

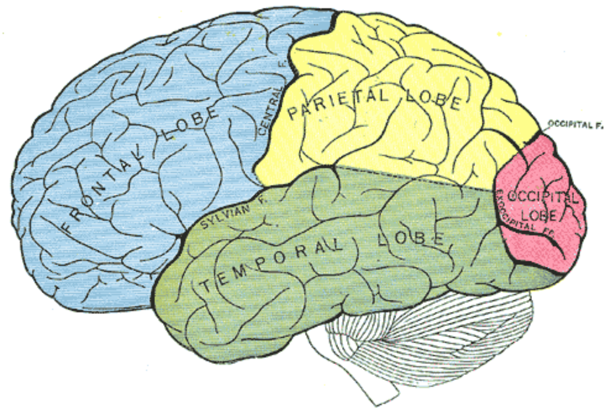
The brain, the center of our nervous system, is essentially the quarterback for all of the body's functions with a virtually inexhaustible capacity to learn. It is made up of two types of matter: gray, comprising 40 percent, and white, 60 percent. The brain remains an extraordinarily complex organ as scientists continue to explore how it enables us to think, move, feel, see, taste, see, and smell. It's informational processing is essentially endless and it facilitates our ability to cultivate an increasingly complex capacity to accomplish intricate analysis, especially as we continue to broaden and deepen the amount of information we can store. In the plainest explanation, the brain accomplishes its functions by producing electrical signals, which together with intricately complex chemical reactions, enable its holistic impact and performance. The brain is segmented into three main parts: the cerebellum, the cerebrum and the brain stem, the medulla. The skull protects the brain from the risks of injury, destruction, and disease (see Exhibit 1). Both the brain and spinal cord are protected by a translucent membrane called dura mater, which is the outermost and most fibrous of the three membranes that protect the brain and spinal cord – the other two being arachnold membrane, and pia mater. Both the brain and spinal cord are surrounded by a clear watery liquid known as cerebrospinal fluid that cushions the brain and spinal cord from the impact of jolts and other sudden or significant movements or hits that potentially could cause permanent damage (Meninges, 2012).

Exhibit 1

Cerebrum

The cerebrum comprises four lobes (see Exhibit 2): frontal, parietal, occipital, and temporal. The frontal lobe, in the front of the head, is the final area of the brain to develop, and is responsible for higher levels of reasoning, self-control and judgment. The parietal lobe, located in both hemispheres in the upper portions, adjusts the entire body's sensations of touch and pain. In addition, it is the critical part responsible for cognitive understanding and perception of motion. The occipital lobe controls vision, along with the sensations and processing that goes along with vision. It is located in the back portions of the cerebrum. The receptors in the eye, for example, send information directly to the occipital lobe for processing and interpretation. The temporal lobe, located in the lower regions of both the left and right sides of the cerebral cortex, is essential for processing sensory stimuli received from both the eyes and ears. It assists in coordinating speech and spatial navigation and contains the brain structures responsible for long-term memory (Donner, 1999-2012).

Exhibit 2



Cerebellum

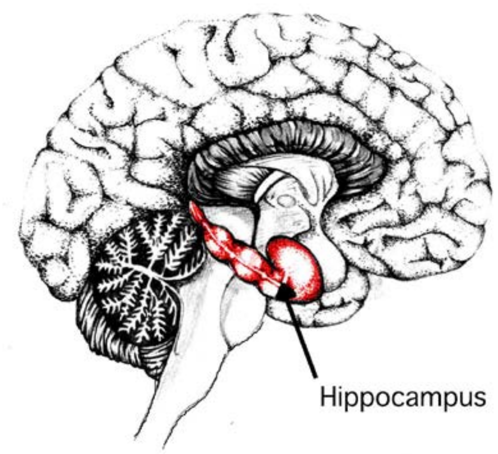
Known popularly as the little brain, the cerebellum (see Exhibit 3) is located at the back of the brain, underneath the occipital and temporal lobes. While the cerebellum represents a small percentage of the brain's total volume, it is packed with a large portion of the brain's total number of neurons. Long thought to be the key originating location for the body's motor commands, scientists now know that the cerebellum acts to modify the motor commands that sharpen the accuracy of the body's finer movements. The cerebellum is responsible for the body's capability to maintain balance and posture and it coordinate the timing and force of muscle actions that give the classic sense of fluidity and flow to the body's movements. Among the cerebellum's most important functions is for the purposes of motor learning, especially critical for those learning to play sports, dance, music, or perform highly coordinated physical tasks. Lastly, the cerebellum does play a role in cognitive functions, particularly language. Researchers still have much to learn about the cerebellum's functions beyond its key role in motor control.

Exhibit3

Source:
http://www.bing.com/images/search?q=Cerebellum&view=detail&id=53E3176E77219DB96FE2F2308FED15F557652F58

Hippocampus
The process of memory forming is a prominent function in the hippocampus, also responsible for organizing and storing of information. Here, the limbic system structure is particularly important in forming new memories and connecting emotions and senses, such as smell and sound, to memories. The limbic system is a complex set of brain structures found on both sides of the thalamus, right under the cerebrum (see Exhibit 4). This area also includes amygdalae anterior thalamic nuclei, septum, limbic cortex and fornix. These elements of the brain comprise a horseshoe-shaped paired structure, with a hippocampus located in each of the right and left hemispheres. The hippocampus acts as a memory indexer by dispatching information and data signals to the appropriate part of the cerebral hemisphere for long-term storage so that they can be retrieved when necessary.

Exhibit 4



Source:
http://www.bing.com/images/search?q=Cerebellum&view=detail&id=53E3176E77219DB96FE2F2308FED15F557652F58

More specifically, the basic features for locale memory can be elucidated as follows (Caine R. N., 2003):

1. Every human being has a spatial memory system, is survival oriented, and has the capacity, which is virtually unlimited.

2. To locale, memories are more free flowing and never really limited to static or context-free facts. These are memories that exist in association to where we are in space, the whole 360 of what we are doing. All of these items have a complex set of relationships among each of these them.
3. Initial maps within the brain tend to form very quickly. This allows for some trial-and-error and instant learning. When you visit an area that is new to you, what happens you look around, to gain an understanding of the surroundings, then within very quickly you gain a sense of the of the surrounding layout that you are in, and that memory map will stay with the individual.
4. A human's brain map is update on a continuous basis. The same can be said for the spatial memory system, which is instantaneously and consistently monitoring and comparing our present surroundings with those of the past.
5. As human beings, we are motivated by novelty, curiosity, and expectation, which then influence the map creation.
6. Locale or spatial memory is enhanced through sensory acuity, or awareness of smell, taste, touch, sound, and so on.
7. Maps for specific places are generated relatively instantaneously for smaller mapping, for larger that might much more intricate maps can take a considerable time to be formed.

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