Is Learning a Predictable and Consistent Construct?

There are four variables and three rules that are necessary for good quality learning. The variables are attention, association, repetition and timing. The rules are: 1. Learn it correctly the first time. 2. Do not guess during recall. 3. Do not struggle to recall. These four variables and three rules form the structure and reasoning behind the Genius by Choice Learning System. In this document, I intend to describe the variables and how they each impact learning. Then I will discuss the three rules and why they matter to good quality learning.

To have complete learning, we need to begin with input—perception of a stimulus. Perception of a stimulus depends on attention to a stimulus that is selected from competing stimuli that are simultaneously available from the environment. The attention acts like a portal or gateway to the information processing capabilities of the brain. When attention has a selected focus, by default, other competing stimuli are de-selecting or filtered out prior to conscious awareness. Once the attention has locked on to an information stream, the brain must begin to process the inputs.

An idea that has gained favor in our information heavy world, is that of multi-tasking. This assumption basically states that the brain is capable of allocating its conscious attention to several stimuli simultaneously. This would be explained as the ability to divide the available attention to various mental activities with the assumption that the brain can process individual portions of the environment with equal facility without one interfering with the other. This is not the same idea as watching and listening to a TV program, for which the brain, with parallel processing capabilities is easily able to do. What multi-tasking refers to is watching three TV programs at the same time, listening to an I-POD, doing homework and chatting with a friend, all at the same time. What is really happening is micro-tasking, meaning something altogether different. Micro-tasking is the rapid switching of attention from one input source to another. This would require equally fast switching on and off of different parts of the brain to keep up with the erratic attention. The result is a fragmentation of all of the information into tiny bits and pieces. There is no sense of coherence that would be experienced from focused attention to a movie, or reading a book, or preparing for an exam. Without coherence it is difficult to sustain sequencing, which refers to the order in which information is perceived by the brain. Therefore, attention, the gatekeeper of the brain, is the first variable that needs be reliably involved in the learning process.

Once the attention has selected its sensory guided inputs, the second stage of learning begins with processing the new information. This requires that the brain perform a ‘Google search’ meaning that what you already know is accessed for familiarity of meaning, sound, spelling etc. This is where the Law of Association begins to establish a link or bridge between existing knowledge and incoming data. All new data must have a location to join with in order to be processed with any comprehension. For example, if you suddenly found yourself in a conference where the speaker switched from English to some obscure foreign language, you would be tossed into a state of mental confusion. Your brain would be doing a search among existing data for similarities and familiarity. Because auditory stimuli would be the primary data source, the brain would automatically search for previous ‘sounds like’. In this case, the search would not produce results, there would be no comprehension, and the attention would ultimately shift to other resources for inputs.

This concept has implications for all students being presented with new information. For example, when introducing a new math concept, the students who are attending to this new material will also be performing a brain search. If most of the language used is already understood by the student, then this search will re-arrange the sequencing or order of the new material, but will be drawing the ‘I already know this’ elements from their own math data bank. If the student has a large math data bank from which to pull previous information, the new information, even though is it being presented in a different and novel sequence, will be much easier to understand.

This is because all new learning depends on previous learning by forming connections among synapses in a new way to accommodate the new knowledge. Because of this dependency on previous learning, a lack of knowledge specific to the topic at hand will create confusion in the learner. Think of an experience you may have had trying to understand someone who was communicating in English, but had a poor grasp of our language, and also carried a heavy accent. All of your attention must be focused on listening and trying to pick up a word or two that you might be able to link to your own comprehension of English. It is frustrating, exhausting, and ultimately, you will not come away from the conversation with more than a vague idea of what the person was saying. Is this because you aren't very smart? No. Was it because you weren't paying attention and trying to gather the meaning? No, not that either. It was because your own knowledge base was not consistent with the delivery of the information, and therefore, you were unable to re-sequence the conversation with existing understanding, regardless of how much you may have wanted to.

When applied to a school setting, it becomes clear why students with weak, incomplete and incorrect foundations in math (or any subject) will become easily confused and will therefore have a very difficult time maintaining attention, similar to the experience of tuning out from a foreign language talk. Essentially, the information may have so little background knowledge to associate with, that new learning becomes mostly impossible, and attention will fade quickly as well.

Therefore it is true that knowing more helps you learn more. There are simply many more places of solid previous knowledge to access for association than if the knowledge bank is riddled with holes, misinformation, and incomplete data.

One of the ways to ensure a properly stocked foundation of knowledge is to use repetition to ensure that growth takes place throughout the synaptic connections. Everyone understands the general idea that when they repeat something over and over, it will eventually 'stick'. That sticking process is the biological procedure of creating stronger connections among neurons. By default, the brain will discharge information at an alarming rate when it perceives that the usefulness of that information has run its course. Creating long-term memories therefore, has a specific recipe of messages that the brain needs to receive before it puts forth the instructions to secure this knowledge for future use. Changing the synapses requires both energy and resources from the brain. Because we are biologically energy conserving by nature, the message to 'keep this information' must be clearly delivered to the brain. Repetition such as seeing something again, hearing it again, or doing it again, begins forming the basis for retaining rather than dumping data.

Finally, each of the previous variables have to be consistently engaged with an eye on the clock. The timing of inputting, processing and repeating is an extremely important part of lasting learning. Think of the neurons as if they were a bunch of wind up toys. Initially, there is a great deal of action from the energy contained in the tightening of the springs. As the energy is used up, the spring loosens and the toys eventually come to a standstill. Neurons act in a similar way. When they are processing information, neurons are highly active and involved. However, when the stimulus stops, the neurons slow down their activity and other parts of the brain become engaged in processing other material. This is the critical tipping point because without re-stimulation and subsequent infusion of energy, the message is interpreted as unimportant and is discarded. There is a small window of time to encourage the same neurons to fire off again where the gains in terms of creating long-term memory are exponential.

Each of these variables, when taken in combination, greatly enhance the probability of creating long-term memory, which is, by definition, learning. With these four guiding variables in place, there are three rules to govern their integration into a complete learning experience. These rules are cautions or caveats against deleterious methods that have negative implication for learning.

Students have long been encouraged or at least not persuaded away from the idea that it is okay to make mistakes. While I would agree with this under certain circumstances, it is certainly not okay when dealing with academic information. While there is a lengthy explanation as to the ramifications of making mistakes with material for which there is only one correct response, or one correct sequence, making mistakes at the very least puts the student further behind than if they had not learned the material at all. This is because the incorrect information activated neurons, pathways were connected, and associations were made. In order to clear the brain from this mistake, those neurons must not be reactivated, pathways need to disconnect and new associations must be made to accommodate the correct information. If the incorrect information is not heard or seen again, this data is most likely to be forgotten, but if it is repeated, the connections will strengthen, and a memory of this material will be formed.

Therefore, rule number one is ‘Learn it correctly the first time’. It not only makes common sense, but scientific sense that when going to the trouble to place attention on information, that the information be correct. There is no question that the quality of learning is highly correlated to the quality of the material and the delivery of the material. Think again about how difficult it is to understand a foreign speaking person, regardless of your personal motivation, goals or desires to do so. We are limited by the quality of the information and by the quality of the delivery, therefore every attempt must be made to ensure that students are inputting the finest quality of information that is free from mistakes, or potentials to create mistakes when there is a way to determine the validity of the material prior to neuronal processing.

Recently, a student brought in some of their social studies grade 9 lesson materials. Included in the photocopied pages was a section that asked the student to correct statements that were false. Essentially, the student was being asked to recognize the wrong information by hopefully already knowing the correct data. Unfortunately, this student did not know the right material, and therefore, in some cases, simply re-copied the wrong information again and in others, focused on the right information, and believing it to be incorrect, changed it. The results were predictable and dismal. The student was completely confused. Even after attempting to re-associate the information correctly, this did not produce immediate results. Forty minutes later, when asked again about "What is the capital city of British Colombia, the student responded with what I call the anti-fact, "Vancouver". There is an assumption that we can toss information into the brain, facts, anti-facts, mistakes with subsequent corrections, and that somehow the magic washing machine of the brain will be able to sort it all out. Darks on one side, whites on the other. What really happens is that it can all turn grey with various degrees of confusion. Perhaps we could think about it this way: Knowing something for absolute certain negates any and all other alternatives. When dealing with rigorous academic knowledge, it is best to ensure that the material and the presentation of that material are as correct as possible.

Focusing on the correct information in the first place is just the beginning of the learning equation. Once the information has interacted with the nervous system and has been processed by the appropriate neurons at least once, the memory for that material is extremely vulnerable to at least two processes. First, the neurons will cease to act (unwind like a spring) and the material will be lost through what is commonly referred to as forgetting. The second process interferes equally with memory placement and can result in cross-learning or memory contamination. This comes from guessing. Imagine that a student has just processed new data. The neurons responsible for dealing with these data have been activated and have established a tentative relationship among each other. If the student is placed in a position of having to respond to a question regarding this newly processed information, and if they are uncertain and guess, they will have formed a different association from the initial correct association. Basically, they will have two pathways leading to two different responses for one question. During active learning, guessing will contaminate the memory and lead to confusion and an inability to distinguish among possible answers. While in the process of dynamic acquisition of information and subsequent establishing of long-term memory, guessing will only serve to thwart a student's learning efforts. There is just one place where guessing is of any benefit and that is during an exam (this only refers to students in higher grades) when it is preferable to place a response in hopes of being on the good side of chance. Rule number two then is 'No guessing during recall'.

At some point, though, students will be required to reproduce what they have learned. Normally, this is accomplished through quizzes, unit exams, and finals. Because retrieving stored data from the long-term memory requires substantially different mental processes from inputting or from memory formation, this activity needs to be established prior to an actual exam. The formations of long-term memories that are able to be accessed for subsequent recall depend on neuroplasticity, or brain changes that occur among synapses. These changes take time to develop due to the requirement of gene involvement, the creation of new proteins, synaptic growth and a host of other changes leading to memory creation. This process can be inadvertently tampered with, resulting in a loss of the information. One mental process that can disrupt the formation of lasting memory is to struggle to recall. This activity is produced when a student goes around and around in their own brain, trying to force a memory to the surface of conscious awareness. In this process, literally trillions of synaptic connections could be activated in the pursuit of the elusive information. This creates a mass of tangles; spider-webs of crisscrossing neural pathways that become mixed up and incoherent. Additionally, the student may or may not locate what they are searching for. Either way, the pathway or the map to the secret location is prohibitively long and convoluted. The chances of following it again are very slim. It is therefore, preferable, to reduce any struggling to reproduce material. A simple re-insertion of the troublesome data and re-firing the correct neurons quickly and correctly will reinforce the memory, leading to an automatic response. Therefore rule number three is ‘do not struggle to learn’.

The Genius by Choice Learning System is based on these concepts, and each of them is derived from a basic understanding of neuroscience. The system has taken about 15 years to organize, perfect, and test. The application of these principles is what we do here at Genius by Choice. Students, primarily from grades 9-12 and post-secondary, come for training about the four variables and three rules, and how, when, where to apply them for all academic subjects.

I hope that this information has been useful for you. This is an excerpt from my new book
“*Genius by Choice for High School*”
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