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Learning how to learn

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Abstract

The purpose of this paper is to analyze and create a discussion regarding the human science of learning. For the last two semesters, I have been involved in tutoring students in the principles of accounting. The key difference between these two semesters was my mindset towards learning. My first semester tutoring I taught "firing from the hip." Simply answering questions or working problems myself and explaining them as I went along. And yes, I do believe this style of tutoring helped these students. Looking back however, I can't help but think of myself as someone living in the 17th century who was more than content with riding their horse. That is to say, I was missing out on massive potential (the automobile) because I believed what I was doing was enough. Relaying back to my tutoring, this massive potential I was missing out on was the understanding of some of the science and techniques behind learning. To kickstart my second semester of tutoring, I read the book *Make it Stick; The Science of Successful Learning* by Peter C. Brown, Henry L. Roediger III, and Mark A. Mcdaniel. This book explores the science of learning through a myriad of stories, real life accounts, and personal findings by the authors. The book, much like learning itself, is not confided simply to the classroom. Instead, it covers topics ranging from sports, neurosurgery, to even jumping out of an airplane. By reading and examining this book, it gave me an entirely new outlook with which to view my tutoring. Coming in the next semester, I was armed with a brand new arsenal of "weapons" I couldn't wait to try out. Just as guns sometimes jam, some of these new teaching techniques fell flat. However, many more proved to be very successful in helping students learn materials faster and for longer. This paper will be going into detail on a few of those techniques and the experiences I had when trying them out. Lastly, I think it would be amiss for me to

solely discuss how the science of learning effected those whom I was teaching. For this new knowledge has had a very considerable and lasting impact on me as well. As such, I will also be including some personal anecdotes I have experienced in my own life following my research into the science of learning.

Introduction

As long as humans have lived, learning has been an essential part of their being. From hedging your survival on which snakes you know are poisonous to succeeding in a job interview when asked a technical question, it is well established that those who learn are more likely to succeed. There is an obvious question that follows that statement, and it is one that has been fervently debated over the course of time. That question being of course, what can we do to learn more? Is the ability to learn one that concerns itself with quantity or quality? Or put simply, are there ways in which we can learn more efficiently? Obviously, this paper wouldn't have a leg to stand on if it simply said that the more you spend learning, the more you will learn. As such, it will explore the belief that learning is a skill that one can become more proficient in. Just as a basketball player can practice his jump shot, we can practice our learning. The tragedy of the topic lies in that many of the techniques attributed to higher levels of learning have been left by the wayside by students, professionals, schools, and almost every other facet of teaching. In fact, strategies that have shown to be the least effective continue to be used by the majority of students everywhere. Re-reading textbooks and highlighting notes are just a few of these poor strategies, but I bet as you read this you can recount a number of times you have relied on those sole strategies for studying. Ironically, when we try to learn, we completely ignore the actual theories behind learning itself.

Like all college students, I have spent the vast majority of my entire life sitting in desks. By that I mean that I had always been the learner, absorbing all I could in class and then cramming the material again when it came time for a test. Looking back, it seems odd that the main focus of my life up until this point has been to learn, learn, learn. Even weirder is the fact

that when you boil my life into that one word "learn," I never once took the time to sit back and wonder what that word even meant. In the most applicable sense, learning to me meant to perform well on assessments. It meant to remember as much as I could before a test, and then spit it all back out when the paper was given back to me. So can it be of any surprise that this was the mindset I continued when I stood on the other side of the metaphorical classroom for the first time? Despite what I was telling myself, I wasn't actually interested in helping these students learn. All I wanted was for them to be able to understand as much information as they could before an exam in hopes of performing well on it. Before we vilify me and my teaching methods, we should recognize that this is the life me and my peers have become accustomed to. Many of our mindsets to learning are not to form lasting impressions towards the subject, but rather to "survive to fight another day." The first and arguably most important step I took to improving my tutoring abilities was to shake off this past mindset and adopt one that nurtured lasting learning.

There was an interesting sensation when I began my first tutoring session that I have to believe is shared by most first-time instructors. First, a strong feeling of unfamiliarity that almost takes your mind out of your body. For so long you have been the one on the receiving end of instruction. When I first realized it was me leading this instruction, a subconscious part of me wanted to sit back and watch myself teach, because that had been the role I played all my life up until that point. Secondly, a feeling of doubt. The realization that what you tell this person becomes ipso facto in their minds. I began to doubt that what I was telling was actually true. Second thoughts about the most basic material flooded my mind. Finally, a feeling of pride. The sensation of passing along the material you pride yourself on to someone first attempting to understand it. For both those who have and who have not taught, I hope it comes across that

these are powerful feelings. Look back on them however, and you might realize these feelings scarcely involve the student. In my experience, the act of teaching was in a way so intoxicating by itself that you forget the entire purpose of it. Think about the nervous presenter who stammers and rushes through their presentation to get done with it as quickly as possible. In the moment, they have forgone the entire purpose of the presentation (informing the audience) in favor of getting off the stage as quickly as possible. This example is not unlike the teacher who focuses too much on their teaching and not on their students learning. It is human nature to reflect on our current actions, and a teacher can easily get absorbed in the feelings they feel at the cost of proper learning. It is a mistake I know I made many times, especially early on. However, after I took the time to look into the science behind learning, it forced me to approach my tutoring sessions from a different angle. I recognized fully that tutoring is a two way street, and thus paid much more attention to the feelings my student might be having.

The first and most important step to increasing your capabilities to learn is to first become aware that it is in fact a capability. One can't learn how to swim if they don't believe they can enter the water. Understanding that learning is something that can be practiced and honed opens the doors to a number of different methods you can use in attempts to become more skilled. While reading through *Make it Stick; the Science of Successful Learning*, three main methods jumped out to me. Firstly, the art of retrieval practice. More commonly known when referred to and dreaded by students as testing or quizzing. However, it has been shown time and time again that forcing ourselves to think back on what we have learned greatly strengthens our knowledge on the subject. Secondly, using spacing when you study. While cramming right before a test might seem like the most effective way to score a high grade, research argues that spacing out your study sessions shows the most positive results. Finally, interleaving (or mixing

up) your studies shows evidence for promoting a more positive learning session. This flies in the face of those who like to categorize their studying "first I'll review chapter 1, then 2, then 3…then I'll repeat that." These were the techniques I decided I wanted to hone in on with my research, and are the ones that I will be presenting in this paper.

Retrieval Practice

Testing is proving to be a more and more controversial subject as time wears on. I know that many of my peers complain that they forget what they have been studying for right after the test. Secondly, they point out the stress that testing can put on students and the negative effects that can follow. While these can be valid points, research shows time and time again that people who are tested on material learn it better. The act of retrieving something from memory forces the brain to build connections that aid in learning the material. For example, the *New York Times* reported on a scientific study that showed that students who read a passage of text and were promptly tested on it retained 50% more a week later than those who had not been tested (29.) Evidence has shown that students in classes that employ the use of frequent quizzes instead of a couple large exams recall the information in the class for much longer following the conclusion of the class. In another interesting study, it showed that students who were taught the material simply by being tested on it repeatedly learned at the same rate as students who studied the material without being tested (35.)

After doing my due diligence on the topic, I knew that the only way for me to see first hand accounts of it was to try it out in the classroom. Right off the bat, I struggled with how I could really implement this sort of testing method in my hour-long tutoring sessions. Maximizing the sessions to include the proper amount of testing while also covering new material became a big concern for me. Initially, my plan was to spend the last 10 minutes or so testing my students on the material they had learned. This seemed all and good, but the more I learned about interweaving (we'll get to that later) the more I began to doubt the strategy. Eventually I decided that I would implement my testing in the form of "pop" questions every 10

to 15 minutes. This allowed the session to include moments where the students were forced to recall material, but also allowed to session to continue moving forward onto new topics.

When I first began implementing these "pop" questions, I was initially met with a lot of confusion. It seemed like the students weren't used to having to repeat things they had just learned and I received a bit of a harsh reaction the first couple of times. However, as the students got more used to the idea, I think they began to almost enjoy it. It allowed them to get some immediate positive feedback during the meeting, which helped liven up the normally dull environment. On the flip side of the coin, it frequently created negative feedback for the students when they got a question wrong. One of the first things I noticed was the different reactions students had when receiving negative feedback. Some would take it as a sign that they needed to concentrate a little harder. Other students became discouraged and began to become less committed to trying their hardest. I soon learned I had to tailor my styles to different students in order to maximize their opportunities based on their learning styles. For students who reacted more positively to negative feedback, I continued to use it as a tool with which I could leverage them to put a little more effort into the session. However I struggled to find a proper way to handle with those who reacted less positively. I didn't want to give up on testing them throughout the session, but was also dismayed at how my sessions could quickly lose steam if the student became unmotivated after getting a few questions wrong. After a few trial and error attempts, I found that my perfect solution lied in a form of passive testing. Instead of asking them a straight up question, I would guide them through problems. While it was me working through the problem, I would constantly look to them to help fill in the next step to the best of their abilities. This forced the students to still recall information we had learned earlier in the session, but also prevented them from becoming overly discouraged with poor answers.

Spacing your Studies

The next method of learning discussed will be the art of spacing out your studies. Interestingly, this is a skill that I feel is known by many in the back of their heads, but yet is rarely practiced to the extent that it should be. By spacing, I am referring to creating breaks in between your studies. It is generally agreed that cramming for a test does not yield as good results as studying for an entire week prior, yet not many people seem to make the connection why. I had always contributed it to the extra time I would be able to study if I gave myself a week ahead of time instead of cramming, rather than any actual science behind it. Studies continue to show that leaving space in between study sessions helps increase the bonds that are needed for long term retention. For example, a group of surgeons were trained on a few short lessons in microsurgery. One group took all four lessons back to back in a single day, while the other group took each lesson spaced out by a week. The results showed that the neurosurgeons who took the time in between sessions had dramatically better results than those who crammed. So why does spacing result in better learning? One belief lies in the difficulty of retrieval that comes with spacing. Relating to the previous topic of retrieval, it is believed that the harder this retrieval is, the more it will stick with us. *Making it Stick* says "When retrieval practice is spaced, allowing some forgetting to occur between tests, it leads to stronger long-term retention than when it is massed" (32.) The harder we force ourselves to recall something, the more we implant the seeds of learning into our heads. Fatigue is also a reason cited for the success of studying with spacing. Just like a muscle, our brain begins to tire as we labor away on an assignment. At a certain point, the utility of any time spent studying becomes so low that you would be better resting. Spacing allows the brain to recuperate so that you can maximize the time you spend on a

particular topic. Lastly, it is believed that converting memory into long term memory is a process that does not come instantly. *Making it Stick* speaks on the matter, saying "It appears that embedding new learning in long-term memory requires a process of consolidation, in which memory traces (the brain's representation of the new learning) are strengthened, given meaning, and connected to prior knowledge- a process that unfolds over hours and may take several days" (49.) With all this evidence pointing to the advantages of spacing out our studying, it is a wonder that very few students practice this effectively. From both my experience and those I have talked to, the overwhelming favorite study method involves studying for a few days in a row leading up to the exam.

An important aspect to remember with spacing is that the time required to properly space can differ depending on how comfortable you are with the material you are seeking to learn. For example, if you meet a brand new set of faces you want to memorize you will need to review them a few minutes after you first see them or they will soon be forgotten. After you begin to get a handle on them, it would be most useful to look at them every few hours and then days. As you become very comfortable with the materials, you may only need to look at them every week or so to promote the most effective form of spacing.

It is important to not fall into the trap that you are learning things because they are coming easy. "Massed learning," or memorizing a bulk of things by reading them over and over may seem productive because it gets easier every time you do it. However, studies show that we learn best when we are challenging ourselves with our recall. Even though it may seem like we aren't learning because we are having a more difficult time answering questions, this effort is actually helping you learn the material for the next time around.

I now faced the challenge of implementing the technique of spacing in my tutoring sessions. Out of all the methods I implemented, this proved to be the most difficult one to successfully integrate. Spacing by definition directly conflicted with the layout of a one-hour tutoring session. I didn't want to sacrifice any of the hour allotted time we had, but I also understood the advantages that spacing can have. One of the solutions I came up with was to break up the normal monotony of the sessions with a little lighthearted conversation and humor. I felt like this could have the advantage of relaxing the students mind for a little, and help them focus up a little more when we hop back into the topic. Additionally, it would distract my student for a little so that when they were forced to recall the information it required a little more effort on their end, hopefully promoting healthy learning.

Another way I attempted to promote spacing during studying dealt with the students habits outside of the classroom. I would ask them to look at specifically materials on different days, hoping that by resting them on certain materials on specific days they would be more challenge regarding the material when they did begin to study it. This technique proved to be a little difficult because I could not accurately measure whether or not my students were following my instruction. Realistically, I have no doubt that the majority of it was ignored, but I do hope that some of the advice found its home.

Interleaving

The final technique I implemented was Interleaving. This is when you mix up and randomize the things you study. For example, instead of reviewing 4 chapters repeatedly in sequential order, interleaving suggest that you should randomize which chapters you review. As *Make it Stick* puts it "When you structure your study regimen, once you reach the point where you understand a new problem type and its solution but your grasp of it is still rudimentary, scatter this problem type throughout your practice sequence so that you are alternatively quizzing yourself on various problem types and retrieving the appropriate solutions for each" (206.) By following this method, you teach yourself to discriminate between different problem types. It allows you to identify unifying characteristics within different problem types and improves your performance on future tests or real world experiences, where problems faced will be presented in random formats.

The hardest part about interleaving is that it goes against our human intuition. When we study, we have the urge to get each section "down cold" before we move onto new and foreign material. This urge presents itself in all faucets of life. Sports players will often practice one repetitive motion over and over in an attempt to master it, but studies have shown that athletes who mix up their training actually have better success at a particular skill (like shooting a basketball from exactly 8 feet) then the athlete who practices that particular skill over and over.

Interleaving was the easiest method for me to implement into my tutoring sessions. Where other techniques faced difficulties based on the format of the one-hour session, interleaving fit the mold perfectly. Instead of approaching the sessions as a linear learning activity, I would ask the student to show me all of the things they wanted to work on ahead of

time. With a little bit of planning, I created lesson plans that maximized interleaving by bouncing throughout different subjects. When I began practicing interleaving in my sessions, one of the most useful tools I discovered was retrieval practice. This allowed me to suddenly quiz students on material they weren't prepared for. Despite feeling a bit jarring, these sudden topic changes have been proven to increase subject mastery.

The most difficult challenge I faced was the student's initial hesitancy to "buy into the program." Most of them were used to and comfortable with the normal linear and segmented form of studying they had used all their lives. The hardest part about interleaving is that one doesn't feel as if they are learning as well. The answers don't come to the student as quickly when compared to segmented studying. Student morale and "trust" in me started to become an issue. It is one thing for a student to not "like" the methods you are using to help them learn, but an entirely different matter when they believe that they are legitimately not learning as well as they could be. Eventually, I told my students to continue to work with me and use the program for a few more weeks until they had taken their first assessment. Following the first assessment, I would give them the option of continue with the interleaving method or switching back to the normal segmented form of tutoring. When decisions came in it was a pretty even split amongst the students, with some wanting to revert back, but also some who had perceived the potential benefit of interleaving and wished to keep it going. There was some interesting results with those who chose to continue the path which will be discussed next in my results section.

Report Card

When I first began to implement these strategies into my tutoring, I wasn't really sure the effect it would have. I was a little skeptical of these new "revolutionary" ways of studying, fearing they might just be some hokey scheme by a hokey guy in a hokey book. Sounding a little like a get rich quick scheme, I also feared that my credibility as a tutor might go down if I started breaking out these new strategies. Thankfully, this was not the case. The vast majority of new strategies I brought to the table showed real beneficial results.

Retrieval practice proved to be one my most effective tools in my toolkit. Once I got the hang of it, it was fairly easy to implement into my sessions. Students also reacted fairly positive to it and as time went on began to welcome it with open arms. I now had to figure out how to measure if my new technique was actually having a positive effect on the students ability to learn. All the research agreed with my testing approach, but it is a different thing entirely to take that research from the textbooks out into the real world. I initially wanted to stay away from measuring performance through the grade in the course. I was worried that the grades reflected might be indicative of cramming for tests, rather than actually learning the material, which was my aim through these techniques. However, after some thought, I came to the conclusion that the principle accounting classes are very cumulative in nature. As such, for students to consistently perform well on assessments, they would have to learn the material rather than just temporarily memorize and forget. Thus, I concluded that the student's overall performance in the class was one indicator of how well my new methods were working. Another method I used to assess performance was how I believed the student was progressing during the individual tutoring session. This allowed me to get some more immediate feedback on how my methods

were working. Ultimately, I would recommend retrieval practice for any kind of tutor or teacher out there. Most students are already familiar with the format and it is proven time and time again to increase learning abilities.

Out of the techniques I began to employ, I believe that spacing was the least effective of them. This is not to say however that spacing as a learning method does not hold up. I believe strongly that spacing can be an extremely effective way to bolster memory and help students build stronger learning bonds. That being said, I think that this is a tool that is best suited for an individual studier. It simply does not agree very well with the format of a classroom or a tutoring session, where you need to spend all your limited time on teaching the student the materials. The most effective way you can implement this technique is to educate your students on the benefits that it can have. But ultimately the student must decide on their own that this is a method they want to actively practice when they engage in individual study.

Interleaving was the most controversial method that I implemented. It drastically changed the status quo of the standard tutoring session, and as such was disliked by many students. As time went on though, this hatred began to defuse for some of the students. For the students who stuck with it, I definitely believe that it was beneficial. Interestingly enough, there were higher grades on assessments from the students who chose to continue with the interleaving style of tutoring. This could be explained by a number of different factors and thus shouldn't be taken as any concrete evidence, but it is certainly was worth mentioning. Ultimately, I think that interleaving was one of the most effective learning techniques when implemented properly and agreed with by the student. It creates as unique learning environment where the student stays actively engaged and on their toes as they are constantly challenged with fresh material.

My Experiences

This "experiment" has arguably affected nobody more than it has me. Doing heavy research on many of the different styles and methods of learning opened my eyes to a whole new subject of knowledge I was not aware of before. By then putting it into practice in my tutoring sessions, I was able to see firsthand what works with students and what doesn't. It has shown me that learning is different for every student, and while there are certainly methods that can be beneficial for everyone, each of these needs to be tailored to each specific individual to achieve maximum results. One of the challenges I have embarked myself on now is determining the exact ways that I learn best. Nothing fits quite like a tailored suit, and I am doing my best to fit these different learning styles to myself in the best way possible.

Throughout this entire semester, I have implemented a number of different techniques into my individual studies. While it took some time to get used to a different way of learning (I had been studying the same way for the better part of my entire life,) I think that it has paid off. I feel like I am actually *learning* the material I look at now, rather than just memorizing it for the exam. This simple fact alone will surely benefit me in my career when I need to put all the things I have learned to the test.

Like almost all subjects out there, there is no true end to the subject of learning. I can try to get as close as I can to understanding my personal best ways to learn, but I know that it will never be the perfect one. With this in mind, I think that the topic is something that I will continue to study throughout my life. As I heard from a professor "We are all lifelong learners, the only difference is that after school the learning comes AFTER we are tested." How effective

you learn is a separate amongst people throughout life, and it is my hope that after this experience I have taken a step in the right direction.

Conclusion

Learning could be considered something of an inexact science. For as long as time people have attempted to learn all that they can. Rarely though, do these same people examine the very ways in which they are trying to learn. A bit like putting the cart before the horse, the majority of people attempt to learn material without first understanding how learning works. By reading *Making it Stick: The Science of Successful Learning*, I was able to increase my knowledge on the science behind learning. In addition to reading about a number of methods in text, I was able to put them to test in my own tutoring environment.

By implementing these new learning strategies into my teaching sessions, I was able to widen my perspective on what makes a good learner and what we can do to increase learning within ourselves. It has impacted me beyond measure, and I hope that I was able to impact some of my students as well.

At the end of the day, I think it is everybody's dream to learn. It can take many different forms, some want to learn subjects in academia, some want to learn to master a sport or an instrument, some wish to learn all they can about social interactions to maximize their enjoyment of them. Regardless of why we do it, we want to do it the best. And never before have I felt like I had to tools to actually better the way I went about learning. I think it is fitting that I end with a famous proverb that encapsulates the importance of the subject, "Learn as if you want to live forever."

Bibliography

Brown, Roediger, McDaniel. (2014). *Make it Stick: The Science of Successful Learning.* Massachusetts: The Belknap Press of Harvard University Press