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Games and Learning

Modern pedagogy is progressively adding games to curriculums to rouse student motivation for learning. The thought process behind adding games to curriculum is that by doing so, it will lead to an increase in student engagement and rising test scores. There seems to be no absence of research when it comes to the subject of games and learning. There is an abundance of psychological studies that have sought to demonstrate correlation between games and cognition by conducting experiments on people of all ages. Remarkably, the findings of this research are often inconsistent. For example, one research experiment cited in this essay observed a correlation between games and an increase in student test scores, while another research study did not observe the same findings. Notably, even though the research around games and learning often seek to prove the same causation, methods and test subjects differ, and therefore, the findings of these research experiments are not always in congruence with each other. The goal of this research paper will be to answer the question: how can games help to increase cognition and lead to better learning outcomes? To answer the question, we must first understand how the brain functions as it pertains to the way we learn, store, and recall memories. Equally important is the need to understand what areas of the brain are involved with these internal processes, as well as the types of motivation responsible for directing behavior towards our goals.

To begin, there are three types of encoding people use to get information into their brain: semantic, acoustic, and visual. Semantic encoding is the type of process our brain uses to associate words and their meaning. When compared to visual and acoustic encoding, semantic encoding contributes towards a deeper level of understanding. According to Rose Spielman licensed clinical psychologist and educator, “we tend to process verbal information best through semantic encoding, especially if we apply what is called the self-reference effect” (Spielman, et al. 8.1 How Memory Functions). The self-reference effect means that we are more inclined to remember something if it has personal meaning to us, rather than something that we view as insignificant to us. In theory, simulation games should take advantage of our natural process of semantic encoding. When describing simulation games, the Center for Educational Innovation (CEI) of University at Buffalo says, “experimentation and risk taking are encouraged by allowing learners to try out alternative courses of action and experience a range of different outcomes” (Simulations and Game-Based Learning). In short, the association of an action with an outcome in a simulation game makes it more meaningful to us, thereby taking advantage of semantic encoding and resulting in stronger memories. The other two processes we use to get information into our brain are visual and acoustic encoding.

Albeit not as strong in forming memories as semantic encoding, visual and acoustic encoding are still powerful ways to learn new subjects. Visual encoding is the process we use to get information into our brain using images. Traditionally, subjects such as human anatomy customarily involve rote memory, relying heavily on repetition to learn the subject matter; however, repetition alone is not the best way to commit things to long-term memory. On the other hand, a game such as “Pictionary” geared towards human anatomy can be a powerful study aid. Games such as Pictionary take advantage of visual encoding because players associate words

with images, thereby forming stronger memories. Conversely, acoustic encoding uses sounds to get information into our brain. Acoustic encoding explains why we can effortlessly remember the lyrics to our favorite songs, and elementary students memorize the alphabet acoustically by singing the ABC's. In summary, games and learning activities that combine two or more forms of encoding processes result in stronger memories than those created through one process of encoding alone. All signs conspicuously point to the fact that games can take advantage of the processes we use to get information into our brain. In addition, research indicates that games stimulate specific areas of our brain which are responsible for building, processing, and storing memories.

The cerebellum, prefrontal cortex, amygdala, and hippocampus are the four parts of our brain responsible for building, processing, and storing memories. The cerebellum controls our motor skills and contributes towards processing mechanical memories, such as playing musical instruments. The prefrontal cortex is the area of our brain which makes each of us unique from one another, it is also responsible for semantic encoding and retrieval of information. The amygdala, along with the hippocampus, performs a substantial role in the advancing and transference of new learnings to our long-term memory. According to Spielman, "the amygdala seems to facilitate encoding memories at a deeper level when the event is emotionally arousing" (Spielman, et al. 8.2 Parts of the Brain Involved with Memory). Stress and excitement are examples of emotions which excite the amygdala area of our brain, so theoretically, learning games which induce these emotions may result in added information being committed to our long-term memory. Coincidentally, decreased grey matter in the hippocampus is associated with risk of memory disorders and conditions such as Alzheimer's disease and dementia.

One of the first research studies to examine the effects video games have on older adults who are in the initial stages of cognitive decline due to their age, suggest that playing 3D video games increases grey matter in the hippocampus and cerebellum areas of the brain (West, et al.). In this study, researchers performed CT scans on the brains of people in late adulthood. The experiment effectively created two test groups and one control group. Researchers instructed participants from the first test group to play Super Mario 3D, while participants from the second test group took self-guided video game style music lessons. The control group did not deviate from their normal daily activities. After six months researchers performed another CT scan on the brains of all participants, and the results were truly astonishing! The Super Mario 3D group showed an increase in grey matter in both the hippocampus and cerebellum areas of the brain. The music group showed preservation of grey matter in the hippocampus and an increase of grey matter in the cerebellum. On the other hand, the control group showed no growth, or even worse, showed a decline in grey matter tissue in both the hippocampus and cerebellum. There is still much to learn about the impact of games on specific areas of the brain associated with memory, but this research study provides definitive evidence which supports the theory that video games can help to increase cognition. Motivation is also critically important in the learning process because it helps drive us towards our goals.

There are two types of motivation which drive us towards our goals, intrinsic and extrinsic. Intrinsic motivation is the type that comes from within. For example, one might enjoy working on vehicles, so they take an automotive class to learn how to fix them. If one takes a class for no reason other than the fact that they like the subject, then their motivation is intrinsic. On the other hand, extrinsic motivation comes from the outside. For example, one might not like math, but they study it anyways so that they can get a passing grade. If fear of getting a bad

grade is what motivates them to study, then their motivation is extrinsic. Often our motivation for learning in classroom environments is a mixture of both intrinsic and extrinsic factors. According to Spielman, “in educational settings, students are more likely to experience intrinsic motivation to learn when they feel a sense of belonging and respect in the classroom” (Spielman et al. 10.1 Motivation). On the other hand, when students feel overwhelmed with exams, or lectures are one-sided, then intrinsic motivation for learning will diminish. Psychological research supports the theory that games can increase intrinsic motivation in students at all levels of academia.

In one study, researchers examined the potential impact games might have on the motivation and learning outcomes of children attending elementary schools in Macedonia. Over one hundred students from five different elementary schools took part in the study. Six traditional games such as “hopscotch” were computerized and geared towards learning outcomes in subjects such as art, math, and social sciences. In the end, the findings of this research study “show that student achievements were directly influenced by their intrinsic and extrinsic motivational factors, as well as perceived experience” (Trajkovik, et al.). This research presents irrefutable evidence that games can increase motivation in learning elementary school subjects. However, not all research supports the theory that games can increase learning outcomes.

In another study, researchers examined the potential impact games might have on the test scores of first year medical students while learning vascular anatomy. Researchers gave test subjects a video game study aid called “Vascular Invaders” and asked them to use it as a supplement in addition to their normal study aid. The control group of medical students did not receive the video game study aid. Unfortunately, researchers did not observe any difference in test scores between the test and control groups at the end of the experiment. Researchers

hypothesized that the reason an increase in test scores were not observed between the test and control groups, might be because medical students are characteristically high performers who use many different study methods to ensure their success. However, the findings did suggest that the Vascular Invaders game-study aid "encouraged more specific, desired actions from students, allowing for greater predictability and assessment of learning outcomes in comparison to non-game study aids" (Gauthier et al.). It makes sense that digital learning games can lead to greater predictability of learning outcomes because programs can record game data as students interact with the game, and then generate reports containing the results. Traditional paper and book study aids do not provide professors with the necessary data to assess student progress, which explains the prevalence of exams in academia to measure learning outcomes.

In conclusion, games which connect sounds and images to meaningful outcomes take advantage of our brain's natural learning mechanisms: semantic, visual, and acoustic encoding. These encoding mechanisms are what we use to get information into our brain. Furthermore, research has observed a direct correlation between video games such as Super Mario 3D, and an increase in grey matter in areas of the brain such as the hippocampus, which are responsible for transferring new learning to long-term memory. Moreover, research studies have observed a correlation with learning games and an increase in both intrinsic and extrinsic motivation, which are responsible for driving us towards our goals. While not all games have proven to increase test scores, especially amongst highly driven pre-med students, scientific research continually proves the efficacy of games and their ability to increase cognition and "lead" to better learning outcomes.

Works Cited

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