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The Brains Behind Brain-Based Research: The Tale of Two Postsecondary Online Learners

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Abstract

This paper is written from the perspective of two postsecondary students who realized the implications for brain-based learning in the online environment. This paper explores the relationship between online learning in regards to how the brain generates meaning and understanding, the role of emotions, the collaborative construction of knowledge, and aspects of neuroplasticity. Throughout the paper, we have made a variety of connections in regards to our experiences with online learning. Finally a brief critique ensues pertaining to the theory of brain-based learning.

Introduction

The 1990's were heralded as "the decade of the brain" (Bush, 1990; Roberts, 2002; Sousa, 2001 as cited in Kaufman et al., 2008) and served as an impetus for investigating the intricacies of how the brain learns optimally (Caine & Caine, 1991). Originating from neurological research, the development of brain-based learning was highly regarded as "the new paradigm of teaching" (Jensen, 2008). The new paradigm recognizes the brain's rules for meaningful learning and redirects teaching according to those rules (Caine & Caine, 1991). In essence, brain-based learning advocates for teaching in ways that are compatible with that we know about the human brain.

Caine and Caine (1990) established twelve key principles of brain-based learning. As postsecondary students, we have chosen to focus on four that relate to our online learning experiences: meaning and understanding; emotions in online learning; collaborative knowledge construction; and lifelong learning and neuroplasticity (Hart, n.d.). Furthermore, we have also included a critique which explores some of the concerns pertaining to brain-based learning.

As postsecondary students in the twenty-first century, many of our learning experiences take place online. Our expectations for our current learning environment differ significantly from how we perceived our learning environments in the past. We seek meaningful learning experiences that challenge us and harness our capacity to learn (Lieb, 1991). Ultimately, we desire learning environments that reinforce our experiences and extend our knowledge base (Lieb, 1991). Therefore, we used the precepts of brain-based learning theory and the concept of neuroplasticity to substantiate our online learning experiences.

Meaning & Understanding in Online Learning

According to Geoffrey Caine, "every human being is driven to search for meaning" (D'Arcangelo, 1998, p. 23) and this is an innate human quality (Caine & Caine, 1990). The brain searches for meaning by registering the familiar while simultaneously responding to novel stimuli (Caine & Caine, 1990). It is an instinctual response derived from our survival-oriented brain that cannot be stopped; but may be focused (Caine & Caine, 1990).

Our brain is actively creating meaning (Hill, 2001) and seeking meaning (Jensen, 2008). The conscious act of "making meaning" for a post secondary learner, involves connecting experiences of both the past and present (Hill, 2001) in a learning environment. There is a considerable difference between meaning

generated from rote memorization and meaning generated from an authentic learning experience (Cercone, 2006). Furthermore, the ways in which meaning is created and interpreted is unique to each learner, what is meaningful to one individual may be of no interest to another (Cercone, 2006). Formulating these connections in an authentic environment, allows the learning to become personalized, furthering comprehension and understanding (Hill, 2001).

In addition to making connections in an authentic learning environment, meaning also becomes relevant when "information is contextually embedded" (Hill, 2001, p. 79). The brain is not quick at learning isolated pieces of information; however, it is quick to learn in real life settings (Hill, 2001). The "real life" that we are referring to, is the collaborative learning that we engage in with our colleagues online. These cooperative environments stimulate discussion and complex problem solving among peers, encouraging one another's learning online. As educators, these types of skills are useful for they are transferable to the workforce and enriching for workplace preparation.

When postsecondary students are engaged in making meaning, they are also intrinsically motivated to learn. Intrinsic motivation is "an internal energy called forth by circumstances that connect with what is culturally significant to the person" (Place, n.d.). Therefore, as stated by Geoffrey Caine, postsecondary learners become deeply engaged in their learning environment when it reflects their purposes, values, and interests (D'Arcangelo, 1998). Our experiences in the online learning environment revealed that we were only motivated to enrol in online courses that were relevant to us. For instance, we have both taken additional qualification courses to further our knowledge base in a particular subject area, based on the course content's relevance to each of us. Similarly, we are currently enrolled in a Masters of Education program because its technological focus reflected our current interests. This sense of interest directly reflects our internal motivation, as opposed to the lack of motivation we felt behind the necessity of our undergraduate degrees.

Emotions & Online Learning

Our emotions play a critical role in the creation of meaning. "What we learn is influenced and organized by emotions and mindsets involving expectancy, personal biases and prejudices, self-esteem, and the need for social interaction" (Caine & Caine, 1990, p. 67). Hence, our emotions and cognition are inseparable (Ornstein & Sobel, 1987; Lakoff, 1987; McGuinness & Pribram 1980; and Halgren et al., 1983 as cited in Caine & Caine, 1990), we cannot examine one facet without considering the other.

In the center of the brain lies our limbic system, historically referred to as the "emotional brain" (OECD, 2007). This region, along with the prefrontal cortex regulates our feelings and emotions (OECD, 2007). However, brain-based research has revealed that our limbic system is also linked with learning and memory (Hill, 2001). "Humans react and learn through the lens of emotionally laden experiences" (Shuck, Albornoz, & Winberg, n.d.) and our emotions "facilitate the storage and recall of information" (Rosenfield, 1988). Moreover, in relation to neuroplasticity, our emotions contribute to the development of stronger neuronal networks (Zull, 2003). Our brain is learning when "emotional chemicals" such as adrenaline, serotonin, and dopamine modify synapses (Zull, 2003). Therefore, neuronal change is "most extensive and powerful when emotion is part of the learning" (Zull, 2003).

According to Robert Sylwester, "our emotional system drives our attentional system, which drives learning and memory and everything else that we do. It is biologically impossible to learn and remember anything that we don't pay attention to" (as reported in D'Arcangelo, 1998, p. 25). Essentially, the arousal of emotions can either impede or motivate learning (Shuck et al., n.d.). Negative emotions inhibit the powers of reasoning and logic (Clemons, 2005) leading to a sense of student disengagement and reducing the students' abilities to learn at optimal levels (Hart, 1983 as cited in Kaufman et al., 2008). In our experience, online learning environments with many participants, intimidated us provoking feelings of anxiousness. We refrained from expressing ourselves fully with the class, we became disengaged rather than focused. We also found that online learning environments that failed to create a stimulating learning environment hindered the overall efficacy of our learning.

Conversely, invoking positive emotions promotes the acquisition of knowledge (Dirkx, 2001) and promotes a state of "relaxed alertness" (Caine, Caine, McClintic, & Klimek, 2005). Students in this emotional state

are more attentive and receptive to learning new information (Caine et al., 2005 as cited in Cave et al., 2005). Our experience as postsecondary students has been that learning environments that are more intimate are also more inclusive, fostering feelings of self-confidence and motivation. We also observed that the in-class chat forums increased "relaxed alertness" in our group and encouraged more participation.

The role of motivation can be described as the resultant force of emotional components and is important during the construction of meaning because it is linked to our emotions (OECD, 2007). The brain is capable of distinguishing whether or not something should be acted upon, resulting in emotional systems which create motivation. When effective learning is taking place, learners are energized and demonstrate full involvement however, the challenge becomes how to maintain purposeful learning and motivation (OECD, 2007).

Consequently, "our thinking and feelings are connected because our patterning is emotional" (D'Arcangelo, 1998, p. 24). According to Jensen (2000) there is an interrelationship between how we create meaning, our emotional response, and the contextual framework that it is rooted in. The production of meaning then is comprised of three factors: connection with existing neural sites; emotions that trigger the brain's chemistry; and the context that triggers pattern making (Jensen, 2000). If the perceived information is personal, emotional, and sensible, the information is deemed meaningful. As postsecondary students, we not only crave learning experiences that enhance our intellectual capacity, but also strive to create felt meaning and a personal relationship with the subject matter.

The Collaborative Brain & Online learning

Another aspect of brain-based learning that is applicable to adult learning in the online setting is the use of collaboration. In fact, the following statement makes a very bold argument in this regard; "If brain-based pedagogy could be summed up in one sentence, it would be; Knowledge should be socially created" (Cave et al., 2005, p. 3). While we believe that there is no singular lesson to be learned from brain-based research, it is imperative to explore collaboration, particularly in comparison to our personal experiences. Much of postsecondary online learning is based on group work. The instructor presents a concept, either new or an extension of what was previously known and then the students are asked to work with questions related to the material. In both of our experiences with online environments, we are often required to work with others to complete these tasks. For some, this may be uncomfortable, as several individuals may prefer to work on their own however, as will be explained in the area concerning neuroplasticity and learning, a certain level of discomfort is actually beneficial. Regardless of a learner's preference for individual or group work, there are a multitude of benefits that arise from this, the first being the creation of synergy (Cave et al, 2005). In our experiences we have noticed that innovative ideas are often generated in a group scenario. Had we been asked to tackle the question individually, this shared creation of meaning may not have occurred, as being a member of a cooperative team fosters higher levels of thought compared to working independently (Parker & Chao, 2007).

Another principle advocated by brain-based learning is that feedback is beneficial, especially when it is coming from a peer and not solely an authority figure (Suron, 2008). We receive constructive comments from our instructors on an ongoing basis, both as formative and summative assessment and also in chat feeds and synchronous online classrooms. However, it is also beneficial when it comes from a classmate because we know that they are struggling to make sense of the material in much of the same ways that we are. They can offer us insights to help us shape our thoughts towards a more informed final product. They also provide us with motivation to continue improving our work. This is perhaps more applicable to post-secondary online learning because students are mature enough to understand the importance of utilizing peer feedback for both academic benefit and overall knowledge acquisition.

Group work is also advantageous in the online learning environment because of the concept that learners solidify their own knowledge through the teaching of others (Dewar, 1999). In online courses, there is often the opportunity to teach our classmates about a particular theory or topic. This knowledge is usually coupled with some kind of presentation. We are not only learning the material, making meaning of it ourselves, and deciding how to represent it visually, we also need to teach these concepts to others. Teaching is generally indicative of greater understanding, especially when we are aware that our classmates can question our research and opinions.

Neuroplasticity & Lifelong Learning

As post-secondary students, lifelong learning is a notion that we can certainly appreciate the value of. Luckily for adult learners such as ourselves, we are not just continuing our education, we are also keeping our brains active and forming new pathways within our brain when we seek out new learning experiences. We contrast the old adage, 'You can't teach an old dog new tricks' (OECD, 2007, p. 50) to the new, 'Use it or lose it' phenomenon (Willis, 2007, p. 301). Before the discoveries that form the basis of neuroplasticity, it was believed that after the age of six the brain simply stopped growing. However, after childhood, neurogenesis can occur (Doidge, 2007), as does the reorganization of brain pathways, as long as one continues to open themselves up to new experiences and learn throughout their lifetime (Bransford, Brown & Cocking, 2000).

There are many ways that the lifelong learning principle associated with neuroplasticity, can help the adult learner; as Aristotle said, "Learning is the best prevention for old age" (OECD, 2007, p. 49). He was clearly ahead of his time as we now have the science to prove that the brain creates new pathways to overcompensate for brain capacities that begin to diminish at the age of twenty (OECD, 2007). Continued learning is also a necessity in our society, as technology can make information about particular subjects obsolete within a decade. For example, our understanding of the capabilities of a cell phone was much different ten years ago than it is today. Thus, to stay competitive in the workforce, one must continue to obtain knowledge. This pursuit of new knowledge experiences stimulates the addition of new synapses and prunes away unused pathways, thus, causing the brain to reorganize itself in a more efficient manner (Paton, 2010). One of the benefits to this includes a higher working memory capacity, as well as a stoppage in the decline of processing speed. In direct relation to us as students in the online environment, increased memory function is an advantage of neuroplasticity. When information is repeatedly activated, the neuronal circuits become highly developed and it becomes stored in long term memory (Willis, 2007). Therefore, we have an easier time training our brains to store newly acquired knowledge. In online education this is increasingly easy because we have access to knowledge at the push of a button. We have found that transferring much of our new knowledge to long term memory has been relatively easy, as we pursue a variety of sources on a subject and then personally work with the material to create meaning.

Another direct connection that we were able to make to online learning and neuroplasticity is the idea that, "neurons that fire together, wire together" (Doidge, 2007, p. 63). The more ways in which new material is introduced, the more synaptic cell-to-cell bridges emerge. This makes them stronger and resistant to pruning (Willis, 2007). Therefore, if information can be introduced both visually in the occipital lobes and orally through the temporal lobes, there is a greater chance that the information will stick, as the more regions that store this information, the more connections are made. This is great news for post-secondary students in the synchronous, online learning environment, as we are often introduced to information using both sight and sound. For example, we may view a power point which features a graphic organizer that the instructor then verbally explains. There is also exposure to online media which inherently includes both sensory experiences. The element of surprise, such as beginning class with a song or costume, also results in neuron arousal (Willis, 2007). Such surprises are attainable in a synchronous environment.

Unexpected actions place the learner in a somewhat uncomfortable position because their senses have been overstimulated in an unusual manner. This idea of stimulation leads into the final connection between neuroplasticity and the adult online learning environment. For optimal plasticity, it is recommended that the learner be placed in Vygotsky's zone of proximal development, that is, the task be challenging but not overwhelming. For learning to occur, some degree of arousal is recommended (Dewar, 1999) and challenging material can be enough to jump start this stimulation. Having to pay careful attention to the information encourages the production of the chemicals acetylcholine and dopamine, both of which benefit the control system for plasticity (Doidge, 2007). When an experience fails to continue being cognitively challenging; for example you master the instrument you were learning to play, the neurotransmitters that were firing from this activity are turned off. The brain stops forming neurons and the creation of new pathways is halted (Doidge, 2007). This is where those who design online courses need to ensure that the abilities and knowledge that their students are asked to master continue to change. For example, in some online courses we are asked to create a Wiki, in another, use online mind maps, both technological skills that neither of us were familiar with previous to this degree. The online environment has the ability to push students to learn new information and technological skills that they are not completely comfortable with.

This combination presents endless possibilities for neuroplasticity.

Critique

Although the ideas of brain-based learning and neuroplasticity can be advantageous to the adult learner in an online learning environment, these theories are not without issue. We will provide a brief general critique. The common mistake that educators make with research surrounding the brain is that they jump straight from the biological findings to application within the classroom (Willinghelm, 2007). Unfortunately, they are missing critical levels of analysis. Before we can understand how to effectively integrate brain research in the classroom, we have to truly understand why they are occurring and what effect they have on the mind (Willinghelm, 2007). There is much literature for brain-based learning that is created prematurely without really having any substantiated basis (Willingham, 2010). There is no denying that these are exciting discoveries and it would be ill advised to not include any of the findings of neuroscience in our educational practices, however, they cannot be the foundation of our teaching (Jensen, 2000,). It is best to understand that this research can help to guide certain strategies and provide possibilities, while still being realistic about the fact that there are still connections to be made between the science and the behaviour (Jensen, 2000).

Another issue that we see with applying the principles of brain-based learning to the adult online environment is its sensory restrictions. We can simultaneously receive information in an auditory and visual manner but even further connection can be made by stimulating other senses (Willis, 2007). Unfortunately we cannot yet tap into smell, touch or physical manipulation in the online environment. The future of technology holds a lot of promise, but we are currently limited in our possible experiences.

Related to this, is the brain-based concept that learning involves the whole body. Sitting in our office chairs and interacting mainly with our computers, is not stimulating our physical bodies at the time of knowledge acquisition. However, we can offset this to some degree by maintaining a healthy and active body outside of our online learning environment. This is not a new neuroscientific discovery, as the quote, “A healthy mind in a healthy body” (Doidge, 2007, p.255) has been around since Roman times. However, we now possess more scientific proof that both learning and neuroplasticity are aided by overall wellbeing. Ending on this more positive note, it is evident that while there are still some negative aspects of the online learning environment in regards to brain-based learning, there are external factors that can alleviate their effects.

Conclusion

Since the 1990’s, the ideas put forth by neuroscience and brain-based research have yielded an array of novel teaching strategies in relation to education. We see these strategies in both traditional educational settings and in the online learning environment. From our perspectives, as post-secondary online learners, we have found that brain-based research informed many of our experiences, as highlighted throughout this paper. However, we must be wary of this new theoretical approach because compared to other educational concepts; it is still in its infancy. Our capacity to understand the malleable mind now brings infinite opportunities for learning. Coupled with the rapidly growing possibilities of technology, there is no telling the limitations of this science in regards to post-secondary teaching and learning.

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