Attention and Memory: Classroom Considerations Regarding Cognitive Processes Involved in Transfer and Retrieval

Steve JUGOVIC[1)]

Abstract

During the past fifteen years or so we have witnessed the emergence of increasing knowledge about the mind and brain to better inform teaching and subsequently learning. Teachers wield significant influence in the students' learning process and even slightly modify their brains on a daily basis. Various difficulties confront the modern-day teacher such as motivation and more specifically the challenge of sustaining student's attention. It is often falsely assume that students are merely *empty vessels* ready to be filled with knowledge, a simplified view far from reality. With greater understanding of the learning process from the students' perspective, teachers may be better equipped to provide more effective learning experiences and to primarily ascertain whether knowledge has been stored in long-term memory. Students have strengths and weaknesses, variable executive functioning and coping mechanisms for managing emotions and dealing with stress. The human brain is constantly shaped by environmental interaction, experienced through the senses. This is the essence of learning and is based on the crucial connected factors of attention and the process of memory, so if they are not adequately functioning, learning will be compromised. Deeper understanding of cognitive processes and more effective teaching approaches should be an aim towards better enabling attention, facilitating memory storage through transfer and retrieving the information for use in different contexts.

Key words：Attention, Memory, Brain, Learning, Teaching

1．Learning and the Brain

Learning involves important variables, and as teachers we may not be aware of, or realize how they are changeable with the individuality of our students. According to Rodriguez (2014, p.51) learning is a dynamic, interactive context-dependent process, based specifically on the aspects of individual biology, nutrition, learning environment, the abundance of learning tools and teachers. In addition, learner's interaction with external influences- friends, family, culture and society further interact to shape the learning brain. Essentially, Rodriguez (2014, p.51) highlights four crucial learning concepts in that learning is; dynamic; both cognitive and emotional; context dependent and interactive with a variety of factors in the learner's environment.

1）スポーツ学部

Various other critical factors affect learning such as feelings, health condition, adequate sleep, nutritious food and emotions. Emotion plays a significant role not only in motivation for learning but also to better enable students' problem solving and decision making, by retrieving relevant information and memories connected to the learning situation (Immordano-Yang, 2016, p.86).

In light of these factors, the role of attention is critical for the learning brain

2．Attention

For various reasons, we often encounter difficulties maintaining student's attention and recognize the variability in the student's recall of classroom content soon after teaching. We can easily initiate attention, such as with flashy images or a loud voice, but these sensory based approaches are merely a method to temporarily gather attention, rather than being the means to sustaining it, such as with content related to students lives or disseminating information in brain-friendly manageable chunks.

Attention spans range from about 10-20 minutes depending on age and ability to focus. We train ourselves to sit and get information but we are also influenced by peripheral perceptions regarding what is taking place around us. By true nature, humans have many competing factors for attention such as threats, a phone beep from an impending message or biological attraction for mating by the individual passing bye. From a biological perspective, the brain pays attention to these questions "Can I eat it?, "Will it eat me?, "Can I mate with it", "Will it mate with me?" and "Have I seen it before?" (Medina, 2008 p.81). This hardwiring is why students are often consumed by seemingly competing distractions, continuously being gathered from our senses in relation to other attention factors. Different neural networks are used for a range of attention factors that include; managing attention; paying attention in social settings, self-regulation of attention, attention and performance, relationship of emotion and attention, and most importantly, the way attention and memory are linked (Tokuhama-Espinosa, 2011, p.164) According to Levine (2002) cited in Tokuhama-Espinosa (2014. p.122-125) memory and attention are at the core of the eight neurodevelopmental constructs in the brain. Further to this, Levine categorizes the role of attention into three control structures; -mental energy control- relating to alertness levels, sleep and wakefulness; processing control- what is important- referring to saliency, and production control- self-monitoring. Greater understanding of these can better enable teachers to plan suitable activities with clear objectives and themes.

According to a leading attention researcher Posner (2007), cited in Tokuhama-Espinosa, (2014. p.124) three attention systems crucial for learning include;

(1)alerting system- forces us to pay attention to something which may be a threat, danger or be on the lookout for reward;

(2)orienting system- placing yourself in time or space in relation others or a specific stimulus;

(3)Executive-function attention network- associated with working memory and encoding, whereby the brain focuses on what is important. This third network is what teachers commonly consider learning. An example could be integrating active learning, whereby students must pay attention if

they are the center of attention. Furthermore, Immordano-Yang (2016, p.88) claims that individual differences in these networks relate to genetic and environmental factors. Planning lessons in accordance with attention systems is important but also depends on memory systems for learning to occur.

3. Memory

Memory is a dynamic process, shifting and changing through experience every time we use it but is often falsely regarded similar to a computer. Both teachers and students are often unaware of the various interrelated factors that play a role in supporting memory networks and function, which include; sleep- the key to memory consolidation; exercise- such as aerobic and strength training; nutrition- improved concentration and neurotransmitter release; fitness level- better fitness levels correlate to greater academic success; plasticity- the brains ability to change throughout life and regarded as the essence of learning; and movement- improved oxygenation and hence better attention spans and retention.

Although many of these factors cannot be controlled by the teacher, understanding them may lead to greater awareness for possible transmission of information (using CLIL- Content and Language Integrated Learning) to students for present and future lifelong learning support. In order to do so, one of the most important factors to consider is when information is presented and the corresponding result is whether the information moves from temporary storage (working memory) to long-term memory (consolidation) or it is lost.

A typical method of better enabling memory consolidation is varying the activities so they more easily connect to different sensory pathways in the brain (Tokuhama-Espinosa, 2011, p.221; Zadina, 2014). According to working memory and learning researcher Baddely (2002) cited in Tokuhama-Espinosa, (2011, p.160) working memory training can enhance learning. Being able to hold information in working memory long enough to perform a task is an indication of good working memory, a necessity for learning. Furthermore, important criteria for memory storage or information loss are connected to the essence of these two questions; Does this make *sense?* - regarding logic and understanding of past experiences, and Does this have *meaning?* - in terms of relevance to the learner (Sousa, 2011, p.52; Tokuhama-Espinosa, 2011, p.163).

Essentially, the majority of memory research relates to humans remembering things that (1) have survival value, (2) can connect with past experiences and (3) have emotional significance. Number two is most closely related to what teachers refer to as learning. A useful example for better supporting memory in learning is the positive influence of spacing the learning moments apart, rather then massing them together

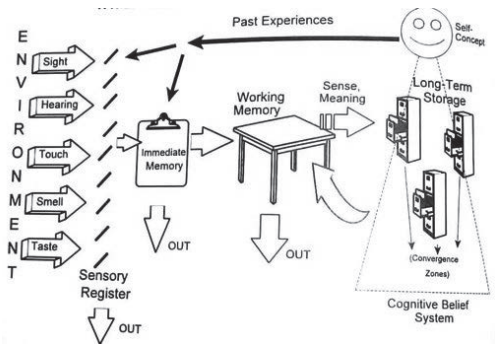

Figure 1.
Information Processing Model. Sousa, (2011)

(Tokuhama-Espinosa, 2014, p.129). This often requires rehearsal to enable transfer to long-term memory so that information can eventually be retrieved and connected to prior knowledge, refer to Figure 1.

4．Rehearsal

Rehearsal is used to enhance retention and the methods used are subject to the topics and content at hand. Methods of rehearsal can be categorized into *rote* and the more complex *elaborative* and support the learners attempt to reprocess new information for establishing sense of meaning (Sousa 2011, p.126). Rote methods include simple repetition and cumulative repetition, while elaborate rehearsal strategies include; paraphrasing; selecting and note taking; questioning; summarizing; and predicting (Sousa, 2011, p.127). In particular, predicting is a very powerful tool that is often underutilized and supports the connection of prior learning to new knowledge and requires a greater use of neural networks. Rehearsal activities and strategies need to be carefully selected for the purpose at hand, in order to better enable the all-important transfer. It is not enough to consider the process of memory in isolation, but rather to have the aim and ability to use the information stored, for different contexts. This is established by the ability to transfer.

5．Transfer

Teachers are often under pressure to cover the allocated content within a specific time period of a course and as such, unwittingly neglect revisiting the content, often until the exam. For successful learning to take place teachers need to consider not only identifying clear objectives or competencies, but also when and how to integrate their reinforcement during the course in order to strengthen neural pathways for future retrieval (Tokuhama-Espinosa, 2014, p.130). This powerful principle of learning is transfer, essentially the essence of teaching. According to Sousa (2011, p.143) transfer is the ability to learn in one situation and then apply that learning to other situations and is central to problem solving, creative thinking and other higher mental processes. This includes *transfer* during learning- influence of previous learning on new learning, and *transfer* of learning- application of new learning to future situations. They key point of transfer is that "the more connections a student can make between past and new learning, the more likely they are to determine sense and meaning and therefore retain new learning" (Sousa, 2011,p.147). An example of this could be the new approaches implemented in Finland, where the introduction of themes and topics are being taught holistically. Students are then better able see the relevance of math directly connecting with science in a thematic unit, rather than *seemingly unrelated* subjects being taught in isolation.

Additional Factors that affect transfer include; (1) *The context and degree of original learning* in relation to quality, (2) similarity of the situation that can be transferred to other environments, (3) *critical attributes* of a concept being identified, (4) *association* of two events, actions or feelings learned simultaneously (Sousa 2011, p.150-3). Transfer is also characterized by the successful use of technology and positive emotions for humor, stories, real-world examples and a general concern of the students' success (Sousa 2011, p.154). Transfer of information to long-term

memory is one important factor but rekindling neural networks to enable retrieval is key.

6. Retrieval

According to Sousa (2011, p.114) *recognition* and *recall* are the two main methods that are used to retrieve information from long-term storage, whereby recognition more likely occurs with multiple choice questions, while recall involves the more complex process of retrieval from long term memory back to working memory. Further to this, when information is retrieved from long-term storage back to working memory it is reprocessed, and as such relearned but vulnerable to modification by pre-existing information in working memory. This reconsolidation may be susceptible to adding to and strengthening the original memory or significantly modifying it (Sousa, 2011, p.114).

One of the most prevalent university teaching methods is the convenient (for the teacher) and passive reception "lecture style" approach, yet this is the least effective for memory retention amongst the variety of approaches available. Amongst other approaches, facilitating student discussions, presentations and peer-teaching opportunities are more effective due to the complexity of cognitive processing required which may also enable a greater likelihood of retrieval.

Various approaches can be included to support retrieval such as; the silent or out loud repetition of concepts or ideas; activities that allow for spaced retrieval of information; rehearsal variation such as repeating- writing- making a mind map-teaching someone; providing numerous ways to input information- talk, read, rewrite, summarize, watch videos, all of which use slightly different neural pathways (Tokuhama-Espinos, 2014, pp.134-5).

7. Conclusion

If a student posed the question, "What is the most effective and efficient way for me to study and remember" what should our response be? Rather than merely responding "study", the method, approach and timing are critical for effective transfer from working memory to long-term storage and subsequent use upon retrieval. From the outset, planning for attention and memory more strongly ensures learning for the majority of students. Having greater understanding of the underlying cognitive functions of the brain in conjunction with planning our lessons with timely activities can support our students' transfer and retrieval to support their overall learning, transferable to other life-related contexts.

The following is a brief combination of factors to support students and considerations for teachers based on recommendations by authors Sousa (2011), Tokuhama-Espinosa (2011, 2014).

Student, Teacher and Teaching Considerations

Undertaking many short study sessions throughout the day (ideally in different locations) is more effective than cramming in one long period and should ideally be followed up with sleep; reviewing the material the same day and then some following days leading up to a test makes a stronger memory link; using different senses- reading, listening, watching a video and drawing the information; teaching someone the informa-

tion involves recruiting various brain regions and makes connections in the brain stronger; rehearse to enhance retention- paraphrasing, summarizing, verbalize to peers or teachers; follow the important considerations regarding sleep, exercise, movement for oxygenation, nutrition, minimize stress; avoid multitasking- task switching and consider the power of emotion in learning.

Teaching Considerations

Primacy Recency effect- is the timely block scheduling of lessons which considers that student learn best at the beginning and end of a lesson; revisit information and build upon former content; use tests as recall reviews- accessing long-term memory (unlike multiple choice); "practice makes permanent"- relevance, content amount, time, and frequency from long-term storage back to working memory enables relearning; explicitly call attention to particular points in the lesson; facilitate active learning- no choice for the student as the center of attention; schedule specific reviews throughout the course to reinforce memory networks- failure to do so weakens memory pathways, *"use it or lose it" principle*; a positive climate increases retention and recall- happy students learn better and finally- *repeat to remember and remember to repeat.*

References

Immordano-Yang, M.H. (2016). *Emotions, Learning, and the Brain: Exploring the Educational Implications of affective Neuroscience.* New York. W.W. Norton & Company.

Medina,J.B. (2008). *Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School.* Seattle: Pear Press.

Rodriguez, V. (2014). *The Teaching Brain: An Evolutionary Trait at the Heart of Education.* New York. The New Press.

Sousa, D.A. (2011). *How the Brain Learns.* Fourth Edition. California. Corwin Sage Ltd.

Tokuhama-Espinosa, T. (2011). *Mind, Brain, and Education Science: A Comprehensive Guide to the New Brain-based Teaching.* New York. W.W. Norton & Company.

Tokuhama-Espinosa, T. (2014). Making Classrooms Better: 50 Practical Applications of Mind, Brain and Education Science. New York. W.W. Norton & Company.

Zadina, J. N. (2014). *Multiple Pathways to the Student Brain: Energizing and Enhancing Instruction.* San Francisco. Jossey-Bass.