3D Learning

Please see video for more in-depth explanations: https://youtu.be/NUbf5hi1sP4

To cite this:

Pastore, R. (2019). 3D Learning. Retrieved from http:// http://raypastore.com/wordpress/2019/03/3d-learning/

1.0 What is 3D Learning?

- Theory that expands on prior 2D cognitive theories (i.e. theories that focused on text and images) to explain how we process content to learn in the real world through all domains (psychomotor/affective/cognitive), from games, experience, virtual reality, hand on activities, etc.
- Its organic – living and changing
- Research has only begun to scratch the surface

2.0 Background Framework

Atkinson & Shiffrin (1968) – Memory Theory/Information Processing

- Memory has 3 parts – sensory, short term, and long term.
- Information is first delivered to sensory memory. In this stage the learner decides how to handle the information or its forgotten
- Short term/Working Memory – This is where information is processed.
- Long term memory – indefinite storage capacity. Information can be stored here and retrieved for later use in working memory.

Miller (1956) – Working memory capacity

- Learners can hold 7 concepts, plus or minus 2, in working memory at one time depending on how meaningful they are

Baddeley & Hitch (1974) and Baddeley (2000) – Model of Working Memory

- Working memory/short term memory has a short duration and is controlled by the central executive. It has 2 channels, one for visual/spatial information and one for verbal information

Paivio (1979) and Paivio (1986) – Dual Coding Theory

Working memory is composed of two channels – verbal and nonverbal (visual). Each channel can function independently or they can work together to use information or store it in long term memory.

Mayer (2001) and Mayer (2005) – Cognitive Theory of Multimedia Learning (CTML)

- Expands on Baddeley and Paivio's theories

- The CTML is based on three assumptions
    - *(1) working memory is made up of a dual modality (dual coding) input channel system,*
    - *(2) there is a limited capacity in working memory, and*
    - *(3) that learners engage in active processing.*

Moreno (2006) – Cognitive Affective Theory of Multimedia Learning

- The CATML is Based on the following assumptions:
    - independent information
    - processing channels
    - limited working memory capacity and virtually unlimited
    - capacity long-term memory
    - dual coding
    - active Processing
    - affective mediation
    - metacognitive mediation
    - individual differences

3.0 Problem:

- These are limited in scope – 2D – Only focused on verbal and visual channels in working memory
- We still have people trying to use learning styles and multiple intelligences even though research does not support them because they seem to make 'sense' to people
- How does any of this account for real hands on learning? Gaming? Virtual reality? Where we use other means of learning besides images and words (narration). Especially if there are more than two channels in working memory?
- Much of our learning combines all domains of learning. Psychomotor and affective tasks require cognitive resources (i.e. are using in working memory). The domains of learning are great for instructional strategy development but do not help explain what happens in working memory.

So I started digging…

- One of the first surprising pieces of information I found was from Baddeley (2012). This really sent me down the rabbit's hole. "…can other modalities such as smell and taste be added without impacting visual or verbal capacity? Are there separate subsystems for smell and taste?" (p. 23) (Baddeley 2012)

- Then I started finding things like this from Quak, et al (2015) who says that we tend to look at the way we process information in a stationary fashion, examining 1-2 channels at a time (i.e. text and images) whereas in real life we take on many at a time – hearing, smell, sight, taste, etc.

Then I started to look at the way we work, play games, use our senses…

- For example, when we play a video game we are using our ears, eyes, and hands. So I started looking at the biology of humans. Specifically focusing on the senses and found that biologists recognize many senses (20-30 or more) such as Visual, Auditory, Haptic/kinesthetic, Olfactory,

etc. I was surprised, but yes, we have many other senses. More than the standard 5 many of us learned in grade school. For example, hunger and thirst. Our body has a lot of senses.

And just like that, I realized we have researched some of these other modalities, though that research was rare and scattered. For instance, Jonsson et al (2011, p.1023) state that examining how the senses (i.e. olfactory system) operate in working memory has "received almost no attention in the literature". Here is a sample of what I found:

- Andrade and Donaldson (2007) conducted a series of experiments that found that there was a modality specific space in working memory for a learner's olfactory system. These results were then again confirmed by Jonsson, et. al (2011).
- Lerch, Cui, Patwardhan, & Visell (2016) conducted an experiment which found that haptic information can be stored in working memory and has its own channel. Seaborn, Riecke & Antle 2010 found similar results.
- So we have some initial evidence that these senses have their own place in working memory! Now this makes sense. The research is aligned to what we really experience. This explains what is happening in working memory when we learn from games, virtual reality, and in the real world! Now I am excited!

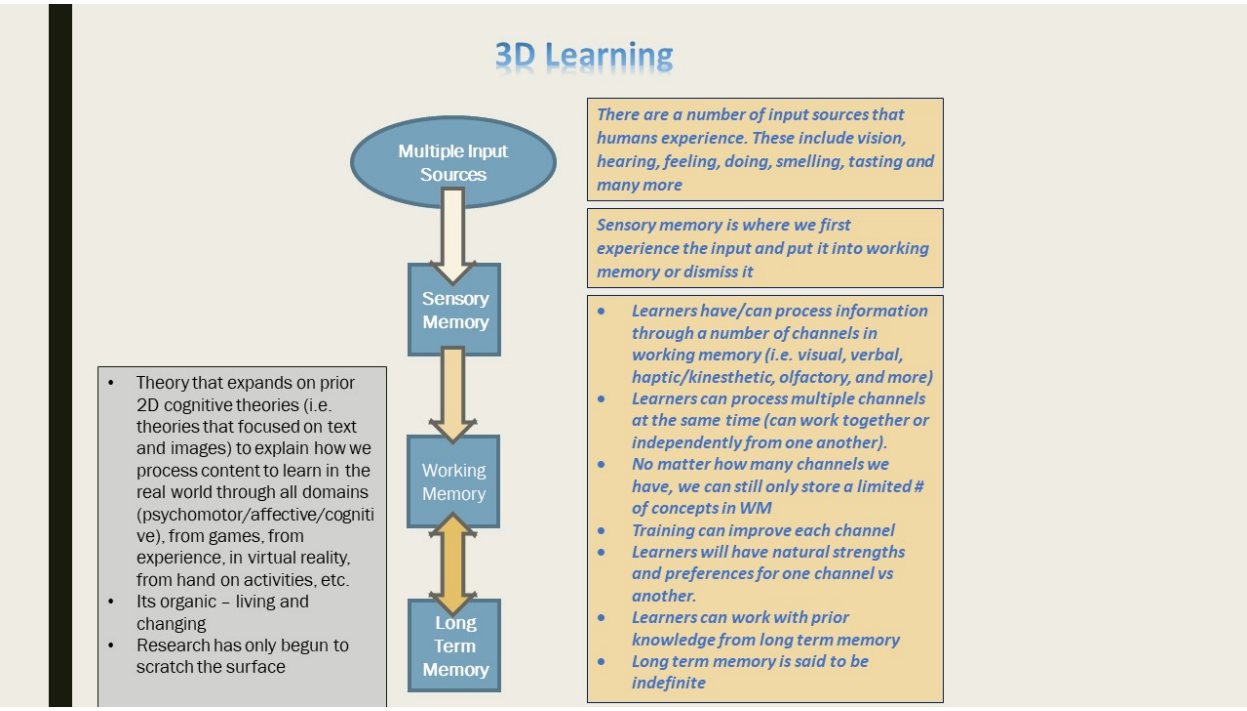
4.0 What I realized is that we have been focusing on a very small piece to a very large puzzle!

3D Learning

- 3D Learning is a theory that expands on prior 2D cognitive theories (i.e. theories that focused on text and images…dual coding) to explain how we process content to learn in the real world through all domains (psychomotor/affective/cognitive), from games, from experience, in virtual reality, from hand on activities, etc.
- Its organic – living and changing
- Research has only begun to scratch the surface
- The model:
    - Multiple Input sources
        - *Multiple input sources - There are a number of input sources that humans experience. These include vision, hearing, feeling, doing, smelling, tasting and many more*
    - Sensory Memory
        - *Sensory memory is where we first experience the input and put it into working memory or dismiss it*
    - Working Memory
        - *Learners have/can process information through a number of channels in working memory (i.e. visual, verbal, haptic/kinesthetic, olfactory, and more)*

- *Learners can process multiple channels at the same time (can work together or independently from one another).*
- *No matter how many channels we have, we can still only store a limited # of concepts in working memory*
- *Training can improve each channel.*
- *Learners will have natural strengths and preferences for one channel vs another.*
- *Learners can work with prior knowledge from long term memory*

- Long term Memory
  - *Long term memory is said to be indefinite*



5.0 What's next…

- We need to expand the multimedia principles…and probably should be calling them the principles of learning
- What are the other channels/how many?
  - *Olfactory, haptic/kinesthetic, taste, etc. How many do we have?*
- What combinations work best? How many is too many?
  - *For example, using our eyes, ears, and hands. Is that too many? How does that impact cognitive load?*

- This is especially crucial to the gaming literature as virtual reality starts to become more common for hands on training

6.0 Sources:

Andrade J. & Donaldson L. (2007). Evidence for an olfactory store in working memory? *Psychologia, 50,* 76-89.

Atkinson, R.C., and Shiffrin, R.M.(1968). Human memory: a proposed system and its control processes. *Psychol. Learn. Motiv.* 2, 89–195.doi:10.1016/s0079- 7421(08)60422-3

Baddeley, A.D., and Hitch, G.(1974).Working memory. *Psychol. learn. Motiv.* 8, 47–89. doi:10.1016/S0079-7421(08)60452-1

Baddeley, A. (2012). Working Memory: Theories, Models, and Controversies Annu. Rev. Psychol. 2012.63:1-29.

Baddeley, A. (2000). The episodic buffer: a new component of working memory? Trends in Cognitive Sciences, 4(11), 417-423.

Jonsson, F., Moller, P., & Olsson, M. (2011). Olfactory working memory: effects of verbalization. Memory and Cognition, 39, 1023-1032.

Lerch, R., Cui, H., Patwardhan, S., & Visell, Y. (2016). Exploring haptic working memory as a capacity-limited information channel. Presented at the IEEE Haptics Symposium Conference.

Mayer, R. E. (2001). *Multimedia learning*. New York: Cambridge University Press.

Mayer, R., E. (2005). *Introduction to multimedia learning*. In R. Mayer (Ed.), The cambridge handbook of multimedia (pp. 1-16). NY: Cambridge University Press.

Moreno, R. (2006). Does the modality principle hold for different media? A test of the method-affect-learning hypothesis. Journal of Computer Assisted Learning, 22, 149-158.

Paivio, A. (1986). Mental representations. New York: Oxford University Press.

Paivio, A. (1971).*Imagery and Verbal Processes*, Holt, Rinehart, and Winston, New York (Reprinted 1979, Erlbaum, Hillsdale, New Jersey).

Quak, M., London, R., & Talsma, D. (2015). A multisensory perspective of working memory. Frontiers in Human Neuroscience. 9, 1-11.

Seaborn, Katie & Riecke, Bernhard & Antle, Alissa. (2010). Exploring the interplay of visual and haptic modalities in a pattern-matching task. Paper presented at the 2010 IEEE International Symposium on Haptic Audio Visual Environments and Games