Designing learning environments that honor what we know about the brain in order to improve student achievement on Information Literacy

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IF/THEN Statement

IF we *design learning that is respectful and relevant to the learner: consider their prior knowledge, personal experiences, and current needs through:*

- identifying and promoting instructional practices, structures, and policies that are supported by research;
- ensuring the workload is prioritized, personalized and manageable;
- developing feedback mechanisms and models of quality work to provide comprehensible information about current performance and how to improve future performance;
- creating space to focus on an assignment, explain thinking and reflect on process;
- creating space to explore alternate solution paths, points of view, tangents, questions, and interdisciplinary connections;
- creating space to struggle without feeling rushed, over-anxious, or penalized; and
- creating substantive opportunities to improve their work.

THEN *we can engage all learners in the acquisition of key knowledge and skills and the development of connections so that they can pursue powerful questions, tackle complex problems, collaborate with diverse people, imagine new possibilities, and communicate their ideas.*

Science of Learning

Learning begins with the need for some motivation, an intention to learn. The learner must then concentrate attention on the important aspects of what is to be learned and differentiate them from noise in the environment. While those important aspects are being identified, the learner accesses the prior knowledge that already exists in memory, because a key to learning is connecting what is known to what is being learned. New information must be processed, structured, and connected in such a way as to be accessible in the future; this process is known as encoding. The deeper the processing of the information in terms of its underlying organization, the better the learning and later retrieval of that information. This processing requires active involvement . The learner must verify an understanding of the structure by receiving feedback, from the internal and external environments, on the encoding choices made. (Svinicki, Hagen Meyer, "How Research on Learning Strengthens Instruction," Accessed on 31 December 2009: http://www.ntlf.com/html/lib/quotes.htm)

1. New knowledge is built as an extension of existing knowledge.

In order for students to be successful, then, they must be able to think of what they are being asked to do, read, consider in light of what they have already experienced. The authors of the seminal work *How People Learn* summarize:

> In the most general sense, the contemporary view of learning is that people construct new knowledge and understandings based on what they already know and believe. . . A logical extension of the view that new knowledge must be constructed from existing knowledge is that teachers need to pay attention to the incomplete understandings, the false beliefs, and the naïve renditions of concepts that learners bring with them to a given subject. Teachers then need to build on these ideas in ways that help each student achieve a more mature understanding. (Bransford, et.al. p. 10)

2. When given a question, problem, or situation, people search their memory banks to look for an answer. Oftentimes, they will rely on what they already know instead of considering alternate paths. Neurologist Daniel Willingham explains:

> When we can get away with it, we don't think. Instead we rely on memory. Most of the problems we face are ones we've solved before, so we just do what we've done in the past. (Willingham 5).

3. Novice learners need to acquire factual knowledge in tandem with conceptual understanding in order to be able to think effectively. While many educators have believed for years that students needed to learn "the basics" before they could engage in more higher-order thinking, research reveals that this is not the case.

> Data from the last thirty years lead to a conclusion that is not scientifically challengeable: thinking well requires knowing facts, and that's true not simply because you need something to think about. The very processes that teachers care about most—critical thinking processes such as reasoning and problem solving—are intimately intertwined with factual knowledge that is stored in long-term memory… The conclusion from this work in cognitive science is straightforward: we must ensure that students acquire background knowledge parallel with practicing critical thinking skills. (Willingham 21-22)

4. There are limits on working memory that impact how much information the brain can handle at one time. The design of a task, then, can have a real impact on the likelihood that learners will be able to successfully complete it.

> “Overloads of working memory are caused by such things as multistep instructions, lists of unconnected facts, chains of logic more than two or three steps long, and the application of a just-learned concept to new material. The solution to working memory overloads is straightforward: slow the pace, and use memory aids such as writing on the blackboard that save students from keeping too much information in working memory”(Willingham 15).

5. The quality of focus during learning impacts the likelihood of whether it will be remembered. A learner who works quickly to finish an assignment or who are attempting to do multiple tasks simultaneously are less likely to generate rich thinking or discern connections.

> “How can the memory system know what you’ll need to remember later? Your memory system lays its bet this way: if you think about something carefully, you’ll probably have to think about it again, so it should be stored. Thus your memory is not a product of what you want to remember or what you try to remember; it’s a product of what you think about”(Willingham 41).

6. The motivation and capacity to learn is naturally intrinsic. When a learner is invested in the task, the energy and spirit to do well comes from within. In 1968, venerated psychologist Jerome Bruner put forth:

> The will to learn is an intrinsic motive, one that finds both its source and its reward in its own exercise. The will to learn becomes a “problem” only under specialized circumstances like those of a school, where a curriculum is set, students confined, and a path fixed. The problem exists not so much in learning itself, but in the fact that what the school imposes often fails to enlist the natural energies that sustain spontaneous learning—curiosity, a

> desire for competence, aspiration to emulate a model, and a deep-sense commitment to the web of social reciprocity. (as cited in Fried, p. 113).

7. Intelligence is largely constructed through determination, application, and hard work. Any learner can greatly improve their current level of intelligence if they are committed to doing so.

> Scientists are learning that people have more capacity for lifelong learning and brain development than they ever thought. Of course, each person has a unique genetic endowment. People may start with different temperaments and different aptitudes, but it is clear that experience, training, and personal effort takes them the rest of the way. Robert Sternberg, the present-day guru of intelligence, writes that the major factor in whether people achieve expertise 'is not some fixed prior ability, but purposeful engagement'"(Dweck 5).

8. What a learner believes is possible for himself or herself shapes the range of possibilities. The stories that learners conjure up about themselves do matter and the quality of their thinking impacts the quality of the experience.

> "My research has shown that the view you adopt for yourself profoundly affects the way you lead your life. It can determine whether you become the person you want to be and whether you accomplish the things you value"(Dweck 6).

While this section is by no means an exhaustive discussion of the subject, it hopefully served its purpose: to inspire those who

design and participate in learning experiences to understand the nature of learning more deeply.

Richard Mayer's Findings about how Multimedia Exposure Affects Human Learning

1. *Multimedia principle:* Students learn better from words and pictures than from words alone.
2. *Temporal contiguity principle:* Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
3. *Spatial contiguity principle:* Students learn better when corresponding words and pictures are presented near to each other rather than far from each on the page or screen.
4. *Coherence principle:* Students learn better when extraneous material is excluded rather than included.
5. *Modality principle:* Students learn better from animation and narration than from animation and on-screen text.

Role of Learning Principles

- Provide staff with an accessible, research-based, conceptual foundation of how people learn.
- Establish parameters for learning within which staff can be free to experiment, innovate, and be creative.
- Guide depersonalized decision-making about teaching practices, selection of instructional resource materials, and school policies/structures.

1. The goal of all learning is fluent and flexible transfer – powerful use of knowledge, in a variety of contexts.
2. Meaning is essential to learning, hence it is essential to teaching and assessing: learning goals must make sense to the teacher and to the learner. There must be regular opportunities to see the value of what we are asked to learn, how it relates to past learning and how it will relate to future learning.
3. Successful learning requires metacognition: learning how to reflect, self-assess, and use feedback to self adjust. These metacognitive processes can (and should) be taught explicitly.
4. The complexity of learning requires teachers to draw upon a rich repertoire of teaching and assessing strategies carefully matched to the learning goals.
5. Learning is most effective when differences in learners' prior knowledge, interests and strengths are accommodated.
6. Greater learning depends upon the right blend of challenge and comfort – knowing that success is attainable, and realizing that persistent effort will pay off.
7. To maximize learning, learners need multiple opportunities to practice in risk-free environments, to receive regular and specific feedback related to progress against standards, and timely opportunities to use the feedback to re-do and improve.

8. All learning-related work in schools should be judged against standards related to learning goals (for both students and adults) and reflecting how people learn.
9. As a model learning community, a school appropriately requires learning from every member of its community, since continual learning is vital for institutional as well as personal success.
10. All learners are capable of excellent work, if the right conditions for learning are established.

– Grant Wiggins and Jay McTighe (2007)