# PEER-LED TEAM LEARNING
# LEADER TRAINING

## STRENGTHENING THE MIND'S INFORMATION NETWORK THROUGH WORKSHOP

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The workshop is beneficial to students in many ways. The social interaction, the peer-led learning process, and the chance to hash out problem areas in a small group are just three of the benefits students have said they get out of the workshop. But is there a less obvious, hidden benefit the students are reaping without even realizing it? Are leaders and students forging new pathways and connections in the brain, forcing a more complete understanding of the material, even when the task at hand seems elementary or even silly? Research in cognitive psychology and neurobiology suggests that new information is more firmly embedded in, and retrieved from memory when it is connected to other pieces of information already existing in memory. If this is so, then the exercises implemented in the workshop may serve to help students strengthen connections made between the new pieces of information they learn in lecture and from the textbook. In fact, this information-linkage process that is so crucial to memory formation may be optimized when workshop techniques are constructed with this purpose in mind.

Associations and Connections

Regardless of what specific techniques the leader employs, the mere existence of the workshop most likely helps reinforce the memory of new information. This is because the workshop is an additional environment or context in which the information is being presented. Every time one piece of information is associated with another, the pieces are connected in a vast network in the memory. "The more places you store information in your mind, the more likely it is that the information will persist and can be found" (Gordon, 96). Research suggests that when someone learns a new piece of information, where that person is, what that person is feeling, what one smells, one's state of mind—nearly every part of what the person experiences is associated with the new piece of information. In this way, the workshop is an additional context in which the information is encountered, and therefore the workshop is just one more piece of information associated with the new material.

The Parallel Distributed Processing Approach

Why are these connections and associations so important? One model of memory formation, called the Parallel Distributed Processing Approach (PDP), mirrors very closely what neurobiologists are discovering about the physical pathways in the brain. The PDP theory "argues that cognitive processes can be represented by a model in which activation flows through networks that link together neuron-like units" (Matlin, 94). According to this model, "knowledge is stored in the association of connections among the basic units ... every new event changes the strength of connections among the basic units by adjusting the connection weights" (Matlin, 96).

Workshop is one such new event that may strengthen connections. The more associations connected to a piece of information, the stronger the net work connections. The stronger the connections to a piece of information, the more easily that piece of information is retrieved, and the more firmly embedded it is in memory.

The PDP model (also called connectionism) "... was developed because of findings that a system of neural connections appeared to be distributed in a parallel array in addition to serial pathways. As such, different types of mental processing are considered to be distributed throughout a highly complex neuronetwork" (Dawson). Dawson outlines the PDP model on The University of Alberta's Cognitive Science Dictionary website: "The PDP model has three basic principles:

1. The representation of information is distributed (not local).

2. Memory and knowledge for specific things are not stored explicitly, but stored in the connections between units.

3. Learning can occur with gradual changes in connecting strength by experience."

My hypothesis suggests workshop plays two roles in this model: workshop as an association, and workshop as an environment where new associations can be created. In the first case, workshop is in itself a piece of information in the network. A line can be drawn directly from the idea of the workshop to any of the new pieces of information encountered in lecture or the text. It is simply one more association connected to the new information. The room workshop takes place in, the people students interact with, the time of day the workshop takes place--these are all pieces of information associated with the thing being learned by the student. They are associations independent of the workshop leader and the techniques he or she uses. The second role workshop plays is as a learning environment where new associations can be created. Leaders can enlarge the information network by presenting the material in new ways. They can vary their techniques and use their training as leaders to create entirely new associations. The activities do not have to be complicated in order for the new connections to form. In fact, even the simplest and most elementary activities can create new associations and strengthen existing connections.

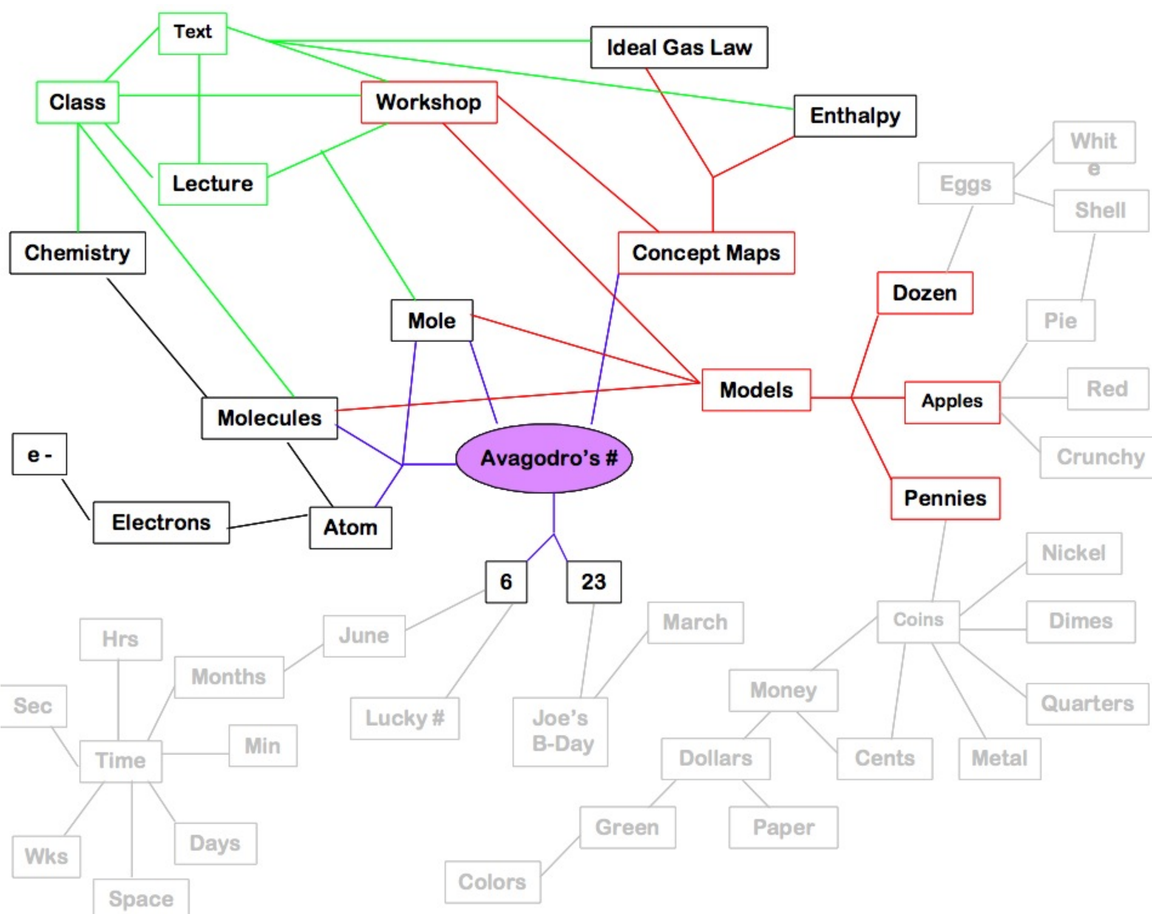
Neural Networks

Patterns of connectivity and connection weights are modified by an individual's experience. In a connectionist system, this is called a learning rule. One example is the Hebbian Learning Rule, which states that when two neurons are excited at the same time, the connection between them is strengthened and they become more tightly linked. This is where connectionism meets neurobiology. In the physical sense, "Learning entails strengthening connections between neurons--by creating more connections between neurons as well as by enhancing their ability to communicate chemically. These changes link neurons in a chain that can be traced to evoke a certain movement or feeling or thought ..." (Holloway, 79).

Neurons are nerve cells in the brain that transfer messages between each other via chemicals, or neurotransmitters. Every neuron can send and receive signals between contact points called synapses. This happens when the dendrites of one neuron connect with the axon of another neuron in a process called synaptogenesis. The dendric spines can change their shape in a matter of minutes. Experimental research has linked the strengthening and weakening of these connections to storing and erasing information in memory.

<u>The Memory Network</u>

The diagram below is a hypothetical network of information connected to the central idea of Avogadro's number. I have modeled this network after the PDP theory, and I have taken the liberty of creating connections and sub-networks that may or may not occur in a typical student's memory. The diagram is color coded to emphasize how workshop creates more connections to the idea, Avogadro's number. Those ties strengthen "connection weights" and possibly even the neural pathways in the brain.



6.02 x $10^{23}$ ... How Did I Think of That?

Every piece of information directly associated with Avogadro's number is connected in the diagram to the central piece with a blue line. In this model, chemistry *Class* is a sub-network of the pre-existing category, *Chemistry*. Some ideas, like molecules, are general enough that they are directly associated with chemistry. Most students form associations between those two pieces of information (even if they are weak associations) long before they ever take a college chemistry class. The *Class* sub-network consists of *Text*, *Lecture*, and *Workshop*. Because *Molecules* is an idea that is also associated with *Class*, it has a green line connected to *Class* as well as *Chemistry*.

Many of the chemistry concepts on this diagram are associated with all three components of *Class* because they are reinforced in the text, lecture, and workshop. These pieces of information have green lines connected to the overall sub-network. While some ideas are connected to both the *Class* sub-network and directly to the *Workshop* category (i.e., *Mole*), others are connected *only* to the Workshop category (i.e. *Models*). These items have red lines connecting them to Workshop. This highlights point number one: workshop is in itself another piece of information. The mere existence of workshop as one of many contexts in which the information is encountered creates additional connections to pieces associated with Avogadro's number, and the increased number of connections signals the memory to prioritize the information.

That's not all ... notice that the text boxes around *Ideal Gas Law*, *Molecules*, *Mole*, and a few others are black. This is because they are associated with more than one category. *Concept Maps* and *Models*, however, have red text boxes because they are ideas directly associated with *Workshop*. In the case of the black boxes, *Workshop* could be knocked out of the sub-network and it would hardly make a difference—the green lines wouldn't be affected. But if *Workshop* was removed from the sub-network, entire other networks that resulted directly from experiences in the workshop (red text boxes) would disappear. Not only would the connections between the pieces of information surrounding Avogadro's number be weaker, but whole chunks of information would vanish. These chunks are crucial. Not only do they affect the connection weight, but they provide alternate avenues for accessing the information. "... [Y]ou have to acquire memories or learn in a way that makes the best and most numerous connections between new and old memories" (Gordon, 87). In a parallel search, the more avenues through the memory, the faster and more likely someone is to reach one's destination (in this case, Avogadro's number is the destination).

The map also has some other interesting features. It reflects the theory that concepts or pieces of information that we often think of as one, are actually broken into separate chunks in the memory. Observe how the number 6.02 x 10^23 is not one piece of information, but it is actually broken into 6 and 23--separate categories unto themselves. (The 10 was omitted for the sake of space). "Intelligent memories are not kept in isolated bins; they have multiple ties to each other so they can be queried in multiple ways" (Gordon, 88). Also, the items in light grey are pieces of information that have nothing to do with Avogadro's number, but they are associated with the information that is connected to Avogadro's number. These associations increase the size of the network that Avogadro's number is embedded in. It isn't very likely, but according to this model, it is possible that the prompts "pie" or "white" could make someone think of Avogadro's number, leaving that person with the familiar, "Why on earth did I just think of that?" feeling! Theoretically, these remote connections still strengthen the network. They could also account for the personification of inanimate objects, or attributing physical characteristics (like the color white) to something abstract (like a number). These attributes reinforce one's memory of Avogadro's number by giving it more definition and familiarity. In a way, remote associations may make a piece of information more three-dimensional. (Notice how "pie" and "white" wouldn't be connected to Avogadro's number at all if it weren't for the workshop?)

## Optimizing the Workshop

What can workshop leaders do to make the best of this process? Barry Gordon, M.D., Ph.D., and author of the recent book, Intelligent Memory, divides the cognitive process into three parts: "Pieces of information, connections between the pieces, and the mental processes that manage the pieces and connections" (7). He offers some suggestions for strengthening the mental process. He points out that while the mind generates some associations automatically, using visualization and imagination help fuse ideas together more strongly. In workshop, one exercise asks students to consider how many pennies each person on earth would get if one mole of pennies were distributed equally among the world's population. This and several similar exercises have been designed to help students conceive just how big a mole is. In fact, many of the techniques leaders are trained to use are exactly the kind of techniques that will help strengthen the memory network. Concept maps, flow charts, and models are all different ways to explore a new piece of information. Gordon tells us, "As you encounter things and ideas you want to remember, consider them from as many perspectives as you can conjure up ... [expand] the visual image of an idea so that it has more places in your mind to lodge" (97).

## Less is More

Sometimes these exercises may seem elementary to students. Modeling molecules with beans or writing down how to tackle a problem step-by-step might not be what some students expect out of college. But these are exactly the kind of exercises that firmly lodge new information in memory. This doesn't mean, however, that there isn't room for improvement in the workshop model. In fact, one problem may be that leaders are given the tools but not the time to use them. Leaders face pressure from the students to explain the complexities of the most difficult problems, and there is always the concern that students will feel their time is being wasted on simpler concepts. Leaders also have a fairly broad range and several exercises to cover in one session. A possible solution is to narrow the focus and broaden the approach. If leaders cover fewer problems, they can use several techniques per problem. To make the best of memory networks in workshop, professors and mentors should discuss with leaders specific techniques that work well with certain problems before each session.

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**Cite This Article as**: Carnevale, N .( (2012). Strengthening the Mind's Information Network Through Workshop. Peer-Led Team Learning: Leader Training. Online at http://www.pltlis.org. Originally published in *Progressions: The Peer-Led Team Learning Project Newsletter*, Volume 5, Number 3, Spring 2004.