eLearning, MetaLearning, and DeepLearning

Finding the key to understanding what our ancestors knew about learning, and applying that knowledge in the modern context.

Greg Millbank, Managing Director, Praxis Technical Group, Inc.
DeepLearning Institute

The Promise of Web-based Learning …

For those for whom it works, it works very well:

- Up to four times faster
- Nearly twice as effective
- Less than one quarter of the cost
- Available everywhere
- Available any time
- Learner-paced
- Learner-scheduled

The Promise of Web-based Learning …

- Easy self-paced, self scheduled high-school, college and university available on-line at your home or place of work
- Huge savings in the cost of physical plants and instructor salaries necessary for conventional educational methods
- A way for people in remote communities to equalize educational disadvantages and to prepare themselves for jobs in the rapidly expanding resource industries

… and its Problems

Outside of specialized, mandatory industrial training applications -- where it is very successful -- for the majority of potential WBT users, the promises of ***anywhere*** and ***anytime*** often become ***nowhere*** and ***never***

- 65% never sign up for voluntary courses
- Of those who sign up, 60% never finish
- Of those who finish, 20% fail
- Only 10% succeed

The eLearning promise has not been fulfilled:

- eLearning is mainly successful in specialized mandatory industrial training applications (Praxis's specific field of operations)
- eLearning companies offering general educational online courseware are going broke
- eUniversities are forced to tolerate massive drop-out rates and are cutting back their eLearning budgets
- On-line schooling remains only marginally successful in comparison with other teaching methods

The eLearning Problem: Lack of "Stickiness"

- students do not "stick" to an eLearning program
- eLearning courses do not "capture" students and keep them motivated.
- students have trouble concentrating
- the eLearning experience lacks "depth."

What is “stickiness”?

- Why are people attracted to some on-line experiences and not others?
  (eg. video games, gambling, porn, etc.)
- Are there neurological differences between a brain engaged in “sticky” activities and a brain which is fundamentally bored?
- If so, can we reproduce those differences?

Machine Learning

- **To a computer, everything is equally "sticky" – computers don't get bored.**
- **In order to learn, computers need help with determining significance. They have to be "set up" by people.**
  - Humans have to choose the right data for computers to learn
  - Humans have to pre-process and pre-validate that data
- **Computers have no notion of "context."**
- **Computers are purely electronic**
- **Computers are not self-aware; they are not "conscious."**

Human Learning

- Humans automatically set themselves up to optimize brain function for any environment / context
- Humans automatically determine what is significant or important in a context, and what is not – data does not need to be pre-processed
- Humans are aware of themselves, that they are in a certain environment, that they are learning or not, -- i.e., they are *conscious*
- Human brains are partly electrical and partly chemical
- Humans are easily bored

Chemical Neuromodulation

- Brain activity is modulated by a large number of neurotransmitting and neuro-inhibiting chemicals
- These chemical systems enable the brain to change its "state" or "set up" to suit different environing conditions or contexts
- The human sensory system, coupled with memory (experience) and awareness / consciousness gives the brain information about context which the brain uses neurochemically to alter its "state."

The Role of Chemical Neuromodulators

"The fact that humans and animals can learn new behaviors under unknown environments suggests that the brain has a mechanism for actively tuning metaparameters, such as the speed of learning, the definition and size of noise versus signal, and the time scale of evaluation. The possible substrate for such metalearning is a number of neuromodulators, such as acetylcholine, noradrenaline, serotonin, and dopamine, that project diffusively to the entire brain."

Kenji Doya
CREST, Japan Science and Technology Corporation
Information Sciences Division, ATR International

Some Neuromodulators and Their Effects

- The dopaminergic system encodes increase or decrease in cumulative future rewards and controls action selection.
- The serotonergic system regulates the time scale of evaluation, i.e., how far into the future rewards are taken into account.
- The noradrenergic system controls the 'temperature,' or the relative "focus" -- the balance between local optimization and global exploration.
- The acetylcholinergic system controls the rate of learning and forgetting.

All Human Learning is *State-Dependent* and *Context-Dependent*

- Attentiveness, focus, arousal level, and memory are all dependent on the brains neurochemical state.
- The brain's neurochemical state is dependent on the context in which the organism finds itself and on how it interprets that context
- Critical aspects of the context and the neurochemical state in which learning occurs are remembered along with specific information generated from that context.
- The neurochemical state of the brain controls what is considered relevant, how much of it is remembered and how quickly it is forgotten.

The Quick and Dirty --How Learning Works--

- The brain is continuously modulating its activity with chemical neuromodulators to keep itself in the optimum brain state to handle the context in which the organism finds itself
- Sensory information from the environing context and a reliance on learned experience provide information by means of which the brain maintains its continually varying state.
- The manner and degree in which the brain defines and selects important (and learnable) “signals” from background environment noise, the degree to which it focuses on these signals, the degree and rate at which it remembers and forgets and even the timeframe over which it evaluates its context are all set by chemical neuromodulators.

Learning:

is brain-state dependent

Brain State:

is dynamically dependent on the environing context

The eLearning Problem:

Computer-based learning is largely context-free

- The learnable content of eLearning is almost completely stripped of contextual clues as it is forced through the internet "pipeline" to appear on a computer screen.
- The only context is the computer itself, which is virtually contextually neutral.
- The brain consequently has difficulty determining and maintaining an appropriate "state" and therefore soon goes to its default setting: --"idle" --and then starts to look for something else to do.
- In other words, the brain is "bored."

What our Ancestors knew, but we have largely forgotten:

It's about the context, stupid!

If you want effectively to teach somebody something, you must place them in a context which is appropriate to learning the thing which they are trying to learn. An appropriate learning context will help their brain establish the internal conditions it requires for them to learn effectively, and later effectively to recall that learning.

Master Kung* said:

"Let a man be first incited by the ancient verses, then given a firm footing by the study of ritual, and finally perfected by music."

He also said:

"When one talks repeatedly of ritual, does one really only mean jades and silk? When one talks repeatedly of music, does one really only mean bells and drums?"

The character for ritual or ceremony. According to Confucius, the most important aspect of civilized life.

*Confucius, 551 B.C.E.; *The Analects*, VIII, 8.

The use of context to promote learning is an ancient art, as is the use of context to promote healing:

An elder speaking to selected young men around a campfire at night is an example of a deliberately constructed context for teaching and learning. The social components of the event, the sensory components and even the circular shape which the group assumes, are all important to learning and remembering what the elder has to say.

Black Robes:

The black robes and white wigs of the judge and barristers in a courtroom, the seating arrangements, the raised platform and monumental desk, etc. are deliberately chosen to create a certain state of mind and a certain brain-state which lends importance to what happens there. This is also closely copied in a Protestant Church in which the aim is to emphasize the role of God as Judge and to creat feelings of importance and respect.

Drums:

The rhythmic drumming and ceremonial activities of the Shamanic Healer can have such a powerful effect on the patient's brain that the brain can "spontaneously" heal the body.

Figure and Ground:

From the brain's point of view, the subject to be learned and the context in which is embedded are equally important. Learning cannot proceed without both the information to be learned and the context in which it is embedded.

Information is to context as a figure is in a background.

"Without the figure, there is no ground and without the ground, no figure."

Contexts:

- Can be artificial or natural
- Can be found, or intentionally generated
- Neuromodulation responses to a context can be spontaneous and natural, or they can be learned.

The Brain's responses to context:

Are dynamic, distributed in time, space, and function, virtually unnoticeable, and are fairly plastic.

In other words:

- Related neuromodulations are extremely complex and always changing
- Are mainly subliminal
- Some are "hard-wired" and many more are learned

How can we utilize these facts?

- By itself, MetaLearning (i.e. learning how to learn) is not adequate since it does not deal with context
- Instead of teaching general learning skills, skills should be taught in conjunction with appropriate contexts
- eLearning courses should be developed which train students to respond through appropriate neuromodulation to specially developed computer-delivered contexts.
- Special "cues" to these contexts should be built into eLearning programs so that trained students using these programs will respond by optimising their brain states through appropriate neuromodulations

DeepLearning™

The development of electronic contexts and contextual cues and the training of learners to respond appropriately to those contexts and clues are what Praxis calls:

"DeepLearning"

Research into DeepLearning is carried out at the DeepLearning Institute in Nanaimo, B.C.

How DeepLearning™ Works

- During the training phase, rhythmic patterns of light and sound which are known to cause specific changes in brain state are presented to learners via special headsets connected to computers.
- In some respects, these patterns are similar to the rhythmic patterns of drumming and chanting used by Shamans and Healers.
- Learner's responses to these specially developed contextual patterns are measured and guided by computerized feedback.

How DeepLearning™ Works

- When optimum responses are fully learned, the related cues are taught. These cues are designed to be presented in the "background" of an eLearning session.
- When the learner has learned to respond to the presented cues, he or she is ready to begin DeepLearning.
- Cues in the background of eLearning programs help the learner to maintain an optimum brain state during the learning process.
- Learning is dramatically enhanced, and boredom is prevented.
- The problem of high eLearning dropout rates is solved.

Principles of DeepLearning technology can also be used in classroom teaching.

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www.praxistech.com

DeepLearning Institute

1618 Northfield Road
Nanaimo, BC, Canada
V9S 3A9