Using Simulations and Virtual Worlds for Success in the Marcellus*

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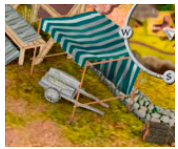
Goal

The goal is to talk about the realities of how people learn and apply what they are learning to a complex, rapidly evolving field; namely, resource plays (and the Marcellus), where success depends on how rapidly and accurately continuous knowledge development and transfer can take place.

Simulation

Thanks to new technologies, some of the most powerful cognitive tools we have involve simulation. It allows you to reconfigure perception, and in doing so, you empower yourself to problem-solve in new ways and create innovative solutions. You can also expand paradigms and memes.



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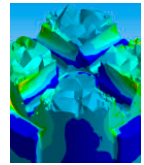

Using Simulations and Virtual Worlds for Success in the Marcellus

Cognitive Tools and Learning Technologies for Today's Information Environment

Susan Smith Nash, Ph.D.
AAPG

May 25, 2011
Baltimore, MD: AAPG Geosciences Technology Workshop
Success in the Marcellus and Utica

Simulations in Training
How can they help you?

Decision-making

- Horizontal drilling / geosteering
- Fracturing decisions
- Modeling fluid flow
- Equipment selection
- Determining behaviors of materials

Processes & Procedures

- Competency
- Skills
- Geological history

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Using Simulations and Animations

- **Creative Envisioning**
- Decision-making
- Problem-solving
- Improving workflows
- Team-building
- Cost-effective uses of technology

Presenter's Notes: With new technologies and new developments, what you're doing, in essence, is monetizing new knowledge or new combinations of monetizing ideas.

You must act quickly because the concept is huge; the idea is one of the classic "Big Ideas" that has the capacity to inspire / inflame the decision-makers who control large amounts of money, technology and human capital:

Problem-Solving / Creativity

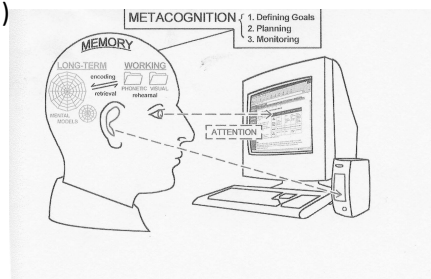
--Juxtapositions

--Making connections between unrelated areas

--Pushing interdisciplinarity (because of the natural propensity to foster creativity).

How do people learn?

- Information is perceived and processed (input auditory / visual)
- Working memory: limited (like RAM)
- Learning = new knowledge and skills in working memory have to be integrated with existing knowledge in long-term memory called ***encoding***.
- Active processing in working memory is called ***rehearsal***.
- Retrieve skills from long-term memory back into working memory is called ***retrieval***.



Working memory is very limited. From Hornik, 2006

Presenter's Notes: What's Wrong with the Old Way? Face-to-Face Training / Field Trips.

Need to supplement with web-enhanced elements or enable people to access 100% via the web.

Let's juxtapose the needs for new ways of learning and doing things with the quickly emerging new learning technologies and ways of sharing knowledge.

Social Networking

Shared Knowledge Repositories

Animations / Simulations

Role-Playing / Interactive Collaborations.

How effective are they? Are you learning anything useful? Are you being trained to think and conceptualize in a new way? This is, after all, the most critical element to consider; that is, the "meta-cognitive." Once you've learned new ways to empower your creative thinking and problem-solving abilities in conjunction with managing (and reality-checking) the new knowledge, and developing solid organization systems (schemas) you're on the way to thinking for yourself, and in conjunction with your group, and not simply regurgitating the most popular or convenient explanation.

Learning Preferences

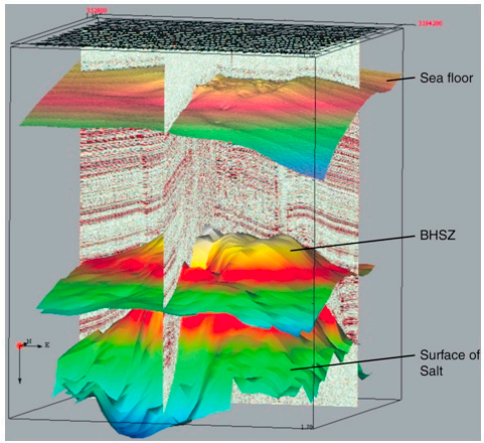
**Visual

**Audio

**Kinaesthetic

Cognitive Tools

- Simulations
- Animations
- Reflective Activities
- Meta-cognitive (modeling)



3D visualization can involve simulation and meta-cognitive modeling. Review in a team involves reflection.

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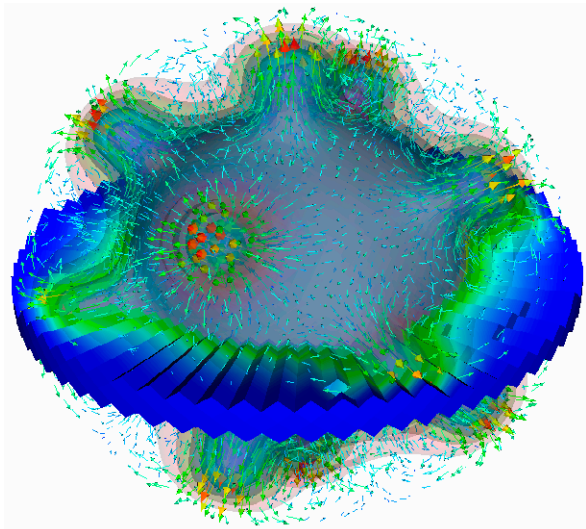


Simulation:

Reconfiguring Perception

Empowering Problem-Solving

Creating Innovative Solutions

Expanding Paradigms / Memes

Mathematical simulation of earth-mantle convection (Texas A&M)

Presenter's Notes: Thanks to new technologies, some of the most powerful cognitive tools we have involve simulation. Simulation allows you to reconfigure perception, and in doing so, you empower yourself to problem-solve in new ways, and create innovative solutions. You can also expand paradigms and memes.

Material in the earth mantle -- the zone between the metallic earth core and the solid crust -- convects as a consequence of heating from below and cooling from above. The picture shows the early stages of a three-dimensional numerical simulation of this convection, starting from a fluid at rest but with an unstable initial temperature field. The arrows show flow speed and direction, isosurfaces and solid colors show the temperature field.
http://www.math.tamu.edu/imagedocs/hedgehog.html

Finding Simulations and Virtual Worlds

University of Delaware Island

- Virtual Worlds (Second Life)
- http://www.secondlife.com
- Serious Games
- http://www.seriousgames.org
- Prototypes
- Genomics Digital Lab
- http://www.exploregdl.com/gdl/default.cfm?thePage=CA/home
- Models for analysis and decision-making

Presenter's Notes: Knowledge is not static; knowledge is in flux; the facts, data, conclusions, theories undergo changes.

When making a decision about what is "right" or "wrong," whose voice carries the most weight?

Must know this going into the game.

That said, develop your simulation teams or problem-solving teams so that they include at least one person who represents that "power" or "authority" voice / presence. (an engineer? Geophysicist? Financial officer?)

Downes (2007)

Reality is a Construct

Libraries and events in Second Life

- "Teleology is suspect"
- Integrate as many related data points as possible
- Avoid specious causality – "The butterfly effect"

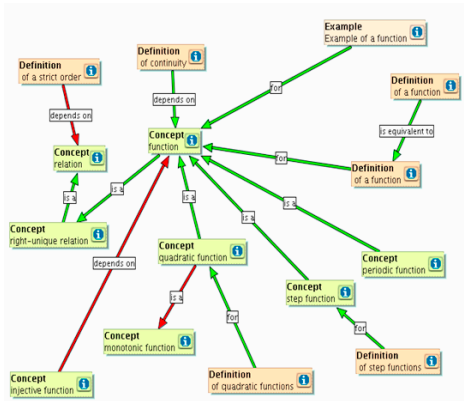
Presenter's Notes: Social Construction of Knowledge

How do you know what you know? Who decides?

Socially mediated knowledge; people share the same "vocabulary" which has certain implications; namely, the articles and journals that are the most easily accessed and widely disseminated are likely to be the most utilized and referred to – even if they turn out to be inaccurate, biased, or incomplete or otherwise flawed.

How many maps do you see repeated endlessly? Social reinforcement of a certain knowledge / approach. After awhile it reaches the level of dogma. How do you fight it? Often, to question what has become an untouchable, unassailable verity involves great risk to self and reputation (with the potential for cybersmearing and cyberbullying, thanks to email and the Internet).

Concept Mapping



- A method for understanding the reality that you have constructed
- Using your reality as a point of departure
- Triggered connections/ thought

Presenter's Notes: "Learning occurs through learners' engagement with creative experimentation and activity: tools and "objects to think with"

Be willing to use tools in innovative ways.

Think of LEGOS. Instead of squarish static structures, how can you make round, moving objects that interact with other objects?

Think of your tools in the same way.

Theorist: Papert and Idit (1991)

Become aware of your own favorite patterns / habits of interpretation.

Listen to yourself as you create explanations.

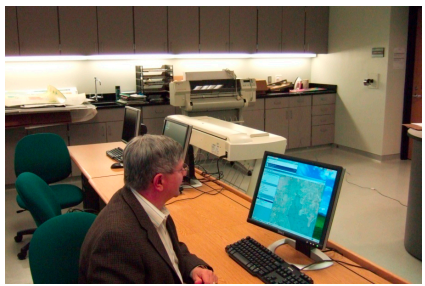
What are your favorites? Take them apart. Question them.

Likewise, when doing log interpretation or reviewing a fracing plan, listen to your own rationale.

Group Problem-Solving: Question the rationales, the narratives, the "plugged in" (but not questioned) "narrative lubricants." What do you say in between to make your story "flow" and sound credible? What do your team members say?

Integrating Difficult-to-Integrate Information

Simulations: Bring it together



PetroEd / TechnoMedia petroleum industry-related simulation-based training

- Regional studies
- Cross-sections
- Type sections
- Core information
- Geochemistry
- Seismic
- Microseismic
- Pore pressure
- Lithology
- GIS

Presenter's Notes: Training / Education becomes a complete overlap of the business itself.

Important to know

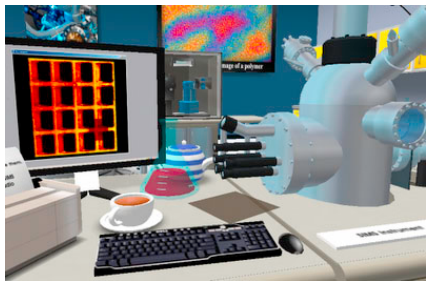
**How the mind makes meaning.

**How learning takes place.

**How knowledge is acquired.

**How creativity / problem-solving are both a matter of technique rather than of a "lightning strike."

Knowledge Transfer Strategies



The SIMS microscope in the clean room on Nanotechnology Island in Second Life, why not feed real data to the microscope in real-time?

- Problem-based learning
- Collaborate
- Question

- Avoid passive learning /acceptance
- **Identify pitfalls – where is the data incomplete**?

Presenter's Notes: Learning is a social process.

Isolation must be avoided. Why? For accuracy? Partly, but more importantly, because you won't know the common vocabulary and you will be ineffectual as you try to sell your ideas and content.

If doing simulations, discuss them with others.

If you're taking online courses that involve self-paced guided modules in which you have no interaction with others, always move back and discuss them with a group.

Models Are Fallible but Good Springboards for Invention

Virtual Worlds: Collaborative Questioning

Critical evaluations

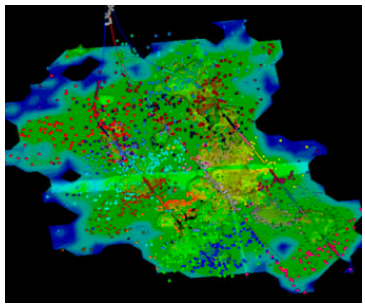
- Question everything
- Think horizontally
- Think inside-out
- Reconfigure perception

- Change the order of processing
- Propose multiple pathways to get to the same place

Presenter's Notes: Pattern recognition is the key to knowledge acquisition and transfer.

"Humans may be predisposed to identifying certain patterns on the basis of their neurological makeup; these patterns, in fact, may be intrinsic qualities of mind."

Make It New



Example microseismic mapping for a dual-well horizontal hydraulic fracture project in the Marcellus shale. Events are colored by stage and the stimulated reservoir volume (SRV) is displayed by the colored blue/green surface.

https://www.esgsolutions.com/english/view.asp?x=1

Revisit Processes as well as the data

- Explore data
- Collection technique
- Data acquisition methods
- Algorithms
- Assumptions about "noise" and the need to force a pattern
- Discuss the issues

Presenter's Notes: We are entering into an era of radical discontinuity.

The methods we use to transfer knowledge and to train still have little to do with the way that people actually use the knowledge or tools.

The tools and methodologies we cling to have little or no relation to what we're doing with the knowledge; where we're going.

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