Using Our Brains to Increase Student Learning and Student Success

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My Background

- Biologist who teaches chemistry
- Experience with first year students
- Teaching, learning, and assessment
- Faculty development
What is student success?

Who is responsible for student success?
Accreditation

- What is in this for us?
- How can we make every single bit of this work contribute to student success?
College of Marin Learning Outcomes

- Critical Thinking: Differentiate between facts, influences, opinions, and assumptions to reach reasoned and supportable conclusions.
- Problem Solving: Recognize and identify the components of a problem or issue, look at it from multiple perspectives and investigate ways to resolve it.
Please write....

1. All of the ideas (memories, images, definitions) you associate with the word “organic”
2. Share your associations with one neighbor and briefly compare and contrast your definitions with hers
3. With your neighbor select (and write), the associations/definition most applicable to this session
Outcomes For the Hour

- Describe at least three ways you can apply how brains learn to your teaching (or training of those you supervise) and implementation of outcomes-based education.
- Discuss the importance of understanding your students’ neural networks (or those of your coworkers or people you supervise).
Outline

- Brains and learning
- How to serve our students brains in our implementation of Outcomes-Based Education?
- Student brains/faculty brains/staff brains
- How to support this work on campus
Outcomes

- Refer to Results in Terms of Specific Student Learning, Development, and Performance (Braskamp and Braskamp, 1997)

- Answer the Question – “What Do We Expect of Our Students?” (CSU Report 1989)

- Describe Actual Skills, Understandings, Behaviors, Attitudes, Values of Students
Brains and Learning

- Evolution
- Control
- Emotion and learning
- Consciousness
- Abstract thinking
- Learning cycles
- Functions of the cortex

- Experience and neurons
- Neural networks
- Teaching for transformative learning
Assumptions

- Teaching is valuable in so far as it produces learning
- We’re after something more than students as consumers of information
- Transformative learning = students as producers of information
- Caveats: Parts of the brain I’m talking about
  - Different parts of the cortex
  - A few parts of the limbic system
  - Just the broad brush strokes
- How do we know?
Consider Yourself and Your Students

- As animals
- With vast, rich, ancient evolutionary pasts
- What strategies have worked through the millennia?
Evolution & Brains (What do Brains Want? What Motivates Them?)

- Natural selection
  - Brains want to survive

- Reward system (biochemical)
  - Pleasure for things that contribute to survival (sweet, fat, sex)
  - Fear (reject/avoid) of things that detract from survival

- Why learn (what are the intrinsic rewards for learning)?
  - Future access to resources
  - Ability to recognize and avoid danger

- What is in this for us?
  - When we (students and staff and faculty) don’t understand why a given thing (theory, class, president mandated assessment project, etc) is important for us, we leave (emotionally if not physically)
What Do Brains Want
Continued…Control

- Intrinsically valuable
- We gravitate towards it—always
- Access to future resources and being able to avoid danger (learning) contributes to control—contributes to survival
- Giving students (those in our power) more control decreases their anxiety…which allows for higher cortical function
Emotion and Learning

- Fear center (amygdala)
  - Scanning for danger
  - When it fires strongly, prefrontal cortex (abstract thinking) comes off line
  - In general less active in social interactions
  - Less active when engaged in abstract (prefrontal cortex) thinking

- Pleasure centers
  - Location
  - When pleasure centers are active, amygdala is less active
Emotion and Learning Cont.

- Attention is based on emotion-positive emotion feeds attention
- Ultimately make decisions on emotion, how things feel, not through the intellect
Note pleasure area’s proximity to prefrontal cortex.

Amygdala sends signals to many parts of the cortex

Dark=limbic cortex

Amygdala (fear)

Basal structures (pleasure)

Front

Back

Zull, 2002
Consciousness

- The vast majority of all thinking (work of the brain) is not conscious
- Small groups (a tiny fraction of the whole) of neurons that function mainly in inhibition
- Fantastic amounts of information coming from the senses each moment—we’re barely aware of any of it
- True for your students and you
Hey, cool! A wishing well!

Sure, kid... go crazy.

Can I do the wish, sir?

Okay, let's see... world peace...

An end to hunger... and disease... and to all bad stuff...

Just love, and brotherhood, and...

Whoa, whoa, whoa, kid!

Is something wrong, sir?

The job loss, the economic dislocation, the social upheaval...

Wow.

Have you thought what would happen if all that came true?

It would be chaos!

I didn't realize.

Okay, then... a million in cash!

It's for the greater good.
Abstract Thought

- List the three most important abstract ideas in your courses (teach to those under your supervision) and briefly describe how you help people learn them.
- Linked to concrete experience through metaphor.
- Justice, compassion, freedom—all connected to concrete experience.
- Brains are great at forming images (understanding is “seeing”).
- Helping students /employees /coworkers /children create their own images is an important part of effective teaching.
Kolb Learning Cycle

1) Concrete Experience
doing/having an experience

2) Reflective Observation
reflecting/reviewing on the experience

3) Abstract Conceptualization
concluding/learning/model building from the experience

4) Active Experimentation
trying out what you learned
Given That Learning is Biological…

- And Kolb’s learning cycle has general application
  - What does that mean about the brain?
Zull, The Art of Changing the Brain, 2002
Write it down (make it happen)

Compare/contrast/select best

See word "organic"

Consider/remember meanings

Zull, The Art of Changing the Brain, 2002
What Creates Learning (What Stimulates New Connections and New Neurons)?

- Experience (no experience, no learning)
- Experience through the senses (the external world brought into the brain)
- Thinking (internal experience-the brain generating its own experience)
  - Conscious, focused, directed
  - Reflection
  - Dreaming
- Richer experience-more connections between neurons
Experience and Neurons

- Brain is constantly changing
- Neurons - in the brain
  - Highly branched
  - Highly connected (10,000-100,000 connections per neuron)
  - More connections between neurons than there are cells in the rest of your body
- Knowledge manifests physically as neurons and connections between neurons or neural networks
- New neurons and connections between neurons form as a function of experience
- Use strengthens the networks and connections
Neural Networks

- Organic: you wrote all the images and related memories that came up as you considered the word “organic”
“Organic” How Many of You Wrote Down…

- Someone who grows, eats, lauds, or pooh poohs organic food?
- A hippie (whatever that is)?
- Some negative stereotype of the challenge of organic chemistry?
- That organic chemistry was scary?
- The terrible smells of organic chemistry lab?
- These are examples of neural networks connected to the concept of “organic” in our brains
Knowledge is Housed in Neurons and Neural Networks

- Prior knowledge is a fact (all of us have it and it is housed physically as neurons and neuronal networks)
- It is persistent (we can’t get rid of what learners already know)
- Very important to strengthen new learning through practice, reflection, use. More use = more strength
- Prior knowledge is where acquisition of new knowledge begins
- Knowledge from the past creates the learning environment of the future
- Many of my students think that hydrogen gas is in bubbles in boiling water—an example of a logical, erroneous, neural network.
Prior Knowledge

What is the gas in boiling water?

- Their neural networks say “hydrogen and oxygen”
- How can we use this? How can we build on what they know…that ain’t so?
From a Biological Perspective, When We Say We Want to Produce High Quality Learning . . .

- What we mean is that we want to: Build new neurons and new connections between existing neurons and neural networks in the brains of learners.

- Strengthen those new neurons and connections through practice, engaging learners in reflection, helping learners develop images of this new learning, and require learners to develop and test models
Traditional Modes of Teaching and Learning

- Rely heavily on memory
  - Information intensive
  - Passive environment
  - Rarely understands students’ prior knowledge (neural networks)
  - Rarely intentionally engages students’ motives and emotions

- Fails to take advantage of and require integration of other parts of the cortex
Zull, The Art of Changing the Brain, 2002
Bloom’s Taxonomy

- **Knowledge** Ability to recall previously learned material.
- **Comprehension** Ability to grasp meaning, explain, restate ideas.
- **Application** Ability to use learned material in new situations.
- **Analysis** Ability to separate material into component parts and show relationships between parts.
- **Synthesis** Ability to put together the separate ideas to form new whole, establish new relationships.
- **Evaluation** Ability to judge the worth of material against stated criteria.

Each step down requires a more and more sophisticated integration of the cortex.
Organic Outcomes: Home Grown, Student/Faculty/Learner Centered

1) Brains
   - What do they want?
   - How do they work?
   - How can we take advantage of what they want and how they work to improve student success?

2) Learning outcomes and outcomes-based assessment
   - Implications for curriculum
   - Implications for pedagogy
   - Implications for assessment
   - Implication for faculty and staff development

3) What are The Connections?
Why Should I Develop Learning Outcomes and Rubrics? Close Your Eyes and Imagine

- You are going up for promotion
- Don’t know the committee members
- Have no idea what you will be evaluated upon (not only the what, but the importance of each thing)
- How do you feel?
- What would you like to know?
I’m Guessing

- If they want publications….how many?, what kinds?, published where?
- If teaching….what matters? Student evaluations? Student learning?...uhh ohh…how do I measure that???
- If university service…which committees have status? How do I document my contributions?
- What if we had never done some of these?
- Why do we want to know these things and how does knowing them change how we feel about the process?
- Gee…Dr. Department Chair…mam……do you think I might be able to get a rubric that describes how the committee will assess my portfolio for tenure?
How do Outcomes and Rubrics Serve Brains? (when students understand what we expect and how we will assess them…)

- When someone in a position of power has an expectation…but we don’t know what it is?
  - Apprehension, nervousness, and fear…Anxiety decreases our capacity for abstract thinking
- Outcomes make expectations explicit-makes for easier integration of the different cortexes
- Allow students to focus their efforts
- Increases motivation
Using Outcomes to Build Brain-rich Instruction

- Deconstruct outcomes into core pieces
- Align with pedagogical and curricular approaches that stimulate neural growth
**Brain Rich**

**Critical Thinking:**
Differentiate between facts, influences, opinions, and assumptions to reach reasoned and supportable conclusions.

<table>
<thead>
<tr>
<th>Engage their senses</th>
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</thead>
<tbody>
<tr>
<td>Motivation-why important, calm amygdala</td>
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<tr>
<td>Prior knowledge</td>
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<tr>
<td>Structure for reflection</td>
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<tr>
<td>Pictures and images</td>
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Brains, Outcomes, and Pedagogy

- Is the *experience* we are providing actually leading to the learning we desire?

- Does the experience we’ve created:
  - Help learners understand how the outcomes are important to them?
  - Require them to practice (that is, are we strengthening the neurons and neuronal connections they’ve formed in response to our teaching)?
  - Help learners feel safe (working to calm the amygdala)?
Brains, Outcomes, and Curriculum

- Easy to develop learning outcomes
- How do we make sure that the curriculum flows from and supports the outcomes?
  - Analyze the curriculum
  - Are we using it to develop mastery of the outcomes?
  - Are there tight connections between what we are teaching and knowledge sets, skills, and abilities we require of our students?
- Are we approaching curriculum from the faculty or student perspective?
## Critical Thinking:

Differentiate between facts, influences, opinions, and assumptions to reach reasoned and supportable conclusions.

<table>
<thead>
<tr>
<th>Teaching Activities</th>
<th>Differentiate between facts, influences, opinions, and assumptions to reach reasoned and supportable conclusions.</th>
<th>Reach Assumptions</th>
<th>Assumptions</th>
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</thead>
<tbody>
<tr>
<td>Learning/Practice/Assignments</td>
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<tr>
<td>Assessment</td>
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Brains, Outcomes, and Assessment

- Does our assessment actually align with the skills and abilities we want in our students?
- Are our students *learning* from our assessments, are they involved in helping create them, helping design the rubrics (are we working towards giving students control-calming their amygdalas)?
- Are our assessments structured and timed to minimize stress and fear (big exam at the end of the semester???).
- Do they understand our schematics for evaluation (did we give them the rubric with the assignment)
- Do our assessments require integrated use of the cortexes?
– Is it sense rich-can they see, hear, touch, and taste the abstractions we are talking about?
– Require them to develop their own images?
– Help them develop and test their own models?

- Have we structured time blocks to use the most effective kinds of pedagogies
- If we want transformative learning, we have to make time for integration
- Changing brain circuitry takes time
Building Images

- Work with your neighbor to draw a picture or schematic of an analysis
Validity/Quality

Multiple Perspectives

Information/Evidence

Personal Bias

Analysis
More Powerful…

- Our students’ (workers’/childrens’) images of “analysis”
- Give insight into their neural networks (knowledge)
- Inform teaching
Faculty and Staff Development on Outcomes-based Assessment

- Draw on what faculty/staff already know (their existing neural networks) and build on what is correct

- Motivation
  - Pleasure in sense of accomplishment
    - Appropriate challenge with appropriate support
  - Control…choice…owners
  - Motivating to them (my motivation does not translate into faculty motivation)

- Engage the senses
- Reflection-time and structure for thinking (recognize relationships-connection building)
- Help faculty build images
- Have faculty build and test models
Anticipate Their Motivations

- Food (pleasure calms the amygdala)
- Retention/Promotion (control)
- Money
- Release time
- Connect learning outcomes to what faculty value
  - Teaching
  - STUDENT SUCCESS!
Recommendations

- Start small fires and feed them
- Build on your faculty/staff strengths
- Don’t dismiss your older faculty/staff
- Anticipate and work to undermine faculty/staff fear
  - Low stakes
  - Results won’t come back to individuals

- Develop open ended, inquiry-based, faculty/staff-centered processes
Teaching for Transformative Learning

- Uses the whole cortex
- Takes advantage of what the brain was designed (through evolution) to do
- Builds on what learners know (existing neurons and neuronal networks)
- Connects with learners in ways that are meaningful/important to them (motivation)
Continued

- Gives control (makes outcomes and assessment criteria and standards public) to students
- Actively works to calm amygdalar (fear center) activity
Brains Anticipate

- They project/apply their past experience (what they’ve learned) onto the present.
- When someone does not know/is not able to do what we want them to, it is almost certainly a function of their experience.
Go Back to Your Three Abstract Concepts

- List three ways how you might apply what we’ve discussed to how you teach to these concepts