**LEARNING AND THE BRAIN CONFERENCE NOTES - BOSTON, NOVEMBER 2019 (MATERIALS)**

Opening Keynote:
Learning How to Learn: Helping Students Succeed in School

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- How did you change your brain?
  - "Follow your passions and **broaden** your passions so that you can do things that will help others."
- Brain: Use of metaphor (pinball machine)
  - Focused mode
    - task positive
    - patterns built by what you've already learned
  - Diffuse mode (random)
    - task negative
    - patterns built for new concepts - thoughts arrange much more broadly
    - Having active breaks can help brain learn via diffuse mode
  - When you're learning something, you can't be in both modes at the same time, but go back and forth
- Research shows that the louder the classroom, the better the grades
- Procrastination
  - When faced with a difficult or unpleasant task, you get unhappy feeling. You then turn your attention to something more pleasant - temporary happy feeling.
  - Pomodoro Technique (best for home study):
    - Turn off all distractions
    - Set a timer for 25 minutes (known endpoint)
      - For children: age + 1
    - Focus
    - *Rest* - 5 minutes (allows for diffuse mode to kick in)
      - Move
      - Do something active and enjoyable
      - Do not pick up cell phone (rabbit hole - Focus mode) - overwrites some of the info just learned
    - Do 2 hour Pomodoro session, then go back to technology
- Neuron (80 billion): Metaphor - alien
  - Dendrites (legs) with dendritic spines (toes)
  - Axons (arms)
  - "Foot fetish" - arms reach out to tickle the toes = sending signals
  - Learning = a set of signals between neurons (links)
    - A set of connected links in long-term memory
  - Practice - links get stronger
  - Active learning with sleep in between
    - Without sleep, the brain is unable to grow the neural architecture to learn
    - Sleep is like the mortar between bricks
    - Learning is built brick by brick with sleep breaks to fuse learning
    - Brain is built like a muscle
- What is the most powerful technique to help you learn most efficiently?
  - Reread
  - Highlight or underline
  - **Retrieval practice, recall**
    - If you don't have something in your long-term memory, you really didn't learn it
    - Each time you retrieve something, you strengthen the link
    - *Powerful Teaching* (Agarwal and Bain)
    - The value of metaphor - shared key ideas help bridge ideas from known content to new content
  - Create a concept map

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| | • Students go through years of school/learning, but we never teach them how to learn<br>• Memory:<br>  ○ Working memory<br>  ■ Metaphor: Octopus with four tentacles making links<br>  ■ We can hold about four things at a time<br>  ■ Heavy cognitive load<br>  ○ Long-term memory<br>  ■ Metaphor: Lockers with stored sets of links<br>  ■ Light cognitive load<br>  ○ "Poor memory" is actually good<br>  ■ When something falls out something else goes in<br>  ■ Leads to creativity<br>  ○ "Slow learner" is also good<br>  ■ Racecar brain vs. hiker brain<br>  • Hiker brains take in richer, deep experiences<br>• Learning requires persistence and flexibility<br>  ○ When the data tells you that you are wrong, you can change your mind<br>  ○ vs. a genius who has had little experiencing accepting mistakes. They don't change their minds, rather justify why they are actually right. |
| Teaching for Deeper Learning: Implications of Science of Learning and Development OR How Learning Happens for Students and For Their Teachers<br><br>(Linda Darling-Hammond, EdD Stanford University)<br><br>@LDH_ed<br><br>• Report<br>• Brief | • Shift from genetics to epigenetics (the brain is malleable and plastic)<br>  ○ Only about 10% of human genetic material gets expressed<br>  ○ Nature and the environment have a great impact on brain development<br>  ■ Cognitive skills<br>  ■ Social<br>  ■ Emotional<br>  ■ Physical<br>  ○ Malleable across the entire lifespan<br>• The brain develops as a reaction to experiences that enable or shut down learning<br>  ○ Experiences and relationships active neural pathways<br>  ○ Learning is social<br>  ○ Emotion and learning are linked<br>  ○ Authentic tasks motivate effort<br>  ○ Feedback shapes learning<br>  ○ Language generates thinking as well as represents it<br>  ○ If you're in a classroom where only the teacher is talking, there is not as much learning occurring as if students are having constructive interactions<br>• Key Elements of Adult-Child Relationships:<br>  ○ Secure attachment<br>  ○ Positive regard<br>  ○ Buffering stress<br>  ○ Supporting sense-making<br>• Development of Neural Networks<br>  ○ Enhanced by:<br>  ■ Social interaction<br>  ■ RIch environments<br>  ■ Green space<br>  ■ Physical activity<br>  ■ Mental activity<br>  ■ Mindfulness<br>  ■ Emotional and cultural well-being |

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| | ○ Impaired by:<br>■ Stress<br>■ Anxiety<br>■ Loneliness<br>■ Sleep disruptions<br>■ Dietary deficiencies<br>■ Toxins<br>■ Identity threats<br>● Stereotype threat<br>● Often reinforced in school<br>● Creates physical toxic stress - cortisol + adrenaline<br>● Trigger fight or flight<br>● Can be reduced by:<br>○ Affirmation of value<br>○ Clear commitment to equal access<br>○ Strong relationships<br>○ Cultural competence in all aspects<br>○ SEL<br>● Reduce Cortisol + Enhance Oxytocin (removes anxiety + distractions)<br>● Shared support - all stakeholders<br>● Multiple languages and symbol systems enhance cognitive flexibility<br>○ Music<br>○ Art<br>○ World Languages<br>● What kinds of learning?<br>○ Demand increasing<br>■ Complex Communications<br>■ Expert thinking<br>● At Google, the best predictor of success = “learning-ability”<br>○ Ability to<br>■ Transfer and apply knowledge<br>■ Analyze, evaluate, weigh and balance<br>■ Communicate and collaborate<br>■ Take initiative<br>■ Find and use resources<br>■ Plan and implement<br>■ Adjust and preserve<br>■ Learn to Learn<br>○ Demand decreasing (easiest to test, easiest to digitize):<br>■ Routine Manual<br>■ Routine Cognitive<br>● Structures for continuity support learning<br>○ Well-scaffolded instruction and formative assessment<br>○ Make connections to prior knowledge, cultural practices<br>○ Zone of proximal development (right amount of challenge)<br>○ Metacognition, learning to learn, and growth mindset (through feedback)<br>○ Balance of direct instruction and inquiry instruction<br>■ Inquiry rooted in essential questions<br>○ Collaboration<br>○ Critical thinking<br>● How feedback can be leveraged - Assessment FOR Learning (AFL)<br>○ Errors are welcomed<br>○ Huge effect size of formative assessment feedback (Hattie)<br>○ Growth mindset<br>○ Relearn, redo<br>○ Assessment for learning (not ranking and sorting)<br>○ Peer feedback and support<br>○ Skillful use of rubrics and discussion |

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| | ● Explicit Focus on Social and Emotional Skills and Mindsets<br>○ Collaboration<br>○ Problem solving<br>○ Conflict resolution<br>○ School safety<br>○ Sense of agency and purpose<br>○ Supports growth mindset<br>○ Restorative justice practices vs. exclusion<br>■ Explicitly teach skills and practice them<br>■ Encourage students to take responsibility<br>■ Teach executive functioning<br>■ Enable students to make amends and proactively contribute to their communities<br>■ Build the ability to be self-regulated to enabling autonomous learners<br>● Encourage iteration<br>● Structures that reach beyond the classroom (multi-tiered systems of support)<br>● Educator Development Should Emphasize:<br>○ Knowledge of and support for child and adolescent development and learning across all domains<br>○ Development of practices that support integrated social, emotional, and cognitive development<br>○ Development of a curricular vision that supports progress across domains<br>○ Development of cultural knowledge and competence, including capacity to engage with families/communities<br>○ Development of wide repertoire of resources for scaffolding student learning and meeting needs<br>○ Development of practices for teaching metacognition and strategies for learning to learn<br>○ Everything students need for learning, teachers need too<br>● John Dewey wrote in School and Society: "What the best and wisest parent wants for his child, that must we want for all the children of the community. Anything less is unlovely, and left unchecked, destroys our democracy." |
| Technology & Deeper Inquiry: The Science of Learning: Mind, Brain, and Technology<br><br>(John D.E. Gabrieli, PhD - MIT) | ● MIT Integrated Learning Initiative<br>○ Combination of psychology, neuroscience, machine learning, and education<br>○ Principles of learning that cut across K-12, university, adult learners<br>○ Things that work:<br>■ Deliberate practice - practice problems with frequent feedback (vs. lecturing)<br>● Greater attendance<br>● Higher engagement<br>● Twice the learning/retention<br>■ Practice tests (retrieval practice) - formative assessment<br>● Only if provided impactful feedback before next test<br>● Also applies to online learning - technology can provide opportunities for practice<br>■ Active learning - greater engagement<br>■ Sleep enhances learning<br>● Duration<br>● Quality<br>● Sleep consolidates memories and learning<br>○ Education and Technology<br>■ Need for social interaction - especially World Languages<br>■ Online, video learning: |

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| | ● More impactful when discussion is included<br>● Periodic testing (formative assessment), review questions along the way<br>● Passive viewing vs. active viewing<br>■ Study shows that when students take lecture notes on technology, 42% are off task<br>● Better learning by taking notes longhand or sketchnoting<br>● **My questions: Why are you still lecturing?!**<br>■ Technology does allow for personalization + self-pacing |
| Teen Brains & Deeper Learning: In Search of Deeper Learning<br><br>(Jal D. Mehta, PhD) | |
| Deeper Learning for EVERY Student: Neuroscience, Technology, and Universal Design for Learning<br><br>(David H. Rose, EdD - Harvard)<br><br>@DavidRose_CAST | ● Disruptions/Perturbations (Piaget) cause deeper learning<br>● Context determines ability vs. disability - spectrum<br>○ Culture sees categories and determines the cut-off:<br>■ Disability, abnormality<br>■ Normal<br>■ Gifted<br>○ What determines where each of us are on the spectrum?<br>■ Biology matters:<br>● Neuroanatomy<br>● Phylogeny<br>● Genes<br>■ Environment matters:<br>● Culture<br>● Language<br>● Instruction<br>● Timing<br>● Technology<br>● Context<br>○ Spectrum from hypo- to hyper-connectivity<br>■ Kids on the autism spectrum are hyperconnected (overwhelming)<br>■ ADHD is hypoconnectivity (bored, not enough stimulation)<br>○ “I’m on the spectrum and so are you.”<br>■ Ask yourself: Where am I on the spectrum?<br>■ We ritualize high emotion situations (weddings, funerals…)<br>● The simplest neural network:<br>○ Sensory neuron<br>○ Motor neuron<br>○ Interneuron (relay neuron)<br>■ Affective, emotional, set priorities<br>■ Determines reflex/learning<br>● UDL to reduce the barriers for some and increase options for all<br>○ Provide multiple means of representation<br>○ Provide multiple means of engagement<br>○ Provide multiple means of action and expression<br>● Simple view of reading (successful reading = reading for meaning):<br>○ Decoding<br>○ Language comprehension<br>■ Old view: bottom up - decode, then comprehend (Chall)<br>■ New view: reciprocal networks (neural science) - heterarchical<br>○ When you read, you use affect/emotion<br>■ Kids with reading disabilities are in a threat state |

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| | ○ You read with your whole brain<br>○ Reading spectrum<br>■ Hyperlexia (autism, aspergers)<br>■ Dyslexia<br>■ Alexia<br>● CAST - a foundation for flexibility<br>○ Use technology to make multiple representations of text<br>■ Visual<br>■ Tactile<br>■ Languages<br>■ Audio<br>● Schools need to make learning materials universally accessible<br>● Technology can help with spectrum stimuli<br>○ StayFocused app<br>○ iPhone app that focuses what you hear (works with hearing aids - association vs. amplification)<br>○ Executive functioning apps |
| Keynote: The State of the Onion: Peeling Back 20 Years of the Science of Learning and Instruction (MBE, L&B)<br><br>(David B. Daniel, PhD) | ● Goal: Be evidence-generated, not just evidence-based (What does this mean?)<br>○ Gets people talking about evidence without telling you what's good evidence.<br>○ Hypothesis, not practice for teachers<br>○ Everything has evidence that it works (Hattie)<br>○ Evidence-Based vs. Evidence Demonstrated<br>○ Everything is filtered through interpretation<br>■ Credible or just persuasive<br>● Mind Brain Education: Education by any means necessary - encompasses all of these:<br>○ Brain-Based Education<br>○ Neuro-Education<br>○ Educational Neuroscience<br>○ Science of Learning<br>○ Mind, Brain, and Education<br>● Historic Learning Styles (hypotheses are not supported in research) - They really don't exist, but practitioners think they still do. These are just metaphors for individual differences in learning. You can do harm if you only teach to a dominant "learning style"<br>○ Visual<br>○ Auditory<br>○ Read/Write<br>○ Kinesthetic<br>● Science of Learning (inherently cognitive)<br>○ SEL<br>● There is a Science or Learning, but we don't have a Science of Teaching<br>○ Need a Science of Teaching<br>■ Evidence-generated<br>■ Science dissects the evidence and practitioners evolve it<br>■ Translators - help translate this to your practice<br>● How do I share and evolve that?<br>● Honor the complexity to develop more sophisticated models<br>● Do look for "best practices" - They don't exist.<br>■ Goal = flexible arsenal of tools that work to have the greatest impact<br>■ Good teaching = cumulative impacts<br>■ "An intermediary, inventive mind much make the application" |

Developing Deeper, Authentic Learning, and Critical Thinking Through Project-Based Learning (Dayna Laur, MEd)

@daylynn
@Proj_ARC

Project ARC

- Authentic & Relevant:
  - Why do I need to know this? Why should I care?
  - Students need to know the relevance in order to buy into the project.
- The Power of Silence - allow students to "stew in the unknown"
  - Teachers need to resist the urge to help right away. Stop filling the silence because silence allows for processing time, greater inquiry
  - There shouldn't/isn't a "right answer"
  - Thinking is always happening, processing allows something new to emerge (creation)
- Student Agency:
  - Ownership promotes risk-taking
- 5 Stages of Project Assessment (not linear)
  - Challenge and Purpose:
    - "Traditional projects don't take a long time to design, but authentic learning experiences take intentional and explicit development to ensure our learners are empowered to dig deeper in the learning process." (Laur & Ackers, 2017)
    - Open-ended challenge "simmering in ambiguity"
    - Our Challenge: How can we design authentic, relevant and complex challenges that strengthen deeper reasoning, retention, and reflection in our learners?
      - What is an authentic challenge?
        - Is it binary or is there a sliding scale
      - How do we measure deeper reasoning?
        - Observable in student reflections, conversations, conferencing
        - How do we build reasoning skills?
      - How do we define relevance?
        - Standards
        - Student interest
        - A single prompt/project doesn't suffice
      - Scaffolding
        - Does adjusting complexity impact authenticity?
        -
      - Design thinking
        - Build empathy
      - Students' statements should be reframed as questions
      - Assessment
        - Pre-assessments - invoke prior knowledge
        - Formative Assessment
        - Feedback (vs. advice) that drives/modifies instruction and learning
  - Inquiry and Ideas
    - The Learning ARC
      - Authenticity: Real-world work in a community or career context
      - Relevancy: Personally and developmentally meaningful work
      - Complexity: Deeper learning that results from dynamic interactions in a learning ecosystem
      - All three are interconnected
    - Standard PBL vs. ARC Challenge
    - Let's Pretend vs. **Let's Practice**
    - Activity-based vs. **Extended Learning**
    - Limited Content Application vs. **Promotes Mastery of Knowledge**

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| | ● Replication vs. **Innovation**<br>● Classroom Production vs. **Community or Global Audience**<br>● Focus on Teacher Assessment vs. **Focus on Audience Assessment**<br>● Engagement Limited to Grades vs. **Empowerment with the Process**<br>● Read About Experts vs. **Expert Involvement**<br>● Field Trip vs. **Field Work**<br>■ https://tinyurl.com/sfmb5lg<br>○ Context and Perspective<br>■ Learning Targets<br>■ How can we…?<br>■ Why should we…?<br>○ Action and Consequences<br>■ How do we know when learners reach actionable solution?<br>■ How will learners use Assessment AS Learning?<br>○ Options and Opportunities |
| The Reading Mind (Daniel Willingham, UVA) | ● Motivation. Fluent decoding. Comprehension.<br>● Comprehension; rules and knowledge<br>● * sentences. Across sentences. Texts.<br>● Evidence for the importance of knowledge<br>● Improving comprehension<br>● Understanding sentences<br>● All of us are constantly omitting information that we assume the audience will already know.<br>● What if you lack knowledge?<br>● The idea that you do not need knowledge and you can just Google it is harmful.<br>● Knowledge of the world is very important to what you bring to the text.<br>● Recht and Leslie, 1988 study on knowledge and reading comprehension<br>○ Raises the question who's doing well on reading tests?<br>■ Someone who knows a lot of stuff<br>● Measure “cultural knowledge”<br>○ You need to know as much about the topic that the author assumes that you know.<br>○ To do well on reading tests, you need wide general knowledge that does not have to be very deep.<br>● Writers omit information that they assume the audience already knows<br>● Comprehension Strategy Instruction<br>● Comprehension is not a skill like hitting a golf ball.<br>● Reading is communication<br>● For younger or older: setting a higher bar for “understanding”<br>● Comprehension strategies - great evidence that it works. Great evidence that you do not need to spend much time on it as it gives a one time boost.<br>● Two bright spots<br>○ It’s never too late to get kids to improve<br>○ Parents are on board.<br>■ Make access to books easy and make reading the most accessible<br>■ Don't enliven boring areas with screens<br>■ Create moments where literacy is logical and makes sense<br>● Because successful reading depends on prior knowledge, it's not enough that it have a lot of “stuff”. Sequence is crucial.<br>● Every teacher is a reading teacher. If you teach content, you are a reading teacher. |

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| The Secret Life of the Teen Brain<br><br>(Sarah-Jayne Blakemore, PhD University of Cambridge) | • Average age of various psychiatric, mental health problems begin in adolescence (defined as from hormonal changes to the age in which you attain stable independence in society) through early twenties<br>• Adolescence is a unique period of biological, psychological, and social development<br>  ○ Natural propensity to take risk and seek sensations<br>  ○ Self-regulation increases until it stabilizes in the twenties<br>  ■ Leading cause of death age 10-24 is accidents caused by risk-taking - preventable<br>  ■ Social aspect to risk-taking<br>  ■ Risk-taking is also beneficial - can't learn without taking risks<br>  ○ Not a new concept<br>  ■ "The children now love luxury; they have bad manners, contempt for authority; they show disrespect for elders and love chatter in place of exercise. Children are now tyrants, not the servants of their households." - Socrates<br>  ■ "I would there were no age between ten and three-and-twenty, or that youth would sleep out the rest; for there is nothing in the between but getting wenches with child, wronging the ancientry, stealing, fighting." - Shakespeare, *Winter's Tale*<br>  ○ Adolescents are hypersensitive to social exclusion |
| Science of How We Learn<br><br>(John D.E. Gabrieli, PhD - MIT) | • Neurobiological Lottery<br>• Different inputs (curriculum, teachers, class size, etc.) lead to different outcomes<br>• Education, Brain, and Socioeconomics<br>  ○ Global income inequality<br>  ○ Widening Academic Opportunity Gap (due to socioeconomics)<br>  ○ Poverty effects brain (gray matter)<br>• Early Language experience and Brain<br>  ○ No explicit instruction<br>  ○ Sound waves (forward speech) gets into the child's brain and causes learning<br>  ○ Conversational Turns (algorithm, back and forth discussion) are more impactful than the sheer number of words<br>  ○ Strength of social bonding<br>• Mindfulness, Stress, and Brain<br>  ○ Are more mindful learners are better learners<br>  ■ Growth mindset<br>  ■ Grit<br>  ■ Mindfulness can be taught<br>• Chronic + severe stress has a direct negative correlation to inability to learn<br>  ○ Anxiety + depression<br>  ○ Chronic drug use<br>  ○ Technology<br>  ○ 100% increase of ER visits for children with suicidal attempts or ideation<br>  ○ Familial risk for depression (40% ages 8-14) |
| Technology & Deeper Inquiry: Real-World Learning: Using Digital Tools and Projects for Deeper Learning<br><br>(Rebecca Stobaugh, PhD Western Kentucky University) | • Apollo 13 problem solving video<br>• Define components to real world learning thinking<br>  ○ Cognitive complexity (Bloom's Revised Taxonomy<br>  ■ Too easy lowers engagement<br>  ○ Student Agency<br>  ○ Authentic and Relevant<br>  ○ Collaboration<br>  ○ Inquiry-based |

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| @rebeccastobaugh | ○ Technology Integration<br>■ YIKES! She things Google Slides and Kahoot are innovative uses of technology.<br>■ |
| | Pecha Kucha 20x20 (Japanese for chitchat) |
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