NEW MEXICO
Education Speaker Series

Connecting Challenges with Ideas & Strategies

– NOTES –

Session II: The New Fundamentals: What Science Tells Us About Learning, Brain Development, and Motivation

July 18, 2018, Thornburg Campus

This is the second of a nine-month lunch series bringing together education and business leaders from around the state to learn from national and local experts about promising and best practices in education in high-performing systems. Participants will engage with each other on possible education reform in New Mexico. The group is using the report titled *No Time to Lose: How to Build a World-Class Education System State by State* created by the National Conference of State Legislatures as a guide.

Speakers:

Melina Uncapher, Executive Director, Institute for Applied Neurology; Assistant Professor, Department of Neurology at Neurospace, University of California San Francisco
Cindy Montoya, President, New Mexico School for the Arts (NMSA), Art Institute
Moderator: Kersti Tyson, Professor, Department of Teacher Education, Educational Leadership, and Policy (TEELP), University of New Mexico.

Uncapher:

The Science of Learning: Misconceptions, Evidence for Innovation, and Principles in Practice

Medical outcomes improved dramatically when medical practice became informed by scientific research. The same dramatic improvement can occur in education, which is the most important applied science, by applying learning science in the classroom through a co-creative process of researchers and educators. In the last three years, Melina Uncapher has moved her research on how brains learn into the classroom, creating a nonprofit to bring scientists and educators together and build a new profession of learning engineering to help learning scientists and educators work together to improve outcomes for students and teachers.

- Most educators don't know the science of learning
- Created 3-day boot camps to help them learn and dispel many myths about how people learn
- Most research has not been conducted in the real-world context of students in a classroom
- New profession of learning engineering pulls researchers and educators together to apply the principles from the science of learning, design engineering, and classroom practice
- Building an ecosystem through research-practice partnerships and education innovation hubs, where through empirical testing (akin to clinical trials) can learn which approaches are effective

- Three phases of learning in the brain: encoding, storing, and retrieving
- Learning techniques that amplify brain signals and produce more durable memories: desirable levels of difficulty, increased attention, meaning, and social relevance coupled with adequate sleep, exercise, and time

Montoya:

We realized we didn't have the stamina to drag students over the line and we did not want to settle for a "wait to fail" model. We looked at research and best practice and decided to go with our "gut" and common sense. We learned about Melina Uncapher's research through a board member. We reached out to her and began a collaboration.

- Help students learn how they learn, which empowers them
- Work on retrieval practices to re-inforce learning: reflecting on everything you know, flash cards, practice tests
- Teachers look at what's not working and figure out better ways
- Worked with local business person to develop a student survey about practices
- Many more students feel prepared
- Teachers have a common language.
- Teachers own the strategies to improve student outcomes and monitor their implementation.
- Modified professional development and focused on the planning domain, which yielded benefits such as differentiated instruction.
- Have received A's from the Public Education Department for six straight years.

What New Mexico can do:

- Develop teacher training programs on learning engineering to stimulate co-creative processes between learning scientists and educators using principles from the science of learning plus design engineering plus classroom practice
- Learn from and build on the successes at the New Mexico School for the Arts
- Promote research–practice partnerships between New Mexico universities (schools of education, learning scientists) and interested districts/schools
- Grow the research-practice partnerships into education innovation clusters

Methodology tips:

- Provide latitude and support for administrators and teachers to "follow their gut" to apply learning science in the classroom
- Create a culture where failure is recognized as important step towards learning for students, teachers, and administrators.
- Develop mechanisms to elicit and use feedback from students and teachers as to what is working, what isn't, and using that information to improve practice.

"*Every single student, every single brain is learning every single second of every single day,"* Uncapher.

"Education is our most important applied science," Uncapher.

"Didn't want a 'wait to fail' model," Montoya

"Students were empowered by learning how they learn. They wanted more," Montoya.

Appendix: Detailed Notes

Melina Uncapher, Executive Director, Institute for Applied Neurology; Assistant Professor, Department of Neurology at Neurospace, University of California San Francisco

- Has spent 17 years researching how brains learn; it's more than just brain scans;
  - 3 years started going out to the field; it's hard to do; can't bring my $3M brain scanner to the classroom;
  - Working with educators on how students learn in a real-world context;
  - Most educators didn't know the science of learning
  - Started a nonprofit to bring scientists and educators together: Institute for Applied Neuroscience
- There's 70-100 years of research on science of learning; need to do more than that; researchers needs to learn from educators; learn how people learn
- Usually do a 3-day boot camp on the science of learning; will try to distill that into 30 minutes
- Cindy Montoya's idea was to step away from a deficit model; instead we need to recognize that every single student, every single brain is learning every single second of every single day → help frame the learning to help them be productive
- Why we need to do this: 1 student drops out every 26 seconds in the US; each will make $200,000 less than high school graduating peers; and $1M than college graduating peers
  - 1.2M students drop out per year in the US losing up to $1.2 trillion in potential earned income
  - Looking at the next to most recent PISA scores, the US was 31st in math; 23rd in science, and 20th in reading
- Can we solve the problem with learning science? Analogy with medicine? Medical practice improved dramatically; could we do it with education? Education is our most important applied science
- What could this look like?
  - New profession – co-creative process of learning scientists and educators – equal voice – iterative – mediated conversation?
  - New profession – learning engineering
    - What works for one student won't necessary work for another
    - Principles from science of learning plus design engineering plus classroom practice
  - Get everyone at the table – ecosystem solution
  - Understanding how kids learn provides foundational principles
- Learning engineer
  - Research –practice partnerships → education innovation clusters (starting to be formed)
- Synching education with evidence for transformative teaching
  - Arms teachers with the science of learning (boot camp)
  - Debunk misconceptions (cover about 20 of them)
    - These can be harmful if they replace effective teaching practices
    - Can misappropriate resources to ineffective programs
    - Which are the leeches and which are the penicillin? (medical analogy)
  - What's the harm?
    - Disney's Baby Einstein – claimed that watching it makes baby smarter; when tested researchers found that it caused problems, such as delays in acquiring language, which led to a class action lawsuit
    - Empirical testing is crucial (like clinical trials)

- Myth of left-brain and right-brain learners – no evidence for this; brain is massively interconnected
  - Can lead to being pigeon-holed; reduce persistence
  - ~80% of teachers around the world believe this
- Myth of auditory, visual, and kinesthetic learning - ~96% teachers around the world believe this
  - May be preferences for perception but not learning and understanding
- Myth of the half-baked teen brain (it's a totally different animal)
  - Puberty leads to a massive remodel; increased plasticity (window of opportunity – 10 to 25 years old) and increased vulnerability – more influence from the environment
  - Limbic (stress, social, emotional) vs. prefrontal cortex (reflective, rational): develop at different rates; limbic develops faster (foot on gas without the breaking system)
  - Evolutionary benefit: increased procreative activities
  - Reasoning comparable to adults in "cold" situations but not in "hot" situations
  - Our expectation should be developmentally informed – can we teach more self-regulation
- Myth that we cannot do anything about trauma – everyone can learn
    - Trauma-informed practices; understand impact of Adverse Childhood Experiences (ACEs)
    - Stable & committed relationship with a supportive adult is #1 protective factor
- Myth that action video game play is bad for the brain
  - Studying impact of technology use on brain development – not all bad; action video games can actually be helpful (delete the violence) → pattern recognition → more efficient executive control (>5 hours of action video games per week); better pattern recognition ('learning-to-learn')
  - Proved to be causal
- Reframe
  - What does learning look like in the brain? (Students love this, empowers them)
  - Encode → store → retrieve
  - Encoding: sounds, sights, kinesthetic, meaning (different parts of the brain)
  - Storage → hippocampus monitors the brain and records "Learning is the 'residue of experience' and hippocampus stores that activity" – can't learn if you're hungry, you're thinking about just functioning or getting food
  - Retrieval → hippocampus retrieves original experience and remembers it (reactivates different parts of the brain)
- Apply (practices at each stage)
  - Encoding → storing → retrieval
    - Amplify brain signals – more signal for the hippocampus
    - Attention, meaning, social relevance (especially for adolescents)
    - When learning is easy, it is often soon forgotten (less brain activity and signals); engages the brain less → weak memories
    - When learning is harder, it creates more durable memories → desirable difficulties
  - Myth of fluency
    - Reviewing before the test, highlighting, cramming – not active generative process; makes students feel proficient but not achieve it
    - Build strong memories – practical approaches
  - Support the hippocampus
    - Sleep – dreams replaying brain activity
    - Exercise – aerobic, BDNF released (PE before math and science classes?)

        - Time – space out learning yields improvement; more practice retrieving the better you get – forms more connections with the memory; forgetting curve is dampened (flash cards)
- My research is focused on executive functioning – working memory, attention, multi-tasking
    - Executive functioning is strongly predictive of school readiness, school performance, and social competence in adolescence, also better physical health , higher socio-economic status, less criminal activity
    - Working with over 1200 students in Bay Area to try to develop personalized trying

Cindy Montoya, President, New Mexico School for the Arts (NMSA), Art Institute

Detailed notes

- Collaborating with Melina Uncapher
    - Showed video made by Digital Promise (outside researchers came to the NM School for the Arts)
- Our students are accepted through a blind audition process
    - We looked at research; best practice
    - We received six straight A's from PED
    - Work on retrieval practices: everything you know, flash cards, practice tests
    - Asked students about the practices – helped more students feel prepared
    - Teachers looking at what's not working; surveying students → work to figure out better ways
- Didn't want a "wait to fail" model
    - Realized didn't have the stamina to drag them over the line and wanted them to be prepared and successful in college (no remediation)
    - Followed our gut; common sense – encountered Steve Arnold who put us in touch with Melina Uncapher and we invited her in
    - Students loved art but we were killing their motivation during the day
    - PED requirements (PARCC, NMTeach) were producing unhappy students and teachers
    - So we and our teachers "went for it"; already had a culture of creativity; held ourselves accountable on learning to learn: make thinking visible; students learning how they learn; metacognitive was empowering; students wanted more
    - Students would identify which strategies were based on learning sciences; students helped hold teachers accountable to using evidence-based practices
    - Created survey for students using someone from the Santa Fe business community
    - Practicing is key for dancing, singing – students could understand that failing was part of learning; not just retaking the test; provided additional learning opportunities; the missed questions motivated the students
    - Took learning science techniques into math and science
    - Teachers had a shared language and could understand how they could become a better teacher
    - What other opportunities can we create to support this? E.g., disciplinary policies; understand flight, fight, and freeze reactions → change the way we talk to students → build trust → build respect → enabled students to talk to adults about what they need to learn
    - Focus on need for sleep (parents loved it)
    - Didn't cost much money; flash cards are cheaper than a full curriculum from Pearson
    - Teachers owned the strategy → owned their teaching → it was all about the outcomes
    - Implementation – teachers picked strategies; monitored them → changed PD; focused on planning domain (degree of difficulty forced differentiation)

Discussion

- At pueblos, students are taught to retrieve traditional knowledge
  - Cindy - Prior knowledge and practice that a child brings is huge; need to respect and build on that; it has a huge positive effect
    - Changed focus to highlight personal identity and students learning about themselves
- How do I become a learning engineer?
  - Melina - We're finding that teachers are more excited than researchers to become learning engineers – very generative
    - Working with Stanford to put together a course (hopefully, will be on line)
    - Happy to come to NM to train learning engineers; action research support structure
  - Cindy – have training days at our school
- Executive function training
  - Melina – research shows that formal schooling is an important approach; compared students who were before and after school cutoff; formal schooling promoted executive function training
    - Directing attention in sustained way is training executive function
    - Built a game that tries to build executive training that is evidence based'; phase 3 of clinical trials; could be prescribed – video game
    - Aerobic exercise with a cognitive component – Tai Chi
- How do we go to #1 from #50?
  - Melina - Empower students and teachers as to how they learn; students and teachers are generating their own practices
    - What works for whom, when, and where
    - Teacher training programs – learning engineering